Chapter 3: Alternatives Analysis

US 64 east of
Haw River
(October 2009)

CHAPTER 3. ALTERNATIVE ANALYSIS

The alternatives considered for the study are described in this chapter. Each alternative is evaluated with respect to its ability to the meet the needs of the study. A number of alternatives were considered during the early phases of the project studies, including the No-Build Alternative, transportation system management alternatives, transportation demand management alternatives, mass transit and build alternatives. For the build alternatives, both short-term (interim) and long-term alternatives were considered.

3.1 PRELIMINARY ALTERNATIVES CONSIDERED

The following alternatives were evaluated to determine if they met the goals established for the study.

Study Goal

The goal of the study is to develop a master plan to preserve and enhance mobility and safety along US 64, while balancing community access and interests.

3.1.1 NO-BUILD ALTERNATIVE

The No-Build Alternative assumes the local transportation system would evolve as currently planned, but without implementation of the recommendations proposed in this study. With the exception of routine maintenance, no change would take place along the existing corridor within the study area. The traffic operations for the No-Build Alternative were analyzed and included in Chapter 2. The results of the analysis showed that 10 of the 11 signalized intersections along the corridor would operate at a failing level and that the travel time for the 19-mile corridor would increase to as much as 54 minutes. Therefore the corridor would not provide the mobility that is desired for a Strategic Highway Corridor as the congestion would not be acceptable to the motoring public and is not considered a reasonable and feasible alternative for this study.

The No-Build Alternative is typically given full consideration and provides baseline conditions with which to compare the improvements and consequences associated with the alternatives being evaluated as a part of this study.

3.1.2 TRANSPORTATION SYSTEMS MANAGEMENT ALTERNATIVES

The goal of transportation system management (TSM) is to coordinate all individual elements of transportation systems through regulatory and control policies, so as to achieve the maximum efficiency, safety, productivity and utility of the existing transportation system. TSM measures enhance the operations of a facility while minimizing capital outlay and inconvenience to motorists.

3.1.2.1 Operational Improvements

TSM measures may include operational improvements such as optimizing traffic signal timing, signal coordination, speed restrictions, access control, and turn prohibitions. TSM operational measures usually can be implemented easily and require little capital investment.

3.1.2.2 Physical Improvements

TSM physical improvements include such measures as turning lanes, intersection realignments, or new traffic signals. These physical improvements require greater capital investment than operational improvements; however, the benefits of these physical improvements would be more substantial.

The implementation of TSM operational improvements would not acceptably rectify the long-term operational deficiencies along existing US 64, but do provide benefits as a short-term solution for the corridor. The short-term solutions are described further in subsequent sections of this chapter.

3.1.3 TRANSPORTATION DEMAND MANAGEMENT ALTERNATIVES

Transportation demand management (TDM) is a term given to a variety of measures used to improve the efficiency of the existing transportation system. TDM addresses traffic congestion by reducing travel demand rather than increasing transportation capacity and focuses on alternatives such as ridesharing, flexible work schedules, telecommuting, guaranteed ride programs, bicycling and walking.

TDM tools, such as ridesharing and guaranteed ride programs, reduce congestion by increasing vehicle occupancy rates. Other TDM tools, such as flexible work schedules, move trips from peak congestion times to non-peak periods. Telecommuting allows people to work from home, reducing the number of trips. Encouraging alternate modes of transportation, such as bicycling and walking, also reduces trips.

The Triangle region has a well established TDM program and has recently expanded the role of TDM in the Triangle by developing the Travel Demand Management Plan for the Triangle Region (www.triangletdmplan.com). TDM measures in place are at least partially accounted for in the calibration of the Triangle Travel Demand Model (the model used to project future traffic volumes for the region), through the evaluation of vehicle occupancy and peak hour evaluation.

TDM is a valuable component of transportation planning in the Triangle region. TDM measures implemented alone would not meet the goals of this study. TDM measures would not substantially reduce peak hour traffic and would not provide adequate relief of congestion along the US 64 corridor. Therefore, TDM is not considered a reasonable and feasible alternative for this study.

3.1.4 MASS TRANSIT ALTERNATIVES

The Mass Transit Alternative includes bus or rail passenger service and could include the implementation of express lanes for transit vehicles. A major advantage of mass transit is that it can provide high-capacity, energy-efficient movement in densely traveled corridors. Additionally, it serves high and medium density areas by offering a low-cost option for automobile owners who do not wish to drive, as well as service to those without access to an automobile.

Based on the 2000 Census, 1.2% of workers in Wake County and 0.2% of workers in Chatham County use public transportation as their method of transportation to work.

3.1.4.1 Bus Alternatives

The most typical multi-modal transportation system in North Carolina involves a fixed route, fixed schedule bus system. Because the proposed project corridor serves both local and long distance trips, the evaluation of bus services that meet each need should be examined.

For regional and statewide users, Greyhound Lines, Incorporated (Greyhound) currently provides daily commercial bus service to and from the Triangle Region at stations located in Durham and Raleigh. There currently are no stations in the vicinity of the US 64 corridor that serve longer trips.

Triangle Transit currently operates two peak hour bus routes along the US 64 corridor. Route 305 runs along US 64 from Lake Pine Drive, east to the US 1 interchange and into downtown Raleigh at Moore Square, while Route 311 runs from Lake Pine Drive along NC 55 to Research Triangle Park (RTP). Triangle Transit's *Short Range Transit Plan* includes extending express service from UNC-Chapel Hill to Pittsboro along the US 15-501 corridor in 2011. Cary Transit provides both fixed route and door-to-door transportation within Cary, however the existing routes do not serve the US 64 corridor or adjacent roadways. Cary Transit's door-to-door service is for Cary citizens who are at least 60 years old or disabled and provides service to a portion of the US 64 corridor.

Future plans for Triangle Transit show adding express bus routes along the US 64 corridor from NC 55 to Lake Pine Drive that connect to RTP. An express bus route is also planned along the entire I-540/NC 540 corridor.

3.1.4.2 Rail Alternatives

The only existing passenger rail service in the Triangle Region is provided by Amtrak. The nearest station on the Amtrak system is located in downtown Cary, approximately 3.5 miles north of US 64 and serves three routes: the Carolinian, the Piedmont and the Silver Star. Freight rail in the vicinity of US 64 is served by CSX Transportation and includes two grade separated crossings of US 64 between Laura Duncan Road and NC 55.

Future transit options for the Triangle region were evaluated from May 2007 to April 2008 by the Special Transit Advisory Commission (STAC), which was a broad based citizen group with 38 members from across the region and was appointed by CAMPO and the Durham-Chapel Hill-Carrboro MPO (DCHC MPO). The purpose of STAC was to assist in the joint development of a plan for a regional transit system and to craft recommendations for the transit component of their respective Long Range Transportation Plans, with a focus on major transit investments. The STAC began by selecting corridors that represent the most heavily traveled and intensely developed activity centers as well as areas emerging as new high-activity centers. A total of 18 corridors were selected for detailed analysis including three corridors that cross the US 64 corridor, as follows:

- Durham to Apex corridor
- Southern Arc I-540 Toll Road corridor
- Apex to Raleigh corridor

The US 64 corridor itself was not selected as a detailed study corridor. The primary reason that the US 64 corridor was not selected as a study corridor was that the goal of the analysis was to connect areas designated as Primary Market Places, which were defined as areas that generate greater than 20 trips per acre or greater that 4 trips per acre for areas with low-income or zero-car households. The only locations along US 64 designated as Primary Market Places by 2035 was the portion of the corridor from NC 540 to US 1. Without any Primary Market Places west of NC 540 it was determined that major transit investment west of NC 540 would not be effective. The three corridors listed above would serve the Primary Market Places designated along the US 64 corridor from NC 540 to US 1, although it would be by crossing the corridor perpendicularly and would not run along the US 64 corridor. The STAC recommendations were then provided to CAMPO and DCHC MPO for inclusion in the Long-Range Transportation Plans. Of the three corridors evaluated in the vicinity of US 64 the Durham to Apex and Southern Arc I-540 corridors were recommended for express bus service and the Apex to Raleigh corridor was recommended to be a light-rail transit corridor with all improvements planned to occur between 2025 and 2035.

3.1.4.3 Express Lane Alternatives

Conventional bus service and fixed guideway rail transit are not the only types of mass transit that are present across the United States. Bus Rapid Transit (BRT) is an emerging technique of providing transit service in urban areas. BRT involves coordinated improvements in a transit system's infrastructure, equipment, operations, and technology that give preferential treatment to buses on urban roadways. BRT is not a single type of transit system; rather it encompasses a variety of approaches, including buses using express lanes as either exclusive busways or high occupancy vehicle (HOV) lanes with other vehicles. BRT service also improves bus service on city arterial streets. Busways, special roadways designed for the exclusive use of buses, can be totally separate roadways or operate within highway rights of way separated from other traffic by barriers.

The use of BRT along the US 64 corridor was considered by CAMPO in the development of the Long-Range Transportation Plan and by the Corridor Study Team and determined that the demand along the corridor was not sufficient to justify the implementation cost, nor would it reduce traffic along US 64 to a level that would make the existing infrastructure adequate. The use of HOV lanes was also considered but was determined to not be reasonable and feasible as it would require expanding the footprint of the project beyond what would be constructed under the build alternative. It was decided that BRT and HOV applications would not be considered as viable alternatives, but that care would be taken in the development of the build alternatives such that it would not preclude implementation of these strategies in the future if conditions change.

3.1.4.4 Ability of Mass Transit to Meet Project Goals

Mass transit alternatives alone would not attract sufficient ridership to alleviate projected congestion along the project corridor. Additionally, the Triangle Travel Demand Model already takes into account transit ridership in the projected traffic volumes for the proposed study area. Therefore, mass transit measures implemented alone would not meet the goals of the study and are not considered reasonable and feasible.

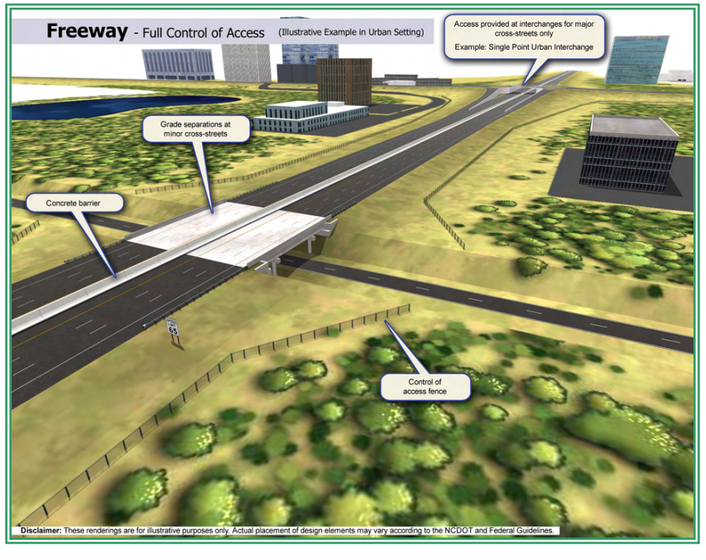
3.1.5 BUILD ALTERNATIVES

The implementation of Build Alternatives would include modifying or expanding the existing US 64 roadway to provide a facility that meets the goals of the study. The primary goals of the study are to preserve and enhance mobility and safety along the corridor while balancing community access and interests. The *US 64 Corridor Study Phase I Report* concluded that the corridor vision for US 64 from Raleigh to Statesville would be a freeway facility. The NCDOT Strategic Highway Corridors Vision Plan includes US 64 as a freeway from west of Asheboro to west of Jordan Lake, as an expressway across Jordan Lake, as a freeway from east of Jordan Lake to NC 540, and as an expressway from NC 540 to US 1. In order to fully evaluate a full range of alternatives for this study the evaluation of the corridor as a freeway, an expressway and as a facility with signalized intersections was undertaken.

The following sections provide general descriptions of each type of build alternative considered as well as a preliminary evaluation of its ability to meet the goals of the study.

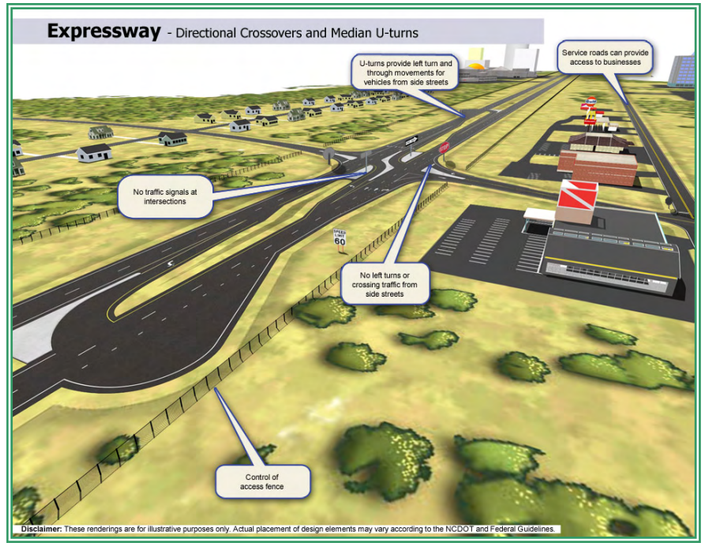
3.1.5.1 Freeway Alternative

Freeways are characterized by a divided roadway with full control of access and include grade separations or interchanges at cross streets. Freeways provide the highest level of mobility of all types of roadways and the lowest level of access, which is allowed only at interchanges. They have a speed limit of 55 mph or greater. The most common application of freeways is on the Interstate system, although numerous freeways exist along routes not designated as Interstate highways. To provide access to properties along freeways, service roads that connect to cross streets with interchanges are typically constructed. Examples of freeways in the Triangle Region include I-40, I-540, US 64/264 Knightdale Bypass and US 70 Clayton Bypass.



Based on the evaluation of a freeway alternative in previous studies and by the CST it was determined that a freeway alternative would meet the goals of the study and would be most appropriate for the portion of the corridor between the US 64 Pittsboro Bypass and NC 540 with the exception of the portion across Jordan Lake.

3.1.5.2 Expressway Alternative



Expressways are characterized by a divided roadway with limited or partial control of access. Access is provided only at interchanges for major cross streets and at-grade intersections for minor cross streets. Expressways provide high mobility with low-to-moderate access and have speed limits of 45 mph to 60 mph. Expressways do not allow traffic signals and strongly discourage direct driveway connections. At-grade median crossovers are allowed for traffic crossing the expressway and for traffic making u-turns. In urban areas with higher traffic volumes, median crossovers may not be provided if adequate safe gaps in traffic cannot be provided. The portion of US 64 from Green Level Church Road to Laura Duncan Road is an example of an urban expressway. The section from Mt. Gilead Church Road to Farrington Road, across Jordan Lake is an example of a rural expressway.

Based on the evaluation of an expressway alternative in previous studies and by the CST it was initially determined that an expressway alternative would best meet the goals of the study and be most appropriate for the portion of the corridor across Jordan Lake and from NC 540 to US 1.

3.1.5.3 Signalized Intersection Alternative

Signalized Intersections are roadways with traffic signals. A corridor of signalized intersections is commonly referred to as an arterial or boulevard and is the existing classification for a majority of the US 64 corridor within the study area.

Based on the evaluation of a Signalized Intersection alternative by the CST it was determined that a Signalized Intersection alternative was not likely to meet most of the goals of the study; however, based on the potential impacts associated with freeway and expressway facilities it was decided that signalized intersection alternatives could be considered, where appropriate, as a means to minimize the effects on the local communities. The CST determined that the only portion of the corridor where a signalized intersection alternative may be appropriate is the section of US 64 from east of Lake Pine Drive to the US 1 interchange.

3.1.6 Preliminary Alternatives Carried Forward for Additional Study

Based on the preliminary alternatives considered it was determined by the Corridor Study Team that the only type of alternative that met the long-term project goals was the Build Alternative. The US 64 corridor was broken into sections, based on facility type, for the development of the detailed Build Alternatives as follows:

- US 64 from US 64 Business interchange to west of Jordan Lake – **Freeway**
- US 64 across Jordan Lake – **Expressway**
- US 64 from east of Jordan Lake to NC 540 – **Freeway**
- US 64 from NC 540 to Lake Pine Drive – **Expressway**
- US 64 from east of Lake Pine Drive to US 1 Interchange – **Expressway or Signalized Intersections**

The evaluation of the Long-term Build Solutions is discussed further in Section 3.4.

Additionally, due to the likely expense and timeframe for implementing the Build Alternatives, it was decided by the Corridor Study Team that Short-term Concepts or Transportation System Management (TSM) Alternatives would also be developed that would improve mobility, safety and pedestrian accessibility along the corridor with minimal capital expenditures, extending the lifespan of the corridor until a time when the long-term Build Alternative could be implemented. The Short-term Concepts for the US 64 corridor are discussed further in Section 3.3.

3.2 SIGNALIZED INTERSECTION, EXPRESSWAY AND FREEWAY CONCEPTS

Based on the results of the preliminary alternative evaluation, three facility types were chosen as potential solutions for portions of the corridor. Potential applications of each of the facility types and the potential benefits and limitations of each concept are presented in this section.

3.2.1 Introduction

An intersection is a junction between two roads without a bridge. For many junctions with major roads in North Carolina, such as US 64 in Wake County, a traffic signal is often used at the crossing of the two roads to let different directions of travel go at different times. Since both roads are at the same vertical grade, these junctions are sometimes called at-grade intersections. The different possible travel movements at the intersection include left turns, (straight) through, etc. from the various directions approaching the intersection.

An interchange is a junction between two roads with a bridge carrying one of the roads over the other and ramps connecting the roadways to provide access. Since the crossing roads are at different vertical grades, these junctions are sometimes called grade-separated interchanges. Sections of divided highways that have zero signalized intersections – with all major crossings using interchanges – are called freeways (i.e., free flow travel without traffic signals) or expressways (i.e., express travel without traffic signals).

The goal of any intersection or interchange design is to provide the best possible user experience within the context of the natural and built environment, and amidst financial, time, and other limitations.

The users of an intersection or interchange might include any of the following modes of travel:

- Pedestrians
- Cars

- Trucks
- Bicyclists
- Transit vehicles
- Emergency vehicles

The purposes of travel for those traveling through a junction could be any of the following:
- Commuting to work
- School
- Shopping
- Out-of-town travel
- Visiting neighbors
- Leisure
- Responding to emergencies

The following are the possible directions of travel for users at a location:
- Major roadway, straight through
- Minor roadway, straight through
- Turning right or left from major roadway to minor roadway
- Turning right or left from minor roadway onto major roadway

Of course, different intersection and interchange options at any location will optimize the travel experience of various user modes, trip purposes, travel directions, and travel origins. In addition, there are other tradeoffs to consider beyond user experience, including cost and context sensitivity. However, while there is no single right answer, some designs will be better than others at meeting various goals.

For intersections along major roadways, such as US 64 in western Wake County, a primary design goal is to streamline travel flow for users in the main direction of travel, while minimizing adverse impacts to other travel directions, within the context of the natural and built environment and amidst financial, time, and other limitations. From a purely traffic operations standpoint, this goal requires the consideration of various intersection design alternatives that will allow users along US 64 to see green lights more often at traffic signals. Each of the intersection options described in Section 3.2.2 are innovative intersection designs that reroute left turns to or from US 64, and/or reroute travel for those crossing US 64. Doing so eliminates the need for the traffic signal to allow for one or more turning or crossing travel movements, and the time thus saved by reducing one or more of those signal phases can be given back to US 64 in the form of longer or more frequent green time. Of course, the best design may or may not be the one that retains the most green time for US 64, since there are other tradeoffs to consider, including financial, neighborhood context, impacts to travel in other travel directions, etc.

For interchanges along major roadways, the primary goal of eliminating travel conflicts with the major roadway has been achieved by definition – by the bridge. In addition, the use of a bridge may (or may not) also improve the user experience for other directions of travel as well. As with intersection design, the goal of interchange design is to improve travel in all directions within the context of the natural and built environment and amidst financial, time, and other limitations. Each of the interchange options in Section 3.2.3 and 3.2.4 are interchange designs that optimize different characteristics at the expense of others, such as land costs, construction costs, pedestrian and vehicle travel along the side street, left turning travel, etc.

The decision of whether to use an intersection or interchange at a given location, as well as the specific intersection or interchange design selection, is always based on an analysis of tradeoffs: financial, available land, construction cost, environmental impact, neighborhood impact, benefits and challenges for users along the major roadway, benefits and tradeoffs for travel along the minor roadway, etc. In general, the worst interchange will still operate better than the best intersection – because the bridge allows two conflicting directions of traffic to go at the same time, one on top of the other. And in general, any interchange will cost far more than any intersection, because bridges cost more than pavement on gravel and earth.

While there is no single right answer, there are better and worse designs for both interchanges and intersections at a given location, based on a particular set of goals for the location as well as the characteristics that pertain to that junction, including context and specific design constraints. It may be that an interchange provides a better set of tradeoffs than an intersection, but funding does not allow for bridge construction, at least in the near term, so that both a short-term preferred intersection design and a long-term preferred interchange design are developed for a location.

Innovative intersection design alternatives are included in Section 3.2.2, with a summary in Table 3.1.

Interchange design options are found in Section 3.2.3 and 3.2.4, with a summary in Table 3.2.

3.2.2 SIGNALIZED INTERSECTION CONCEPTS

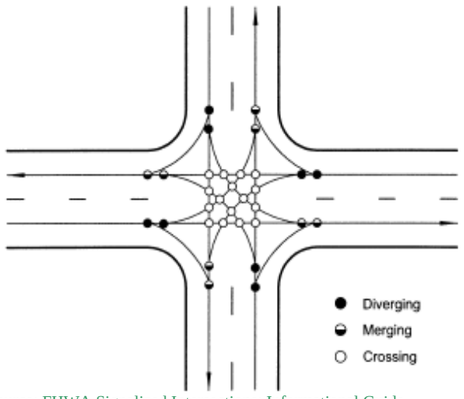
The range of solutions for improving existing signalized intersection facilities is accomplished through either expanding the facility by adding additional through and/or turn lanes or by improving the efficiency of the intersections themselves. For many years the preferred method of improving signalized corridors has been to provide additional capacity by adding additional lanes to the facility. Studies have shown that this method can be very costly and have diminishing returns. This issue has caused a new line of thinking to emerge, with alternative methods being considered to improve the operations of intersections without adding additional through lanes. This section will present the concepts for improving signalized intersection facilities and is based largely on the information presented in the Federal Highway Administration's Publication *Signalized Intersections: Informational Guide*.

3.2.2.1 Traditional Intersection Treatments

Traditional intersection treatments include allowing traffic movements from all directions at each intersection. Signalized intersections typically include providing lanes for turning vehicles and may include providing exclusive green arrows at signals for turning vehicles. Many of the intersections along US 64, including the intersection of US 64 and Mackenan Drive/Chalon Drive (shown at right) would be categorized as traditional intersections.

The benefits of the traditional intersection are that it provides for direct access for all directions of travel and provide for pedestrians crossing the roadways. The fundamental limitations for traditional intersections are that they are limited in the volume of traffic that can pass through them in a given time period. At traditional intersections, the amount of green time is proportioned based on the traffic volumes for each movement. As volumes increase, the green time is forced to be divided among more movements. For example, as the volume of left turn vehicles increases, eventually an exclusive green turn arrow is added to the signal for the left-turn traffic. By adding this additional movement it takes time away from another movement. As more movements are added as exclusive movements the signal becomes more inefficient as it requires time to transition from one movement to another movement.

Eventually the amount of traffic that can be processed by a given intersection is exceeded and the signal begins to fail. When a conventional intersection is no longer able to process the volume approaching the intersection the typical method of improvements is to add additional turn lanes and/or additional through lanes. As stated above, this method of expansion can be cost prohibitive, include impacts to the natural and human environments and provide diminishing returns because the larger footprint requires increased time for vehicles and pedestrians to travel through the intersection.



Source: FHWA Signalized Intersections: Informational Guide

Additionally, the safety of traditional intersections is problematic due to the large number of conflict points. The diagram, shown at left, displays the conflict point for a traditional intersection, with each conflict point representing a location for a potential crash. A traditional intersection includes 32 conflict points.

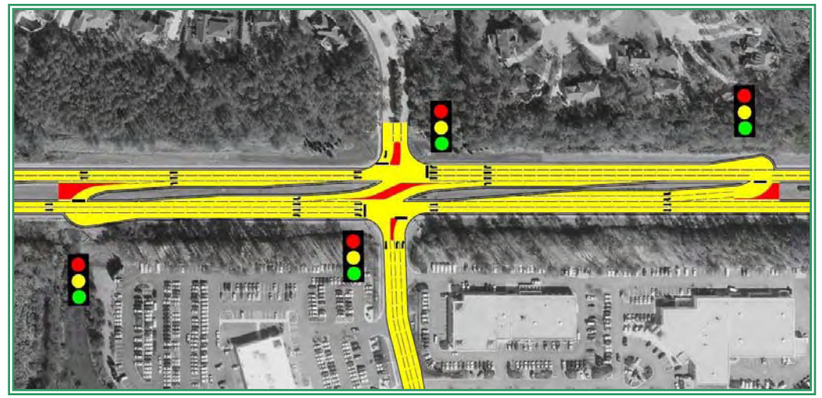
The primary method for improving upon the traditional intersection is to reduce the number of conflict points at the intersection. This provides safety and traffic operations benefits by reducing the number of movements who share the green time and by reducing the number of conflicting volumes at a single location. The goal of many of the unconventional intersections types is to spread out the movements into more than one location to allow for fewer conflict points and more green time for each of the movements. The signalized intersection concepts discussed in the following sections have emerged as the preferred method for improving the safety and efficiency of a corridor without greatly increasing the footprint of the intersections along the corridor.

3.2.2.2 Superstreet

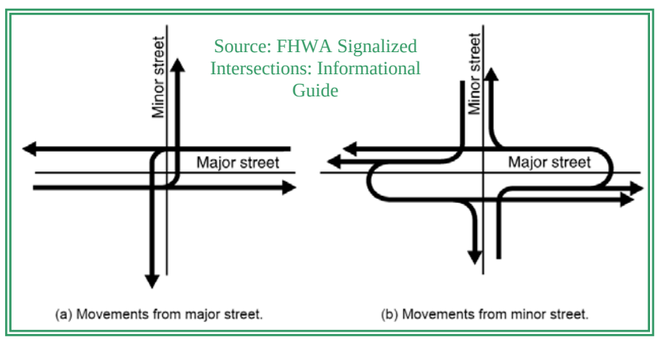
The Superstreet concept refers to a reconfiguration of a traditional intersection by redirecting some or all of the left turn movements away from the main intersection. The left turn movements are re-routed to median U-turn locations approximately 600 feet downstream. There are two primary applications of Superstreets and a third related application that is often considered to be part of the Superstreet concept. The two primary applications are the Superstreet with Direct Major Street Left-turns and the Superstreet with Indirect Major Street Left-turns. The third related type is a Superstreet with Direct Minor Street Left-turns. Each of the three types is described in detail in the following sections.

Superstreet with Direct Major Street Left-turns

The application of the Superstreet with Direct Major Street Left-turns is the most common in urban locations and is the standard application unless there is an overwhelming factor that would result in considering one of the other Superstreet configurations. The Superstreet with Direct Major Street Left-turns requires the through and left turning vehicles from the minor street approach to turn right, proceed to the downstream U-turn and then return in the opposite direction. The movements from the major street are unaffected as the main intersection still allows for all movements from the major street. The illustration below shows the Superstreet with direct major street left-turns.

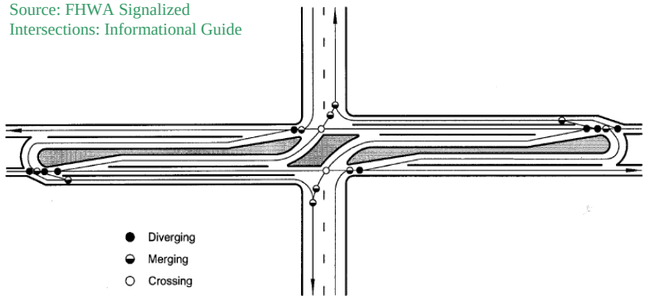


The primary benefit of this configuration is that redirecting the through and left turn movements to the median U-turn location reduces the number of conflicting movements that need separate signal phases at the main intersection to only two. The two signal phases would first give a green light to the major street through traffic, followed by the second phase which would give the green light to the left turns from the major street at the same time as the right turns from the minor street, because the movements do not conflict. The two median U-turn locations would also be signalized and would operate similarly with only two phases; the first again being the through traffic and the second allowing the U-turn movement. The reduction in the number of movements that occur at each intersection allows the intersection to operate more efficiently and to give more of the green time (typically about 70% of the total cycle length) to the heavy through movements. An additional benefit of the Superstreet concept is that because no traffic is crossing the median from the minor street, each direction of the major street can operate independent of the other direction allowing the signals to be coordinated to progress as though each direction were a one-way street. Due to this increased ability to coordinate the signals along the corridor, it is likely that as long as the motorists follow the speed limit, they will only need to stop once along the length of the Superstreet corridor. A comparison of the



Source: FHWA Signalized Intersections: Informational Guide

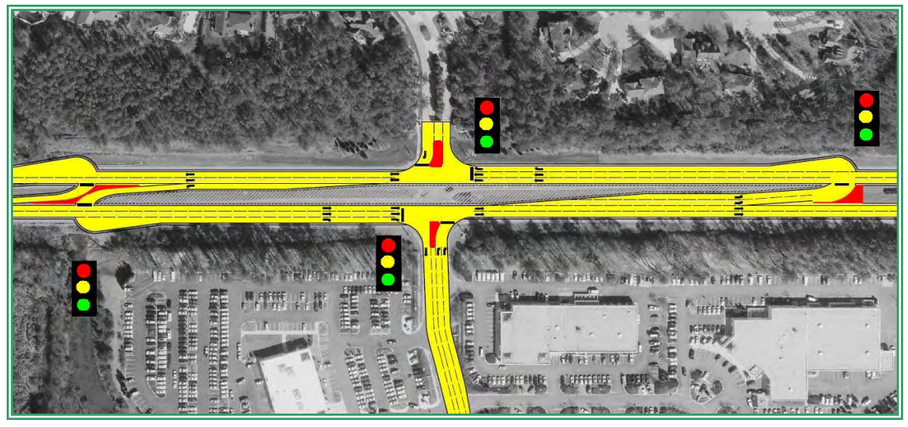
safety of the Superstreet configuration to a conventional intersection shows that the number of conflict points is reduced from 32 to 20 with the most dangerous crossing maneuvers (causing angle or “t-bone” accidents) reduced from 16 to 2 as shown in the following illustration.



The Superstreet does have a potential limitation for pedestrians because it utilizes a two-stage diagonal crossing that also requires some pedestrians to first cross the minor street before crossing the major roadway. The pedestrian crossing maneuvers occur at the same time as the major street traffic is turning left and the minor street traffic is turning right, thus allowing for pedestrians to cross without a conflicting traffic movements as typically occurs at traditional intersections.

Superstreet with Indirect Major Street Left-turns

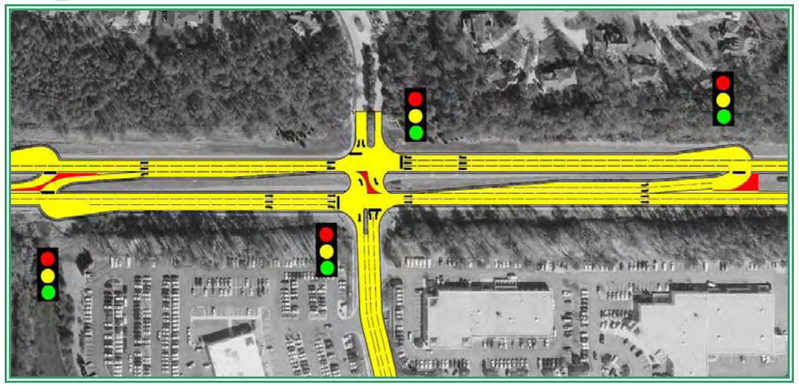
The Superstreet with indirect major street left-turns is very similar to the configuration with the direct major street left-turns with the exception that the left-turn movements from the major street are redirected to the downstream U-turn location as shown in the following illustration.



The benefits of this configuration over the previous configuration are that it provides for a more aesthetic environment, provides additional refuge for pedestrians and further reduces the number of conflict points to 12 including the elimination of all crossing conflicts. The redirection of the major street left-turn movement can result in additional stress on the u-turn signals and have the potential to reduce the efficiency of the traffic operations slightly.

Superstreet with Direct Minor Street Left-turns

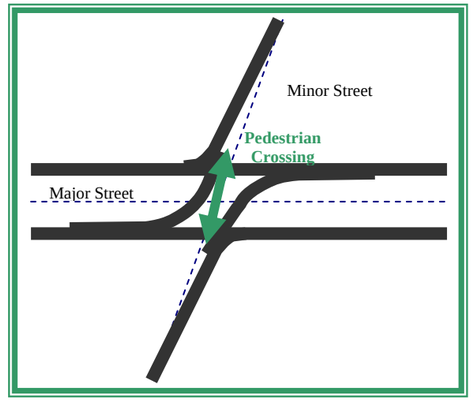
The third variation of the Superstreet concept is the Superstreet with Direct Minor Street Left-turns, which allows left-turns from the minor street directly onto the major street roadway. The left turns from the major street roadway to the minor street are directed to a downstream u-turn location, identical to the movement in the Superstreet with Indirect Major Street Left-turns. The minor street through movements are accommodated in the same manner as with all of the other Superstreet concepts requiring vehicles to turn right and make a u-turn at a downstream location. The Superstreet with Direct Minor Street Left-turns is shown in the following illustration.



The benefits of this configuration over the other Superstreet concepts are that it can accommodate high left-turn volumes from a minor street which may overwhelm the U-turn signal. The limitations associated with this configuration are that it does not allow for both sides of the major street to operate independently due to the left-turn movements requiring the major street traffic signals be combined as a single signal. There are also concerns with how pedestrians would navigate this configuration as the crossing pattern is a two-stage crossing that has more conflicts with turning traffic due to the left-turn movements and would likely require a longer wait time in the median to make the second stage of the crossing.

Superstreet Concept at Skewed Intersections

The Superstreet with Direct Major Street Left-turns concept can be modified slightly at skewed intersections to allow for a nearly perpendicular pedestrian crossing of the major street roadway. This configuration creates a larger central island increasing the pedestrian refuge and allowing for additional safety for pedestrians waiting in the median.



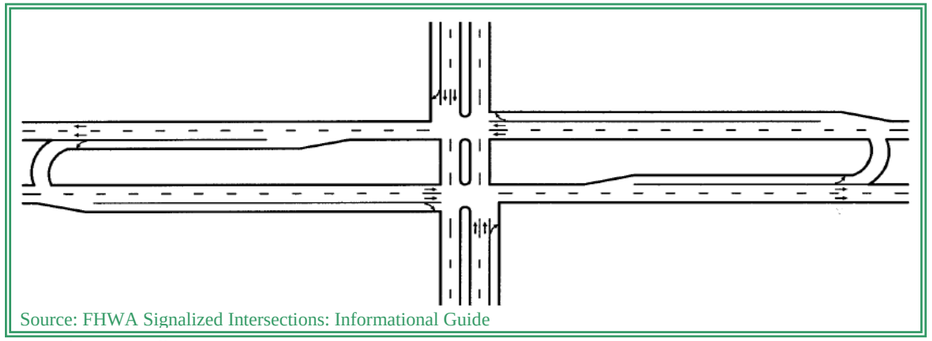
Summary of Superstreet Concept

The Superstreet concept provides for substantially improved traffic operations by reducing the number of movements that occur at a single location and by allowing for improved coordination along the facility. The Superstreet does generate several concerns related to safety for pedestrians with a two-stage crossing, concerns with navigation for bicyclists and access to adjacent properties. The Superstreet concept also has several concerns related to bicyclists crossing the intersection, where the bicyclist is forced to avoid the intersection, act as a pedestrian or act as a vehicle. There is not a significant issue if a bicyclist acts as a pedestrian; however if they act as a vehicle there are concerns with safety for bicyclists as they must travel a longer distance and mix with weaving vehicular traffic. The potential benefits and limitations for the Superstreet are shown in Table 3.1.

3.2.2.3 Median U-turn Crossover

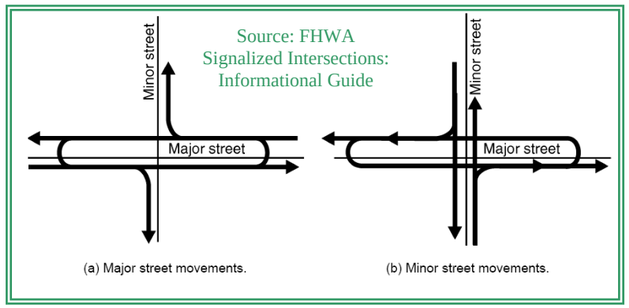
The Median U-turn Crossover is another unconventional intersection type that improves traffic operations by reducing the number of movements that occur at a single intersection. The Median U-turn Crossover is also commonly referred to as the Michigan Left turn due to the widespread use of this intersection type throughout the state. The Median U-turn Crossover concept eliminates all left-turn movements at the main intersection and moves them to median crossovers beyond the intersection. To turn left from the major street the driver crosses through the main intersection, makes a U-turn at the median crossover, returning in the opposite direction, turning right onto the minor street. To turn left from the minor street onto the major street, the movement would be the same as with the Superstreet, where the driver would turn right onto the major street and make a U-turn at the median crossover and continue back through the main intersection. The difference

between the Median U-turn Crossover and the Superstreet is that the Median U-turn Crossover allows through traffic from the minor street to pass through the main intersection instead of turning right and using the median U-turn as is required for the Superstreet. The illustration below shows the Median U-turn Crossover.

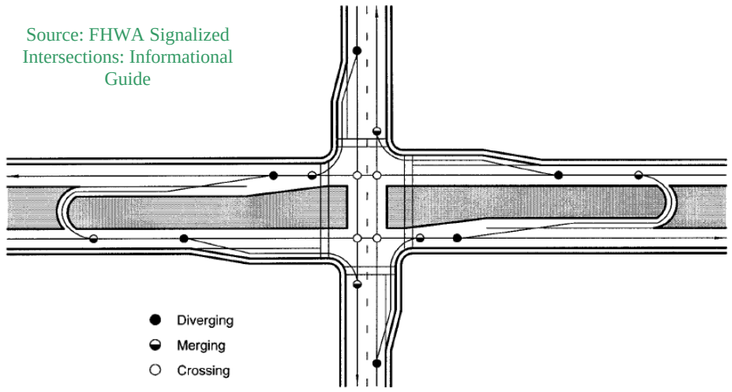


Source: FHWA Signalized Intersections: Informational Guide

The median U-turns could also be placed on the minor street and would operate with the same traffic pattern or the median U-turns could be placed on both the minor street and the major street to further improve efficiency. The Median U-turn Crossover requires a wide median with a recommended width of 60 feet; otherwise additional pavement should be added to the outside travel lane to safely complete the U-turn maneuver. The ability to coordinate the signals along a corridor is less efficient than with a superstreet because the signals along the corridor must be coordinated in both directions. To improve the efficiency of the signal coordination the Median U-turn Crossover concept is best for corridors with uniform block widths, such as the grid pattern that makes the systems in Michigan very efficient. The Median U-turn Crossover is most suitable for locations that have relatively high major street and minor street through volumes and relatively low left-turn volumes.



Source: FHWA Signalized Intersections: Informational Guide



Source: FHWA Signalized Intersections: Informational Guide

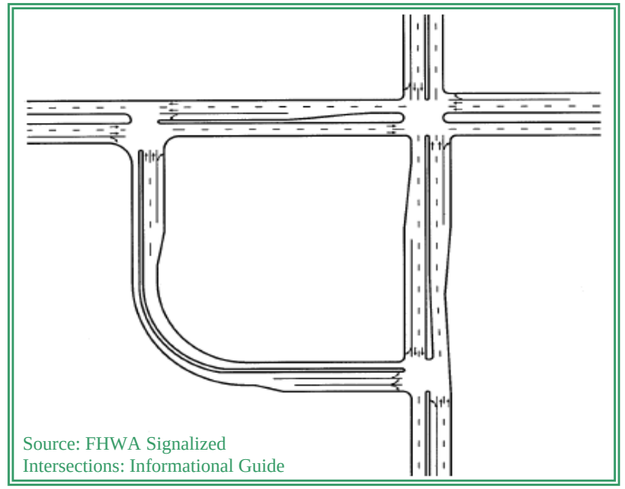
The safety of the Median U-turn Crossover has been evaluated extensively due to the widespread use in Michigan and based on a research study it was determined that the crash rate for facilities with median u-turns was 49 to 52% less than for roadways with traditional intersection configurations along corridors with more than one signal per mile. A comparison of the number of conflict points for a Median U-turn Crossover, shown at left, and a traditional intersection show that the number of conflict points is reduced from 32 to 16 with the Median U-turn Crossover where all 12 of the left-turn crossing maneuvers are eliminated.

The Median U-turn Crossover allows for traditional pedestrian crossings at the main intersection and due to the elimination of the left-turn movements reduces the number of conflicts to pedestrians. The increased median widths required for the Median U-turn results in longer crossing distances for pedestrians and increased delay to vehicular traffic due to long pedestrian crossing time for the signal. Due to this additional length some locations require the use of a two-stage crossing for pedestrians. The Median U-turn Crossover provides for bicycle movements more efficiently than a Superstreet intersection; however for unsignalized Median U-turns the turning paths for u-turn vehicles should be evaluated to ensure that they do not encroach on bike lanes.

Summary of Median U-turn Crossover Concept

The Median U-turn Crossover concept provides for substantially improved traffic operations by reducing the number of movements that occur at a single location and by allowing for improved coordination along the facility. The Median U-turn Crossover does generate some concerns related to enforcement and education to prevent illegal left turns at the main intersection. There is also the potential for impacts to the access for parcels with direct driveway access to the major street because the access may need to be restricted within the influence area of the median U-turn locations. The potential benefits and limitations for the Median U-turn Crossover are shown in Table 3.1 at the end of this section.

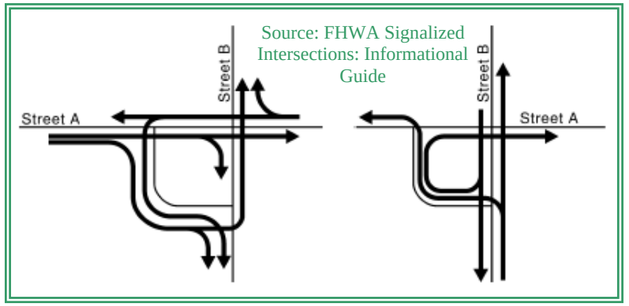
3.2.2.4 Quadrant Roadway



Source: FHWA Signalized Intersections: Informational Guide

The Quadrant Roadway concept includes providing an additional roadway between two legs of the intersection that accommodates the left-turn movement traffic. Drivers who wish to turn left from either the major street or minor street will be required to drive further, but the efficiency of the main intersection is greatly improved by eliminating the left-turn movements. The Quadrant Roadway creates two additional intersections, approximately 500 feet from the main intersection, to accommodate the left-turn traffic. The illustration at left shows the Quadrant Roadway configuration.

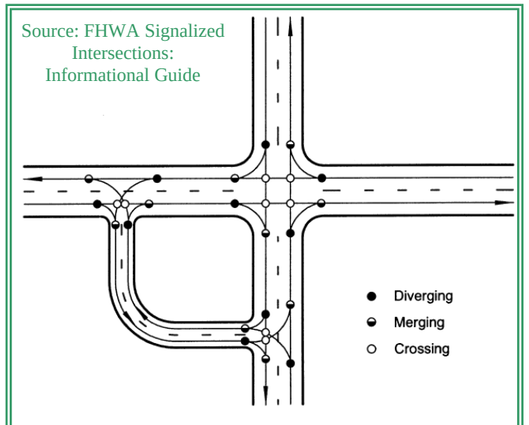
The Quadrant Roadway concept is most applicable for locations that have both high through volumes and high left turn volumes. The concept is also a very good option when the quadrant roadway and intersections already exist as part of the existing development pattern. By eliminating the left-turn movements at the main intersection more green time can be given to the through traffic. The two offset intersections also operate efficiently because they create three-leg intersections. The three leg-intersections are efficient because they allow time for each of the movements; the through movements, the left turn movements to the quadrant roadway and the left turn movements from the quadrant roadway to the major street. The three-leg configuration only includes one of the through movements making it more efficient from a traffic operations standpoint.



Source: FHWA Signalized Intersections: Informational Guide

The Quadrant Roadway is also an effective way to set up an intersection that will eventually be upgraded to an

interchange or become a grade separation as it provides for movements that are similar to a ramp and loop at an interchange. For this reason, Quadrant Roadways are often referred to as Square Loop intersections. The Quadrant Roadway concept allows for traditional pedestrian crossings at the main intersection and due to the elimination of the left-turn movements reduces the number of conflicts to pedestrians. The elimination of left-turn lanes also decreases the median width resulting in shorter crossing distances for pedestrians and reduced delay to vehicular traffic due to the shorter pedestrian crossing time for the signal. The pedestrian, however would have to make an additional crossing due to the new intersection included by creating the Quadrant Roadway segment.



Source: FHWA Signalized Intersections: Informational Guide

A comparison of the safety of the Quadrant Roadway concept to conventional intersections shows that the number of conflict points is reduced from 32 to 28 with the number of merging/diverging conflicts increasing from 16 to 20 and the number of crossing conflicts being reduced from 16 to 8. The results of the safety evaluation show that the Quadrant Roadway offers the potential for a minor increase in rear-end collisions and a major decrease in left-turn collisions. The illustration at left shows the conflict point diagram for the Quadrant Roadway concept.

Summary of Quadrant Roadway Concept

The Quadrant Roadway concept provides for substantially improved traffic operations by reducing the number of movements that occur at a single location. The Quadrant Roadway does generate some concerns related to enforcement and education to prevent illegal left turns at the main intersection. There is also the potential for impacts to access to parcels with direct driveway access to the major street because the access may need to be restricted within the influence area of the Quadrant roadway locations. The potential benefits and limitations for the Quadrant Roadway are shown in Table 3.1 at the end of this section.

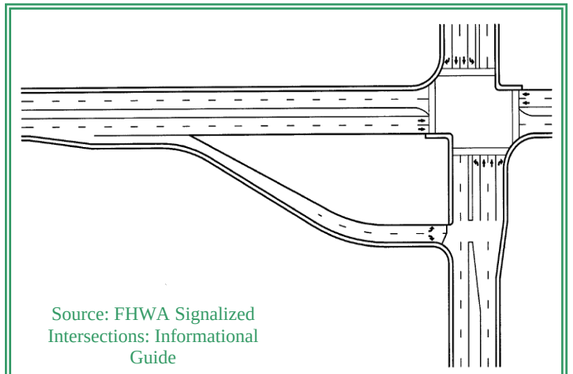
3.2.2.5 Quadrant Roadway with Grade Separation

The Quadrant Roadway with grade separation is a variation on the Quadrant Roadway discussed above. The Quadrant Roadway with Grade Separation adds an overpass at the main intersection improving the operations of the intersection substantially. This configuration can also be developed with Quadrant Roadways in two quadrants and is known as a Quadrant Interchange (discussed in Expressway Concepts section) that eliminate the left-turn movements at one of the roadways and make the intersection operate similar to a scaled down interchange. An example of a single quadrant (left turns allowed on both roadways) is shown at right.

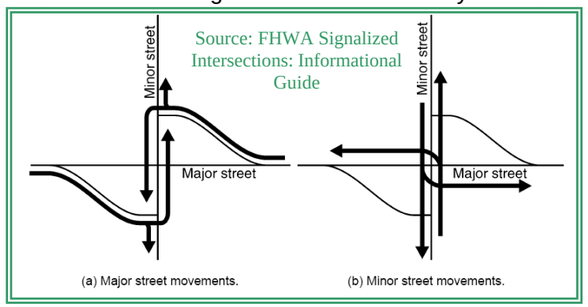
The safety of the Quadrant Roadway with grade separation further improves safety by removing an additional 12 conflict points, reducing the total number of conflict points to 16 as compared to the 32 for a traditional intersection. The safety for pedestrians is greatly improved with the grade separated crossing as it allows for free movement through the intersection due to the overpass structure. One potential limitation of the Quadrant Roadway with Grade Separation is that it may require the acquisition of additional property to allow for the increased elevation of the overpass and may restrict access near the overpass due to the grades on the roadway. Additionally, construction of the overpass at existing intersections may require substantial detour routes or relocation of the roadway in order to keep the existing roadways operational during construction. The potential benefits and limitations for the Quadrant Roadway with Grade Separations are shown in Table 3.1 at the end of this section.

3.2.2.6 Jughandle

The Jughandle is an unconventional intersection concept that redirects left-turn movements from the major street by creating a one-way ramp that connects to the minor street to allow left-turn movements. The Jughandle concept includes placing the ramps in two quadrants of the intersection in advance of the intersection in each direction. All major street turns – left, right and U-turns are made from the right side of the roadway. Drivers wishing to turn left exit the major roadway at the ramp on the right side and then turn left at the minor street and continue straight through the intersection along the minor street. The illustration at right shows the Jughandle concept.

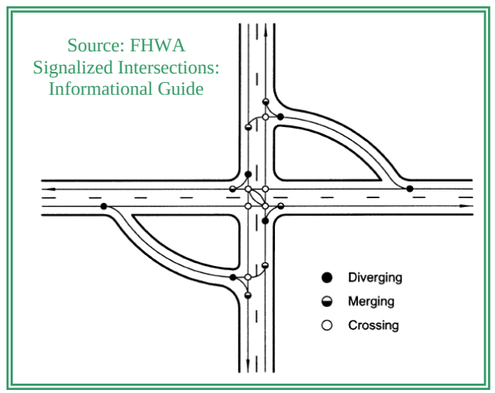

Source: FHWA Signalized Intersections: Informational Guide

The Jughandle concept is most appropriate for intersections with high major street through movements, low-to-medium major street left-turn movements, low-to-medium minor street left-turn movements and any amount of minor street through volumes. The Jughandle is also a very effective solution at intersections with narrow medians that cannot accommodate a left-turn lane or cannot accommodate large vehicles making u-turns. The signing of the intersection is vital to the Jughandle concept as it is not intuitive to exit to the right to turn left and requires adequate advanced notice to the driver. The Jughandle concept increases the exposure of pedestrians to traffic due to the additional intersections required, however the pedestrian crossing at the main intersection is narrower due to the lack of left and right turn lanes.



Source: FHWA Signalized Intersections: Informational Guide

The safety of the Jughandle concept is demonstrated by reducing the number of conflict points in comparison to a traditional intersection from 32 to 26 which offers the potential for a substantial decrease in left-turn collisions. The following illustration shows the conflict diagram for the Jughandle concept.



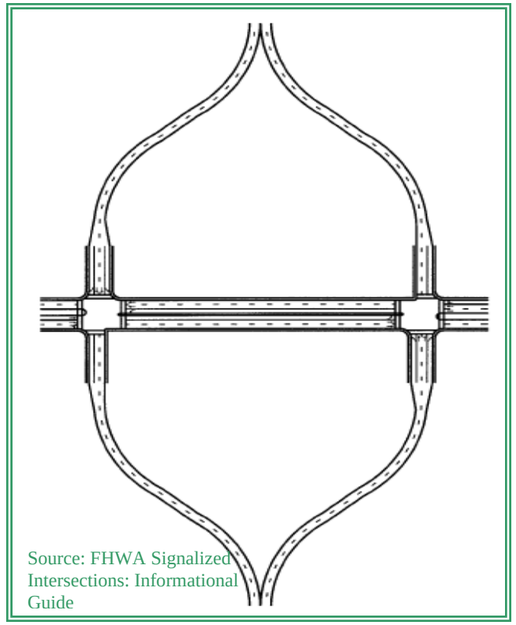
Source: FHWA Signalized Intersections: Informational Guide

Summary of Jughandle Concept

The Jughandle concept provides for improved traffic operations by redirecting the left turns away from the main intersection, allowing more green time to be allotted to the major street through traffic. The Jughandle does have some potential limitations due to the increased footprint to accommodate the ramps and the potential for conflicts between bicyclists and vehicles at the exit point to the ramps. There is also the potential that the location of the Jughandle ramps may require additional control of access along the minor street which may have an impact on access to adjacent properties. The potential benefits and limitations for the Jughandle are shown in Table 3.1 at the end of this section.

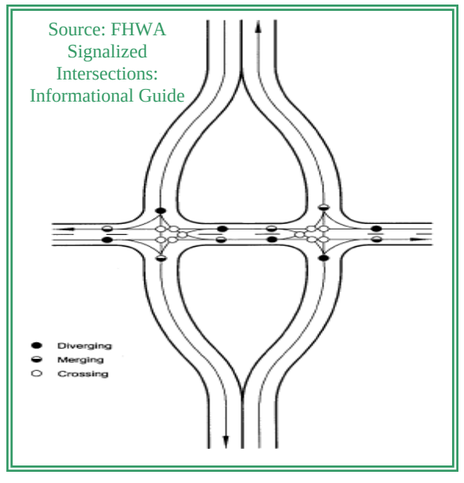
3.2.2.7 Split Intersections

The Split Intersection concept essentially creates an at-grade diamond interchange between two roadways. The Split Intersection requires that the major street roadway split into two one-way streets as it approaches the minor street. This configuration creates two intersections where each intersection serves fewer movements than a single traditional intersection. Each of the intersections would have separate allotments of green time for the major street through, left and right traffic, the minor street left turn traffic and the minor street through traffic, resulting in improved traffic operations. The illustration to the right shows the Split Intersection concept.



Source: FHWA Signalized Intersections: Informational Guide

The Split Intersection concept is most applicable where a future interchange is likely to be constructed but either cannot yet be justified or is too expensive to construct. The benefit of the Split Intersection is that there would not need to be any additional property acquired to construct the diamond interchange in the future. This concept is best used for new roadways being planned or for those that are being retrofitted with an increased level of control of access, such as converting an arterial with signals to an expressway or freeway. The split intersection reduces the pedestrian crossing distance substantially, but because the intersections have the look and feel of an interchange, pedestrians may find them intimidating and drivers may be less aware of pedestrians' presence.



Source: FHWA Signalized Intersections: Informational Guide

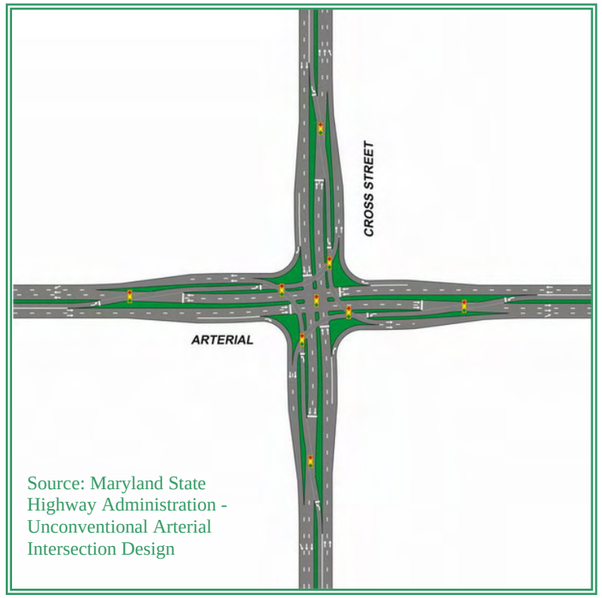
A comparison of the number of conflict points between a Split Intersection and a traditional intersection configuration shows that the number of conflicts is reduced from 32 to 22 with the potential for a significant decrease in left-turn collisions. The illustration at left shows the conflict diagram for the Split Intersection concept.

Summary of Split Intersection Concept

The Split Intersection concept provides for improved traffic operations by splitting out the movements that occur at a traditional intersection into two separate intersections. The concept allows for a substantial increase in the amount of green time that can be allotted to the major street through traffic. The concepts main limitations are that it requires additional land to construct initially and tends to have a higher initial construction cost as compared to other unconventional intersection configurations. The potential benefits and limitations for the Split Intersection are shown in Table 3.1 at the end of this section.

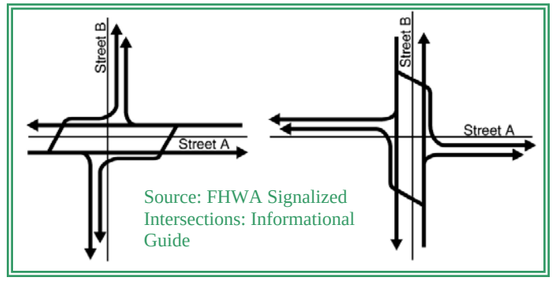
3.2.2.8 Continuous Flow Intersection

The Continuous Flow Intersection concept is another unconventional intersection concept whose goal is to reduce the number of conflicting movements at the main intersection in order to allow for more green time for the major street through traffic. The Continuous Flow Intersection removes the conflict between left-turning vehicles and through traffic in the opposite direction by crossing the left-turn traffic to the left side of the roadway. The crossing from the right side to the left side is accomplished at a midblock signalized intersection for each approach that will include the continuous flow lanes. Note that this section describes an at-grade concept; a grade-separated version of the Continuous Flow Intersection was patented, but the patent expired in 2003.



Source: Maryland State Highway Administration - Unconventional Arterial Intersection Design

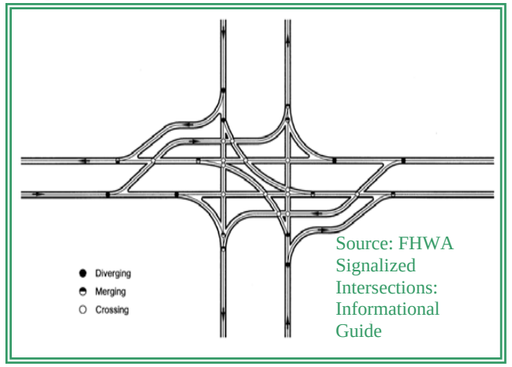
The Continuous Flow Intersection concept is most appropriate with high through and left-turn volumes and minimal u-turn volumes as the configuration restricts these movements. The left-turning vehicles are likely to experience more delay at this type of intersection; however the through traffic operations are substantially improved. The Continuous Flow Intersection concept is extremely flexible and can be implemented from only a single leg to all four legs of the intersection depending on the traffic volumes.



Source: FHWA Signalized Intersections: Informational Guide

The Continuous Flow Intersection does present some challenges for pedestrians although the concept does provide a substantial benefit to pedestrians because all crossings are completed when there is not conflicting turning vehicles. The pedestrian crossing for this concept requires a two-stage crossing and the layout and operation may not be readily apparent to pedestrians, especially visually impaired pedestrians. Due to the unconventional traffic flow the audible clues that visually impaired pedestrians utilize are disrupted and consideration should be given for specially designed pedestrian signals at Continuous Flow Intersections.

The safety of the Continuous Flow Intersection as compared with a traditional intersection configuration results in the total number of conflict points being reduced from 32 to 30 (shown at right) with the potential for a major reduction in left-turn collisions and the potential for a major increase in angle collisions. The education required for drivers at Continuous Flow Intersections is a concern although limited studies have found that drivers quickly adjust to the configuration and after an initial break-in period there is little driver confusion. The maintenance of this concept is also potential concern for snow removal and safety in the event of power outages to the signalized intersections.



Source: FHWA Signalized Intersections: Informational Guide

Summary of Continuous Flow Intersection

The Continuous Flow Intersection concept provides for improved traffic operations by splitting out the left-turn movements in advance of the intersection to eliminate the conflicting movements at the main intersection. The concept allows for a substantial increase in the amount of green time that can be allotted to the major street through traffic. The concept's main limitations are that it requires a larger footprint than traditional intersections; however it is more compact than a typical interchange. There are also concerns with access to adjacent properties due to the requirement for greater access control in the vicinity of the midblock crossing signals. The potential benefits and limitations for the Continuous Flow Intersection are shown in Table 3.1 at the end of this section.

3.2.2.9 Summary of Signalized Intersection Concepts

A summary of the concepts discussed above is shown in Table 3.1. Each of the nine unconventional signalized intersection concepts are compared relative to the Traditional Intersection Treatment for the following attributes:

- Safety (evaluates the vehicular safety of the intersection by comparing the number of conflicts points (potential crash locations) for the concept with the number of conflict points for a traditional intersections)
- Traffic Operations (evaluates the traffic operations of the concept based on overall intersection travel time)
- Bicyclist and Pedestrian (evaluates the ability of the concept to provide for safe and efficient mobility for bicyclist and pedestrians)
- Footprint (evaluates each concept based on the amount of land required to construct the concept)
- Access (evaluates each concept on its ability to provide for efficient access to adjacent parcels and roadways as compared to a traditional intersection)
- Education and Enforcement (evaluates each concepts ability to understood by the driver and the ability to enforce the traffic pattern included in the concept)

The table provides a description of the potential benefits and potential limitations for each concept as well as a qualitative rating for how well it addresses each individual attribute.

The qualitative rating system includes the following measures:

★★★★★ - Favorable

★★★★ - Slightly Favorable

★★★ - Average

★★ - Slightly Unfavorable

★ - Unfavorable

It should also be noted that these qualitative evaluations are for each individual attribute and that the weight of each of the attributes is not equal. Different individuals are likely to prioritize certain attributes higher than other individuals would. For example a business owner may prioritize access to their business with much greater weight, while an avid cyclist may prioritize bicycle/pedestrian considerations. The challenge in evaluating the concepts and developing a solution is that a balanced approach must be taken as no one concept is superior for all attributes. When applied to the US 64 corridor it is important that the individual context for each location be considered when evaluating the potential options.

Table 3.1: Signalized Intersection Concepts Summary

Concept Type		Safety	Travel Operations	Bicycle/Pedestrian	Footprint	Access	Education and Enforcement
Traditional Intersection Treatments		★	★	★★★	★★	★★★★★	★★★★★
		32 Conflict Points	Inefficient operation due to many movements being required at a single location	Standard crossing pattern for pedestrians and bicyclists; however some conflicts with vehicles	Larger footprint to accommodate turn lanes and inefficient operation requires more lanes	Provides full access to all movement	Standard configuration, well understood by drivers, pedestrians and bicyclists
Superstreet with Direct Major Street Left-turns		★★★★	★★★★★	★★	★★★	★★★★	★★★
	Potential Benefits	20 Conflict Points	Less delay for major street movements	No conflicting vehicle movements	May reduce need for adding additional lanes	Provides same access as traditional intersection for major street traffic	None
	Potential Limitations	None	Longer travel distance and slightly longer time for minor street movements	2-stage diagonal crossing and concerns with bicycle crossing	Needs wider median or u-turn bulb-outs	Redirects side street through and left-turns to u-turn location	Potential for driver, pedestrian and bicyclist confusion
Superstreet with Indirect Major Street Left-turns		★★★★★	★★★★	★★★	★★★★	★★★	★★★
	Potential Benefits	12 Conflict Points	Less delay for major street through movements	No conflicting vehicle movements and increase refuge in median	May reduce need for adding additional lanes, more aesthetic	Provides same access for major street through and right movements	None
	Potential Limitations	None	Longer travel distance and time for minor street and major street left turns	2-stage diagonal crossing and concerns with bicycle crossing	Needs wider median or u-turn bulb-outs	Redirects major street left and side street through and left-turns	Potential for driver, pedestrian and bicyclist confusion
Superstreet with Direct Minor Street Left-turns		★★★★	★★★	★	★★★	★★★	★★★
	Potential Benefits	20 Conflict Points	Less delay for major street through movements	None	May reduce need for adding additional lanes	Provides for major through and right movements and minor street left-turns	None
	Potential Limitations	None	Longer delay for minor street through and right turn movements	2-stage crossing with extended wait time and bicycle concerns	Needs wider median or u-turn bulb-outs	Redirects major street left-turns and minor street through movements	Potential for driver, pedestrian and bicyclist confusion
Median U-turn Crossover		★★★★	★★★	★★★	★★★	★★★	★★
	Potential Benefits	16 Conflict Points	Less delay for major street through movements	Standard crossing for pedestrians and bicyclists with fewer vehicle conflicts	May reduce need for adding additional lanes	Provides same access for major and minor street through movements	None
	Potential Limitations	None	Longer travel distance and time for minor street and major street left turns	2-stage crossing is typical	Needs wider median or u-turn bulb-outs	Redirects all left-turn movements to u-turn location	Potential for illegal left-turns & driver and bicyclist confusion
Quadrant Roadways		★★	★★★	★★★	★★	★★★	★★
	Potential Benefits	28 Conflict Points – Potential major decrease in left-turn collisions	Potential reduction in delay and queuing	Decreases crossing distance at main intersection by removing left turns	Benefit if roadway already exists	None	None
	Potential Limitations	Potential minor increase in rear-end collisions	Potential for longer travel distance for turning movements	Number of intersections to cross increases	May require additional land and have high construction cost	May reduce access to quadrant roadway and redirects some turns	Potential for illegal left-turns & driver, and bicyclist confusion
Quadrant Roadways with Grade Separation		★★★★	★★★★★	★★★★★	★	★★	★★★★
	Potential Benefits	16 Conflict Points	Reduction in delay and queuing	Removes pedestrian conflicts at main intersection	None	None	None
	Potential Limitations	None	Potential for longer travel distance for turning movements	None	Requires additional land and high construction cost, aesthetic concerns	Redirects more turn movements to quadrant roadway, reduces some access	Minor potential for driver, pedestrian and bicyclist confusion
Jughandle		★★	★★	★★	★	★★★	★★
	Potential Benefits	26 Conflict Points	Reduction in overall intersection travel time	Decreases crossing distance at main intersection by removing left turns	None	None	None
	Potential Limitations	None	Longer travel time for left-turns using Jughandle	Increased number of intersections and concerns with exit to Jughandle conflicting with bicycle lanes	Requires additional land and may have high construction cost	May reduce access near Jughandle and redirects some turns	Potential for illegal left-turns and requires good advanced signing
Split Intersections		★★★	★★	★★★	★	★★★★★	★★★★★
	Potential Benefits	22 Conflict Points	Improves traffic flow for through movements	Shorter crossing distance	Can be step toward interchange at future interchange locations	Provides for all movements	None
	Potential Limitations	Potential for wrong-way movements	May have problems with queuing depending on separation distance	May not be perceived as being pedestrian friendly	High initial land and construction costs	Larger footprint may require some access restrictions	None
Continuous Flow Intersection		★★	★★★	★	★	★★★★	★★
	Potential Benefits	30 Conflict Points	Improves traffic flow for through movements	No vehicle conflicts during pedestrian crossing	None	Provides for all movements	None
	Potential Limitations	Potential for major increase in angle collisions	More delay for left-turn movements	2-stage crossing and concerns with visually impaired pedestrians	Requires additional land and higher construction cost, aesthetic concerns	Larger footprint requires additional access restrictions	Potential for driver, pedestrian and bicyclist confusion

★★★★★ - Favorable ★★★★ - Slightly Favorable ★★★ - Average ★★ - Slightly Unfavorable ★ - Unfavorable

3.2.3 EXPRESSWAY CONCEPTS

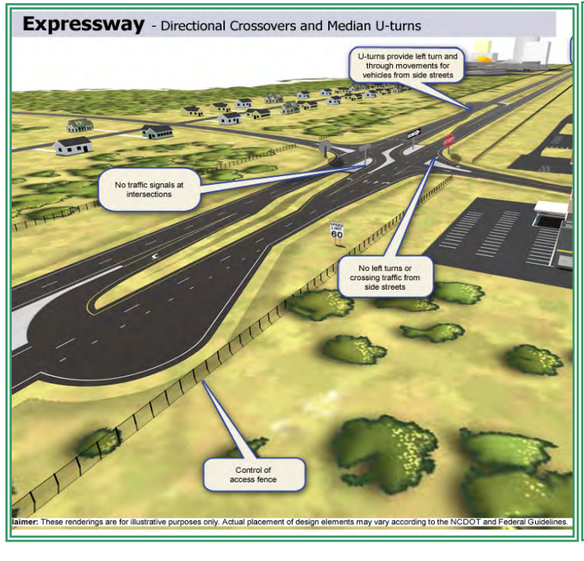
The range of solutions for upgrading an existing signalized intersection facility to an expressway is accomplished through removing the signalized intersections and improving the connections to the existing minor streets. The expressway concepts are generally separated into two categories; urban concepts and rural concepts.

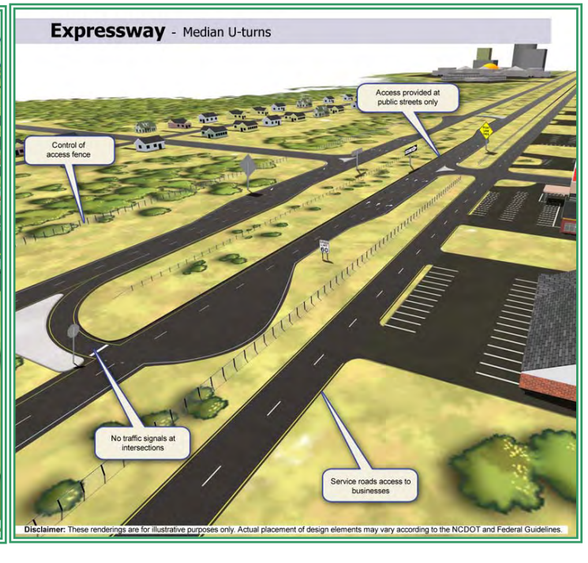
3.2.3.1 Rural Expressway Concepts

The rural concepts are typically converting the major intersections into at-grade unsignalized intersections that allow only right-turn movements to and from the minor street and limited left-turn and U-turn movements at unsignalized locations along the major street. The at-grade intersections include providing adequate acceleration and deceleration lengths to safely transition cars to and from expressway speeds. Rural expressway concepts are typically applicable for divided facilities with projected major street daily traffic volumes less than 25,000 vehicles per day and projected minor street daily volumes less than 2,500 vehicles per day.

Right-in/Right-out with Median U-turns

The preferred method of providing an expressway facility in a rural area is to utilize a configuration that converts minor street intersections to allow only right-turn movements to and from the minor street, which is typically referred to as a "right-in/right-out" configuration. Traffic from the minor street wishing to go straight or left would first turn right onto the major street and then enter a u-turn lane at a location approximately 800 feet downstream where they could make a u-turn in the opposite direction and either turn right into the minor street (completing the through movement) or continue straight through (completing the left turn movement). The left turn traffic is typically handled with either a left turn at the minor street intersection or by traveling beyond the intersection and making a u-turn to travel back to the minor street. The determination of whether or not a direct left turn will be provided is based on the projected volume of traffic on the minor street. This configuration is essentially an unsignalized version of the Superstreet configuration described in the signalized intersection concepts section. The illustrations below show the Right-in/Right-out with Median U-turns concept both with the direct left turns at the minor street (left) and with the median u-turns (right).





3.2.3.2 Urban Expressway Concepts

The urban expressway concepts typically rely on developing grade-separated (overpass) crossings for major side streets and allowing unsignalized connections to minor side streets as long as adequate acceleration and deceleration lengths can be achieved to safely transition cars to and from expressway speeds. The ability to allow unsignalized left-turn and u-turn movements along the major street, as is typical for the rural concepts, is not possible as the major street traffic volume exceeds 25,000 vehicle per day, thus meaning that the access to and from major roadways will require grade separation. In its simplest form, the only way to allow vehicles to cross the median of the major street for volumes greater than 25,000 vehicles per day is with a signalized intersection or with a grade separated crossing. Because expressway facilities do not allow signals, the only means of providing full access is through grade separating the minor street and major street from each other. The following sections detail the concepts that are typically used for expressway facilities in urban areas.

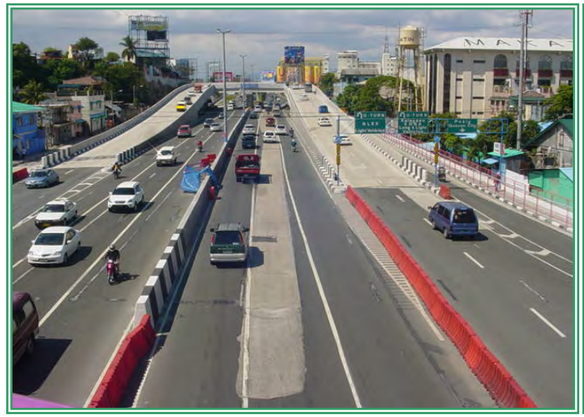
Quadrant Interchange

The quadrant interchange is very similar to the Quadrant Roadway with Grade Separations described under the signalized intersection concepts section. The Quadrant Interchange is commonly referred to as a "Square Loop Interchange" as it emulates the functions of a loop and ramp in an interchange in a more compact form. The Quadrant Interchange includes an overpass at the main roadway intersection and quadrant roadways in two quadrants of the intersection. This configuration eliminates the left-turn movements to and from the major street roadway and makes the intersection operate similar to a scaled down interchange. The configuration can also be used with quadrant ramps in all four quadrants, thus eliminating all of the left-turn movements on both the major street and minor street. The elimination of the left-turn movements from the major street allows it to operate without any signalized intersections in accordance with the expressway definition. The following images show examples of Quadrant Interchanges.

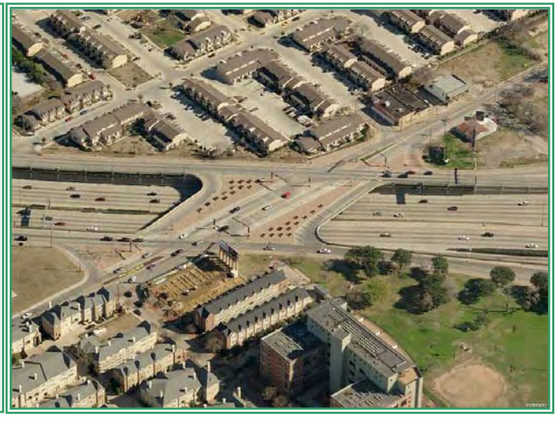
Depending on the traffic volumes on the quadrant roadways, the land inside of the quadrants can be developed with limited access to the quadrant roadways. The major street connections should be designed with adequate acceleration and deceleration lengths to safely transition cars to and from expressway speeds. The length of the quadrant roadways is typically based on the greater of the distance required to connect the grade separated roadways or to accommodate the traffic queued at the signalized intersection on the minor street.

Grade Separated U-turns

The Grade Separated U-turns is a concept that is used along an expressway corridor in conjunction with right-in/right-out intersections to collect all of the traffic that desires to cross the major street as a minor street through or left-turn and have it exit to the right onto a grade separated U-turn bridge. The concept has been utilized in several locations outside of the United States and is typically only used in highly urbanized areas where the cost of acquiring additional property is cost restrictive. The following images show the Grade Separated U-turn concept.



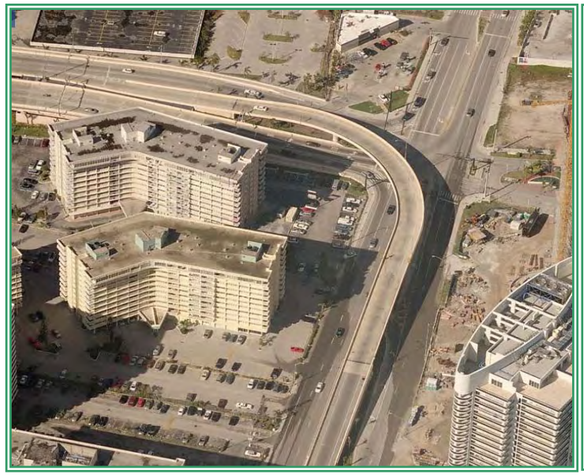
The more common application of the Grade Separated U-turn concept in the United States is in Texas where they are used extensively along with frontage roads that run parallel to the major street roadway. Access to and from local roadways is provided onto the one-way parallel frontage roads and vehicles that wish to turn left follow the frontage road to a location where u-turn movements are allowed either on a bridge over the major street or with the major street passing over the u-turn roadway. The following images show the Grade Separated U-turn concept with parallel frontage roads.

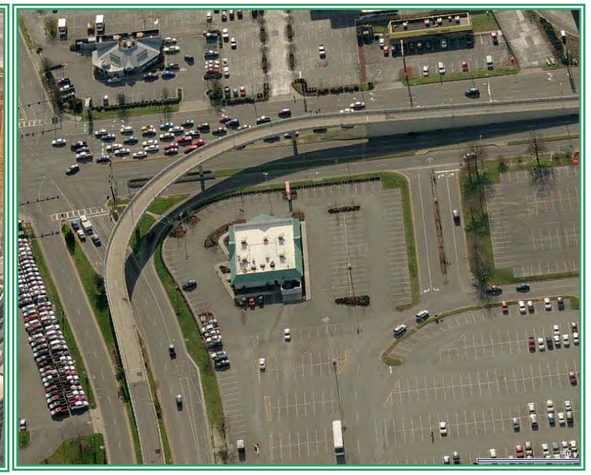


The primary concerns with the Grade Separated U-turn concept is that it takes additional land to construct the frontage roads and the aesthetics related to the grade separation are a concern in the vicinity of residential areas.

Grade Separated Median Left-turn

The Grade Separated Median Left-turn is an expressway concept that allows for left turns from the major street to a minor street by means of a grade separated bridge over the opposing direction of traffic. The use of the elevated bridge eliminates the conflict between the left turning traffic from the major street roadway and the traffic traveling along the major street roadway in the opposite direction. The following images show the Grade Separated Median Left-turn concept.





The primary concerns with the Grade Separated Median Left Turn concept are similar to the Median U-turn concept with the aesthetics and noise impacts related to the grade separation are a concern in the vicinity of residential areas. Additionally, the tighter design for the turning traffic can create the potential for truck rollovers on the ramp

Parallel Frontage Road with Slip Ramps

The most common strategy for urban expressways is to utilize a system of parallel frontage roads that separate local traffic from through traffic. The parallel frontage roads connect to and from the major street through traffic lanes at appropriate locations with slip ramps that enter and exit on the right side of the major street roadway. The parallel frontage road concept is beneficial because it allows for signalized intersections on the frontage road at minor streets that provide access to adjacent property as well as uninterrupted travel along the major street through lanes. With the Parallel Frontage Road concept there are two ways to treat the minor street access points; either as three-leg intersections without major street cross access or as four-leg intersections that include a grade separated crossing of the major street through traffic. The grade separated cross streets can also be utilized for vehicles who wish to make left turns where a minor street intersects the frontage road at a three-leg intersection. To accommodate the left-turn movement, the driver would make a right turn onto the frontage road and travel to the next four-leg intersection with a grade separation, turn left onto the crossing roadway and then left again onto the frontage road traveling in the opposite direction. The driver would then merge onto the expressway at a slip ramp entrance. The locations of slip ramps are placed such that they can provide an adequate level of access to and from the frontage roadways without overloading the major street through lanes or the frontage roads. The location of the parallel frontage roads in relation to the major street through travel lanes is dependent on the constraints along the corridor. The frontage roads could be separated by barriers or retaining walls where there is little available land along the corridor or could be separated from the major street traffic even as far outward as one block away from the major street through traffic with access to property along both sides of the frontage road. The following image shows the Parallel

Frontage Road with Slip Ramps concept along the Durham Freeway.

The primary concern with the Parallel Frontage Road with Slip Ramps is the size of the footprint required to accommodate the frontage roads and slip ramps. Additionally, due to the need to grade separate the minor streets, the major street through lanes are often constructed as overpasses or bridge structures over the existing minor streets which generate concerns due to noise and the aesthetics in residential areas.

Reduced Form Interchanges

The urban expressway often functions similarly to a freeway system due to the need to grade separate the crossing movements to and from minor streets. Because of this, the practice of utilizing freeway interchanges that are modified to be more compact is a common strategy for urban expressway corridors. The design speed of the urban expressway facility is typically less that that of an urban freeway and the expectation from drivers is such that it is acceptable to have lower speed connections to the expressway major street. The interchange types for freeways are discussed in Section 3.2.4 and these configurations can be modified slightly to allow for a more compact footprint that better fits into the context of an urban expressway corridor. The primary changes to the configurations are to allow for lower speed ramps and loops that have adequate acceleration and deceleration lengths to safely transition cars to and from expressway speeds. The typical design speed for ramps exiting and entering an expressway with a design speed of 55 miles per hour would be 30 miles per hour as opposed to 50 miles per hour for a typical freeway. The design speed for loops is typically reduced from 30 miles per hour to 20 miles per hour which results in a much smaller radius for the loop. In addition to standard ramps and loops, any flyover ramps could be constructed with reduced design speeds of 20-30 miles per hour as opposed to 50-60 miles per hour for a freeway facility thus substantially reducing the size of the ramp. The design of any reduced form interchange should be evaluated to determine that the design will operate safely and that it does not violate driver expectations.

3.2.4 FREEWAY CONCEPTS

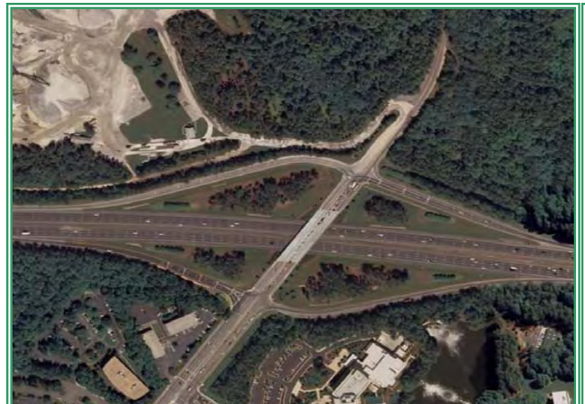
The range of solutions for upgrading an existing signalized intersection facility to a freeway is accomplished through removing the signalized intersections and either removing the minor street connections or upgrading the connections to interchanges. This section presents the different configurations for freeway interchanges. Freeway interchanges are typically broken into two classifications; service interchanges and system interchanges, with the major distinction being the type of facility that intersects the freeway. A service interchange is an interchange between a freeway and a minor street that is not another freeway or expressway and includes unsignalized or signalized intersections along the minor street. A system interchange is an interchange between two controlled access facilities such as freeways and expressways. System interchanges are typically very complex, have numerous potential solutions based on the traffic volumes and in general are unique solutions to the given area. For this reason, this section focuses only on service interchanges. To protect the traffic operations and safety of the interchange, NCDOT policy calls for a minimum length of 1000 feet along the minor street, from the location where the ramp or loop ties to the minor street, to have controlled access with no roadways or driveways allowed in this area. Therefore any service road needed to maintain access along the freeway once it is upgraded must tie in at a location that is a minimum of 1000 feet from the ramp intersection.

3.2.4.1 Simple Diamond Interchange

The Simple Diamond interchange is the standard configuration for NCDOT in rural areas. The configuration includes a single ramp in each of the four quadrants with the intersections along the minor street placed 800-1000 feet apart. The configuration allows for the interchange to be upgraded to include internal loops, if traffic volumes increase in the future, without having to reconstruct the interchange or purchase additional property. This interchange configuration provides low-to-medium traffic capacity, has a low construction cost and requires a medium-to-high amount of land to construct. The following images show examples of Simple Diamond interchanges.

3.2.4.2 Compressed Diamond Interchange

The Compressed Diamond interchange configuration is a variation of the Simple Diamond interchange and is characterized by reducing the distance between where the ramps connect to the minor street from greater than 800 feet to a range of 400-800 feet. This configuration does not allow for the addition of future loop ramps and is best in rural areas where future traffic volumes are not likely to increase, such as in locations in sensitive watersheds or with natural features that limit future growth. This interchange configuration provides low-to-medium traffic capacity, has a low construction cost and requires a medium amount of land to construct. The following images show examples of Compressed Diamond interchanges.



3.2.4.3 Tight Urban Diamond Interchange

The Tight Urban Diamond Interchange (TUDI) is a further variation of the Simple and Compressed Diamond configurations that is typically only used in urban areas where there is substantial constraints on the property immediately adjacent to the intersection. The TUDI further reduces the distance between the ramp intersections to less than 400 feet, which typically requires that retaining walls be constructed between the ramps and the freeway. This interchange configuration provides medium-to-high traffic capacity, has a high construction cost and requires a low amount of land to construct. The following images show examples of TUDI interchanges.

3.2.4.4 Single Point Urban Interchange

The Single Point Urban Interchange (SPUI) is a variation of a TUDI that includes a single signal that controls all of the traffic at the interchange. The signal is located in the center of the intersection and controls three sets of movements. The first set of movements are the through movements along the minor street, the second set is for the left turn movements from the ramps to the minor street and the third set of movements is for the left turns from the minor street to the ramps. The turning movements at a SPUI pass through a single intersection, similar to a traditional intersection, therefore the turning movements overlap each other and can occur at the same time. The turning movements either occur on a butterfly shaped bridge above the freeway or below the freeway overpass. The right turn movements are usually controlled by yield signs with acceleration lanes where the ramp intersects the minor street, although some SPUI's include signals for the right turn traffic, which is detrimental to the overall traffic operations of the interchange. One of the main concerns with SPUI's is that the traffic signal does not include any protected movements where pedestrians can cross perpendicular to the minor street because the traffic flow is continuously flowing. This interchange configuration provides medium-to-high traffic capacity, has a high construction cost and requires a low amount of land to construct. The following images show examples of SPUI interchanges.

3.2.4.5 Partial Cloverleaf Interchange

The Partial Cloverleaf Interchange is an interchange configuration that includes adding at least one loop to a diamond interchange design. The partial cloverleaf interchange has several forms including configurations that place a pair of loop/ramp combinations in opposite quadrants of the interchange or on the same side of the minor street, which is common when there is a constraint such a river or railroad on one side of the minor street. A Partial Cloverleaf Interchange can either use a loop in place of a ramp or in addition to a ramp, allowing for less conflict on the minor street by eliminating some of the left turn movements. In general the traffic operations of a Partial Clover Interchange improve as additional loops are added without the removal of the ramps, thus providing for additional flexibility to accommodate future traffic demand. To preserve the traffic operations of a Partial Cloverleaf Interchange it is important that the design not include surface streets that connect opposite the location where the ramp and loop connect to the minor street as this configuration has a substantial negative effect on the traffic operations of the signal. This interchange configuration provides medium-to-high traffic capacity, has a medium construction cost and requires a medium amount of land to construct. The following images show examples of Partial Cloverleaf Interchanges.

3.2.4.6 Full Cloverleaf Interchange

The Full Cloverleaf Interchange is a further expansion of the Partial Cloverleaf configuration where a total of four ramps and four loops are included in the design, accommodating movements in all directions without making any left turns. The Full Cloverleaf Interchange can be very efficient and is sometimes used for freeway-to-freeway connections for lower volume freeways. The major downside to the Full Cloverleaf is that it includes a total of four weaving movements between each of the loops which can result in traffic safety and operation inefficiency. To improve the safety and operations of Full Cloverleaf interchanges a parallel roadway, called a Collector-Distributor (C-D) can be constructed that exits from the freeway in advance of the interchange, connects to all of the interchange ramps and loops, including the weaving section, and then merges back into the freeway. The C-D roadway redirects the turning movements and weaving movements away from the higher speed through traffic on the freeway, improving the safety and traffic operations of both facilities. This interchange configuration provides medium traffic capacity, has a medium construction cost and requires a high amount of land to construct. The following images show examples of Full Cloverleaf Interchanges.

3.2.4.7 Split Diamond Interchange

The Split Diamond Interchange concept builds off of the traditional diamond configurations; however instead of having ramps tie to a single minor street the Split Diamond has a pair of ramps to one minor street and a second pair of ramps on a parallel minor street with a pair of one-way roadways connecting the minor streets between the ramps. This configuration is beneficial where there are multiple major roadways crossing a freeway that are too close to each other to each have an interchange. The Split Diamond allows for access to these multiple minor street crossings and improves the overall traffic operations in the area by spreading out the traffic onto multiple minor streets instead of just one. This interchange configuration provides medium-to-high traffic capacity, has a medium construction cost and requires a medium amount of land to construct. The images at right show examples of Split Diamond Interchanges.

3.2.4.8 Roundabout Interchange

The Roundabout interchange concept has been used for many years and recently has re-emerged in several revised forms as interchange concepts that are both highly functional for traffic flow and aesthetic.

Rotary Roundabout Interchange

The traditional use of Roundabouts for interchanges included having a single large roundabout where the ramps tie to the minor street, typically with the freeway crossing over the roundabout. This configuration was commonly referred to as a Rotary Interchange and was found most often in Massachusetts and throughout New England. The primary concerns with the Rotary Interchange were that they required a very large footprint and extensive bridging along the freeway while only providing a low level of traffic operations due to the constraint on traffic capacity of the single-lane roundabouts. For these reasons the Rotary Interchange is typically not used in urban areas, with very few having been built in the past several decades, and many of the original interchanges being replaced by more common forms of interchanges such as diamonds and partial cloverleaf interchanges.

Modern Roundabout Interchange

The new form of Roundabout interchanges that have become exceeding popular in the past decade utilize a pair of smaller radius roundabouts at each point where the ramp intersects the minor street. The pair of roundabouts allow for good traffic operation and allow the minor street crossing of the freeway to occur on a single bridge. The bridge crossing of the freeway is typically narrower than for a traditional diamond interchange because the Roundabout Interchanges do not include left turn lanes. For this reason, the Roundabout Interchange has been a popular low-cost retrofit for diamond interchanges that have narrow two-lane bridges over the freeway, because they can vastly improve the traffic operations without reconstructing the bridge over the freeway. For higher volume right turn movements bypass lanes can be constructed such that the traffic does not enter the roundabouts, thus increasing the traffic capacity of the configuration.

Recently a more compressed form of Roundabout Interchange has emerged that combines the best features of the Rotary Interchange with the best features of the Modern Roundabout Interchange to form an extremely compact interchange design. The design is currently being implemented for the first time in Carmel, Indiana along Keystone Parkway. The concept is essentially to create a TUDI interchange with a single roundabout that has been compressed into a figure-eight configuration. The interchange concept allows for excellent traffic operations and in some locations includes a dual lane roundabout and right-turn bypass lanes resulting in traffic operations that are comparable to many diamond interchange configurations. The primary benefit of the concept is that they are much more aesthetic and pedestrian friendly than traditional interchanges and in the Carmel application resulted in substantially fewer property relocations. The Carmel application also lowered the major street through lanes below grade to minimize the effects of noise and to improve the aesthetics along the corridor.

3.2.4.9 Summary of Freeway Concepts

A summary of the freeway concepts discussed above is shown in Table 3.2 on the following page. Each of the nine freeway concepts are compared for the following attributes:

- Traffic Operations (evaluates the traffic operations of the concept based on overall interchange travel time)
- Bicyclist and Pedestrian (evaluates the ability of the concept to provide for safe and efficient mobility for bicyclist and pedestrians)
- Footprint (evaluates each concept based on the amount of land required to construct the concept)
- Construction Cost (evaluates each concept based on the likely cost to construct the concept)

The table provides a description of the potential benefits and potential limitations for each concept as well as a qualitative rating for how well it addresses each individual attribute. The qualitative rating system includes the following measures:

★★★★★ - Favorable
★★★★ - Slightly Favorable
★★★ - Average
★★ - Slightly Unfavorable
★ - Unfavorable

It should also be noted that these qualitative evaluations are for each individual attribute and that the weight of each of the attributes is not equal. Different individuals are likely to prioritize certain attributes higher than other individuals would. For example a property owner who walks to the grocery store may prioritize bicycle/pedestrian accommodations with much greater weight, while a commuter may prioritize traffic operations. The challenge in evaluating the concepts and developing a solution is that a balanced approach must be taken as no one concept is superior for all attributes. When applied to the US 64 corridor it is important that the individual context for each location be considered when evaluating the potential options.

Table 3.2: Freeway Concepts Summary

Interchange Type		Traffic Operations	Bicycle/Pedestrian	Footprint	Construction Cost
Simple Diamond		★★	★★★★★	★	★★★★
	Potential Benefits	Can be expanded with loops to improve traffic operations in the future	All pedestrian crossings can be made without conflicting with vehicles	None	Due to spread out configuration may allow for narrower bridges
	Potential Limitations	Bridges may not be setup to accommodate future expansion	None	Requires a very large area of land	None
Compressed Diamond		★★	★★★★★	★★	★★★★
	Potential Benefits	None	All pedestrian crossings can be made without conflicting with vehicles	None	None
	Potential Limitations	Cannot be expanded by adding loops and bridges may not accommodate future turn lanes	None	Requires a large area of land	None
Tight Urban Diamond		★★★★	★★★★★	★★★★★	★
	Potential Benefits	Traffic signals can be coordinated to allow traffic to flow more freely	All pedestrian crossings can be made without conflicting with vehicles	Can reduce impacts in areas where land prices are very high or where constraints exist	None
	Potential Limitations	Requires additional lanes outside of interchange to hold left turn traffic	None	None	Tight configuration requires wider bridges and retaining walls
Single Point Diamond		★★★★	★★	★★★★★	★
	Potential Benefits	Reduces the conflict between left turning traffic by overlapping movements	None	Can reduce impacts in areas where land prices are very high or where constraints exist	None
	Potential Limitations	If ramp traffic requires signal for right turn traffic operations can be affected	Crossing minor street cannot be done without stopping all traffic. Free flow turns may conflict with pedestrians and bicyclists	None	Tight configuration requires larger or longer bridges and retaining walls
Partial Cloverleaf		★★★★	★★★	★★★	★★★
	Potential Benefits	Adding additional loops and ramps can greatly improve traffic operations	Potential that pedestrian crossings can be made without conflicting with vehicles if loops aren't free flowing	Can convert ramps to loops and eliminate property acquisition in some quadrants of the interchange	None
	Potential Limitations	Adding minor street intersection opposite ramp connections can greatly reduce traffic capacity	Conflicts with pedestrians and bicyclists can occur if free flowing loops are included in the design	Adding additional ramps and loops will increase the property needed	None
Full Cloverleaf		★★★	★	★	★★★★
	Potential Benefits	Eliminates all left turn movements	None	None	Due to spread out configuration may allow for narrower bridges
	Potential Limitations	Creates four weaving sections between each set of loops that may negatively affect traffic operations	Problematic for pedestrians and bicyclists due to weaving section between loops and potential for free flowing ramps	High speed connections require larger radius ramps that increase the size of the interchange	Can be very costly if collector-distributor roadways are needed
Split Diamond		★★★★	★★★★★	★★	★★
	Potential Benefits	Allows for multiple high volume minor streets in close proximity to have access	All pedestrian crossings can be made without conflicting with vehicles	Provides improved access to more property	None
	Potential Limitations	The overall traffic capacity of the interchange is reduced because the ramps include through traffic movements	None	Requires land to construct roadway between ramps connecting minor streets between ramps	Requires additional roadways and more bridges and can include retaining walls if there are constraints adjacent to the freeway
Roundabout - Rotary		★★	★★★★	★★	★★★
	Potential Benefits	None	Accommodates pedestrians well for low volume roundabouts with low speeds	None	None
	Potential Limitations	The traffic operations are constrained by the roundabouts ability to handle the traffic volumes	Can increase pedestrian distance for larger radius roundabouts. Do not accommodate bicyclist as safely	Requires large footprint to accommodate larger radius roundabout	Larger radius roundabouts require either very long bridges along the freeway or multiple bridges for the roundabout
Roundabout - Modern		★★★	★★★	★★★★★	★
	Potential Benefits	Can include multilane roundabouts and bypass lanes for high right turn traffic	Accommodates pedestrians well for low volume roundabouts with low speeds	Can reduce impacts in areas where land prices are very high or where constraints exist	None
	Potential Limitations	May not be able to handle extremely high left turn volumes	Potential for conflicts with right turn bypass lanes and for visually impaired pedestrians. Do not accommodate bicyclist as safely	None	Tight configuration requires retaining walls and non standard bridge shapes

★★★★★ - Favorable ★★★★ - Slightly Favorable ★★★ - Average ★★ - Slightly Unfavorable ★ - Unfavorable

3.3 SHORT-TERM SOLUTION

The short-term goal for the corridor is to enhance mobility, safety and pedestrian needs at the major intersections along US 64 at a minimal cost. The process used to determine the effectiveness of the potential signalized concepts described in Section 3.2.2 at addressing the short-term goal is described in this section along with the recommended short-term solutions resulting from that process. The long-term goal and recommended solutions are discussed in Section 3.4.

In the discussion of the short-term solution, the following terms are used:

- **Concept** – refers to a type of treatment at an intersection, like those described in Section 3.2 (e.g., superstreet).
- **Configuration** - one concept may have multiple designs or configurations (e.g., Superstreet with Direct Major Street Left Turns, Superstreet with Indirect Major Street Left Turns, etc.).
- **Solution** – refers to the application of a concept (and configuration) at a specific location (e.g., the application of the Superstreet with Major Street Left Turns is the solution at Edinburgh Drive). The solution recommended for each intersection is a part of the overall Short-term Solution.

3.3.1 INITIAL EVALUATION OF SHORT-TERM CONCEPTS

The initial evaluation of short-term concepts was geared toward evaluating the potential signalized intersection concepts and selecting a short-term solution that would best meet the short-term goals established for the corridor. The discussion in this sub-section provides the results of the initial evaluation of the short-term concepts in general terms. A summary of the initial evaluation process is provided in Section 3.3.2 and intersection- and corridor-specific details are described in Section 3.3.4.

3.3.1.1 Traditional Intersection Treatments

The use of traditional intersection treatments was eliminated as a potential short-term solution because numerous signalized intersections along this corridor were already operating at an unacceptable level and the only means to improve the traffic operations if this concept was used would be to add additional through lanes along US 64. The cost of adding through lanes was not compatible with the short-term goal and would have impacts to adjacent communities due to the additional roadway width.

3.3.1.2 Superstreet

The Superstreet emerged as the preferred concept for treating intersections along the corridor with the Superstreet with Direct Major Street Left-turns being the configuration that was the most appropriate for urban corridors. The Superstreet with Indirect Major Street Left-turns was considered but was not chosen as a viable configuration due to concerns with roadways not having direct access off of US 64 and slightly reduced operations associated with routing the US 64 left turns through the median u-turn locations. The Superstreet with Direct Minor Street Left-turns was considered but was not determined to be a viable configuration as many of the intersections did not include high enough left-turn volumes to warrant this configuration, nor was there enough of a benefit to overcome the negative effect on the ability to coordinate the signals.

3.3.1.3 Median U-turn Crossover

The Median U-turn Crossover concept was given a great deal of consideration, particularly at a few of the higher volume intersections, because it allows for minor street through movements and traditional pedestrian crossing patterns. However, due to the irregular spacing of the minor streets associated with this concept, it would be difficult to coordinate the signals along the corridor and improve traffic flow substantially. Upon detailed discussion and evaluation by the Corridor Study Team, it was decided that the superior traffic operations associated with the superstreet concept outweighed the positives associated with the Median U-turn and it was eliminated as a potential short-term solution in the initial evaluation.

3.3.1.4 Quadrant Roadway

The Quadrant Roadway concept was evaluated for several intersections along the corridor; however, it was determined that the quadrant roadway was either not feasible or would not provide a substantial enough benefit to justify the expense and additional land required for construction. This concept was eliminated from further consideration as a short-term solution.

3.3.1.5 Quadrant Roadway with Grade Separation

The Quadrant Roadway with Grade Separation was eliminated for the same reasons as the standard Quadrant Roadway. There was only one location along the corridor where the concept would be feasible (Lake Pine Drive) and the Quadrant Interchange configuration was being proposed as the long-term solution.

3.3.1.6 Jughandle

The Jughandle was considered for the intersections along the corridor. Due to the development patterns along the corridor, the land required to construct the Jughandle ramps, and the more modest improvements in traffic operations as compared to the other potential options. It was determined that this concept was not viable and was eliminated.

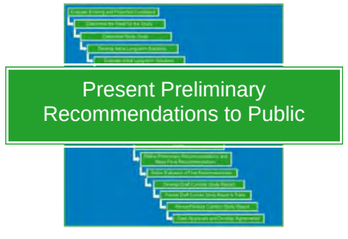
3.3.1.7 Split Intersection

The Split Intersection concept was eliminated by the Corridor Study Team because it would have required a substantial amount of additional land to construct and is intended more for new roadways that will eventually be upgraded to an interchange. Because of the impacts associated with this concept and since this is not a new construction project, the Split Intersection was eliminated from further consideration.

3.3.1.8 Continuous Flow Intersection

The Continuous Flow Intersection concept was considered because of its substantial benefits to traffic operations. It was eliminated because it was determined by the Corridor Study Team to be unsightly, not matching with the context of the corridor and too confusing for drivers and pedestrians.

3.3.2 INITIAL SELECTION OF SHORT-TERM SOLUTIONS



Based on the initial evaluation of short-term solutions, it was determined that the Superstreet with Direct Major Street Left-turns would be the initial preferred solution for each of the intersections along the US 64 corridor. The preliminary short-term solution design plans and traffic capacity analysis were then completed and the results were presented to the public at a second workshop on April 27-28, 2009. Based on comments received at the workshop and during the comment period following the workshop, a community meeting was held on July 16, 2009 to further discuss the long-term and short-term solutions for the corridor. Based on the comments from the workshop and community meeting, a list of public concerns with the short-term solutions was developed by the Corridor Study Team. The following list represents the major concerns with the Superstreet as a short-term solution from the public perspective:

- The Superstreet would not be safe, especially with requiring u-turns and weaving across traffic.
- Aesthetics along the corridor would be negatively affected by the Superstreet.
- The speed limit along US 64 is too high for superstreet design.
- The Superstreet would not preserve the community along the corridor and would divide the communities on the north and south side of the highway.

- Connectivity across US 64 would be negatively affected, especially to Apex Community Park.
- US 64 is a local road and should be treated more like a street and less like a highway by not giving the majority of the green time to the through traffic.
- The Superstreet would have negative effects on access to neighborhoods and businesses.
- The Superstreet would increase the response time for emergency access vehicles.
- The navigation of the Superstreet would be confusing and would not improve traffic flow for vehicles.
- The navigation of the Superstreet for bicyclists (especially advanced bicyclists) would be unsafe if they were required to make the u-turn movements with vehicular traffic.
- The Superstreet would have negative effects on traffic operations for the minor streets.
- The Superstreet would be unsafe for bicycle travel along US 64 due to the u-turn bulb-outs.
- The two-stage diagonal pedestrian crossing required at Superstreet intersections is unsafe.
- The Superstreet would have a negative affect on access to the library.
- The use of a Superstreet at Laura Duncan Road near Apex High School would impact the safety of students crossing US 64 since they would have to wait in the median during the two-stage crossing.
- The Superstreet would have a negative effect on school bus safety.

3.3.3 Further Detailed Evaluation of Short-term Concepts

Due to the public's concerns, the Corridor Study Team decided re-evaluate the corridor for both the short-term and long-term solutions. The Corridor Study Team decided that the corridor, while it functions as a system, has unique circumstances at different intersections and that, for this reason, a single concept and configuration cannot be used as the short-term solution along the entire corridor. Additionally, it was determined that some of the concerns with pedestrians and bicyclists may not be able to be accommodated to an acceptable level by a signalized intersection concept, such as those considered for the short-term solution, and that expressway options may be the best way to address the concerns. The Corridor Study Team decided that, if a viable short-term solution was not available, the intersection would be prioritized for an upgrade to a long-term solution that could better address the needs without spending money on a short-term solution that would not provide adequate benefits.

Based on the re-evaluation of the signalized intersection concepts, three concepts emerged as strong candidates to address the public's concerns to the greatest extent possible and provide for a short-term solution that addresses the goals for the corridor. Additionally, long-term concepts such as interchanges would be evaluated if none of the three concepts were determined to be adequate. The three signalized intersection concepts and a summary of the potential benefits and limitations of each is presented in the following section.

Superstreet with Direct Major Street Left-turns

This was the configuration originally selected for the corridor and was retained because of the benefits to traffic operations that it provides. The concept has been shown to be a safe design for vehicles and accommodates pedestrians without conflicts with turning vehicles. The main concerns were shown above in Section 3.3.2.

Superstreet with Indirect Major Street Left-turns

This configuration was selected as a potential short-term solution because it would provide, in addition to the benefits of the Superstreet with Direct Major Street Left-turns, a more aesthetic facility and would provide an improved refuge for pedestrian and bicycle crossing of US 64 due to the full median. The potential drawbacks of this configuration are that it cannot process as much traffic as the Superstreet with Direct Major Street Left-turns, it is more restrictive on access to neighborhoods and businesses, it may increase emergency response times and it has the same effects on the minor street traffic flow.

Median U-turn Crossover

This concept was selected as a potential short-term solution because it would provide benefits such as good traffic operations, straight across access from minor streets and a standard pedestrian and bicycle crossing pattern. The potential drawbacks of this concept are that it cannot process as much traffic as a Superstreet due to the limited ability to coordinate signals in both directions, it has the perception of reducing access to neighborhoods and businesses, it disrupts driver expectations if left-turns are allowed elsewhere along the corridor and it can be difficult to enforce the left turn prohibitions.

3.3.4 Short-term Solution Corridor Evaluation

The Corridor Study Team evaluated the US 64 corridor on an intersection-by intersection basis to determine the most appropriate short-term solution at each location. For each location the unique circumstances and context of the intersection were evaluated and a preferred solution was selected. The evaluation only included the major intersections along the corridor and did not include an evaluation of all of the existing median openings along the corridor. The feasibility of maintaining the minor roadway connections and median openings along the corridor would need to be evaluated further. If a pattern of accidents or operational problems emerges in the future, these locations may be modified or closed following a more thorough study and public involvement process.

Firefox Trace

The intersection of US 64 and Firefox Trace is a low volume intersection west of the Haw River and is the only access point along US 64 between the US 64 Bypass of Pittsboro and the Haw River. There is minimal pedestrian traffic at this location and most bicycle traffic would be along US 64. For these reasons the preferred solution for this intersection was determined to be an unsignalized Superstreet with Direct Major Street Left-turns.

Mt. Gilead Church Road/North Pea Ridge Road

The intersection of US 64 and Mount Gilead Church Road/North Pea Ridge Road is an existing, signalized intersection between the Haw River and Jordan Lake. There is minimal pedestrian traffic at this location and most bicycle traffic would be along US 64. For these reasons the preferred solution for this intersection was determined to be a signalized Superstreet with Direct Major Street Left-turns.

Big Woods Road/Seaforth Road

The intersection of US 64 and Big Woods Road/Seaforth Road is an existing, unsignalized intersection,between the Haw River and Jordan Lake. There is minimal pedestrian traffic at this location and most bicycle traffic would be along US 64, although a future county park is planned along Big Woods Road, north of US 64. The preferred solution for this intersection was determined to be a signalized Superstreet with Direct Major Street Left-turns that may be able to be designed such that nearly perpendicular pedestrian crossings are included due to the skew of the intersection.

Farrington Road/Beaver Creek Road

The intersection of US 64 and Farrington Road/Beaver Creek Road is an existing signalized intersection slightly east of Jordan Lake. There is minimal pedestrian traffic at this location and most bicycle traffic would be along US 64. For these reasons the preferred solution for this intersection was determined to be a signalized Superstreet with Direct Major Street Left-turns.

NC 751/New Hill Road

The intersection of US 64 and NC 751/New Hill Road is an existing signalized intersection with minimal pedestrian or bicycle traffic. The preferred solution for this intersection was determined to be a signalized Superstreet with Direct Major Street Left-turns that may be able to be designed such that nearly perpendicular pedestrian and bicycle crossings are included due to the skew of the intersection.

Jenks Road

The intersection of US 64 and Jenks Road is an existing unsignalized three-leg intersection in an area that is beginning to transition into a more suburban area and includes a future extension to the south of US 64. There currently is minimal pedestrian traffic at this location; however, it is likely that pedestrian traffic will increase as the area becomes more developed. The preferred solution for this intersection was determined to be a signalized Superstreet with Direct Major Street Left-turns that may be able to be designed such that nearly perpendicular pedestrian and bicycle crossings are included when the roadway is extended south of US 64 due to the skew of the existing intersection.

Kellyridge Road

The intersection of US 64 and Kellyridge Road is an existing unsignalized three-leg intersection that provides access to the Abbington Subdivision. The existing intersection is approximately 800 feet west of the future quadrant interchange at Kelly Road that will be constructed as a part of the NC 540 Triangle Expressway project. The preferred solution at this location is to convert the full movement intersection to a left-in/right-in/right-out intersection that would only allow right turns onto and off of Kellyridge Road and the left turn onto Kellyridge Road from US 64 westbound. This solution would eliminate the left turn movement from Kellyridge Road to US 64 westbound due to the safety concerns resulting from the close proximity to the Kelly Road entrance ramp. The left turn movement would be provided at the Kelly Road quadrant interchange and there currently is direct access between the Abbington Subdivision and Kelly Road. The elimination of the left-turn out of Kellyridge will likely reduce the amount of cut through traffic in the Abbington Subdivision which was a concern raised at the public workshops.

Kelly Road

The intersection of US 64 and Kelly Road is an existing unsignalized intersection with major street direct left-turn movements allowed. The intersection will be upgraded to a quadrant interchange by the North Carolina Turnpike Authority as a part of the NC 540 Triangle Expressway project with Kelly Road being built over US 64 with ramps connecting the roadways on the west side of Kelly Road. The short-term solution does not include any changes to the planned configuration.

Green Level Church Road

The intersection of US 64 and Green Level Church Road is an existing signalized three-leg intersection. The intersection will be converted to a right-in/right-out configuration by the North Carolina Turnpike Authority as a part of the NC 540 Triangle Expressway project. The short-term solution does not include any changes to the planned configuration.

NC 55 Interchange

The existing US 64 interchange with NC 55 does not include any changes under the short-term solution.

Fern Valley Lane

The intersection of US 64 and Fern Valley Lane was recently converted to a right-in/right-out intersection with a major street direct left-turn. The short-term solution does not include any changes to this configuration.

Davis Drive/North Salem Street Interchange

The US 64 interchange with Davis Drive/North Salem Street does not include any changes under the short-term solution.

Laura Duncan Road

The intersection of US 64 and Laura Duncan Road is an existing signalized intersection and includes the only marked pedestrian crossing of US 64 within the study area. The main concern at this location is the safety of pedestrians and bicyclists due to the close proximity to Apex High School. Four short-term concepts were evaluated for this location and the potential benefits and drawbacks are summarized as follows:

- Superstreet with Direct Major Street Left-turns – The potential safety issues for pedestrian and bicyclists associated with this configuration were of major concern. After discussion, the Corridor Study Team determined that this configuration was not reasonable at this location.

- Superstreet with Indirect Major Street Left-turns – This configuration would provide for improved safety for pedestrians and bicyclists by providing additional pedestrian refuge areas in the median; however it would still require a two-stage crossing. This configuration would also provide for additional green space and would be more aesthetically pleasing than the option with direct major street left-turns. The traffic operations would also be substantially reduced due to the large number of left-turning vehicles for US 64 to Laura Duncan Road that would be required to use the downstream median U-turn lanes. Additionally, there would not be any cross access across Laura Duncan Road and the need for a specialized pedestrian crossing would eliminate many of the benefits gained in being able to coordinate the signals. Based on discussion the Corridor Study Team determined that this configuration was not reasonable at this location.

- Median U-turn Crossover – This configuration would also provide for improved safety for pedestrians and bicyclists by providing additional pedestrian refuge areas in the median; however, it would still require a two-stage crossing to provide for adequate traffic operations. This configuration would also allow for Laura Duncan Road through movements and connectivity across US 64 to the Apex Community Park. The traffic operations would be substantially reduced due to the large number of left-turning vehicles for US 64 to Laura Duncan Road that would be required to use the downstream median U-turn lanes. Additionally, there were concerns with compliance to the left-turn restriction, especially with young drivers at the high school. Based on discussion the Corridor Study Team determined that this configuration was not reasonable at this location.

- Pedestrian Bridge/Tunnel – This concept was evaluated but determined to be the best solution due to the cost and that it would need to be removed once an interchange is implemented.

Therefore, it was determined that none of the potential short-term solutions would provide acceptable traffic operations and overcome the concerns voiced by the public. The Corridor Study Team decided that the Laura Duncan Road intersection would not include a “true” short-term solution (a lower cost interim measure) and that a long-term solution providing an interchange would be prioritized to a level that would allow for the ability to safely move vehicular, pedestrian and bicycle traffic while providing connectivity across US 64 between the high school and Apex Community Park. The description of what will be included for this intersection is covered in detail under the Long-term solution discussion in Section 3.4.5.

Knollwood Drive

The intersection of US 64 and Knollwood Drive is an existing unsignalized three-leg intersection. The preferred solution at this location was determined to be a left-in/right-in/right-out intersection. However, due to the close proximity to Lake Pine Drive and the public's desire to maintain the aesthetics and minimize the amount of construction, the U-turn movement to US 64 westbound is not included immediately downstream of the Knollwood Drive intersection and the U-turn movements would have to occur as a part of the Lake Pine Drive intersection. Because this location is a three-leg intersection; the Superstreet with Indirect Major Street Left-turns is not reasonable as it would move the left turn from US 64 to a U-turn movement which would serve the same traffic, requiring the same amount of construction and potentially adding an additional signal. The Median U-turn concept is not feasible at this location because of the three-leg configuration.

Lake Pine Drive

The intersection of US 64 and Lake Pine Drive is an existing signalized intersection. The main concerns at this location are the safety of pedestrians and bicyclists due to the close proximity to Apex Community Park, the perception that there is a very high volume of through traffic at this location, and the desire to provide good access to the library. Three short-term concepts were evaluated for this location and the potential benefits and limitations are summarized as follows:

- Superstreet with Direct Major Street Left-turns – The potential safety issues for pedestrian and bicyclists associated with this configuration were of major concern as well as the inability to provide for cross access. Based on discussion the Corridor Study Team determined that this configuration was not reasonable at this location.

- Superstreet with Indirect Major Street Left-turns – This configuration would improve safety for pedestrians and bicyclists by providing additional pedestrian refuge areas in the median, provide additional green space, and be more aesthetically pleasing than the option with direct major street left-turns. The traffic operations would be substantially reduced due to the large number of left-turning vehicles for US 64 to Lake Pine Drive that would be required to use the downstream median U-turn lanes. Additionally, there would not be any cross access across Lake Pine Drive. Based on discussion, the Corridor Study Team determined that this configuration was not reasonable at this location.

- Median U-turn Crossover – This concept would also improve safety for pedestrians and bicyclists by providing additional pedestrian refuge areas in the median; however, it would still require a two-stage pedestrian crossing to provide for adequate traffic operations. This concept would also allow for Lake Pine Drive through movements and connectivity across US 64 to the Apex Community Park and facilitate access to the library. The traffic operations would be reduced due to the large number of left-turning vehicles for US 64 to Lake Pine Drive that would be required to use the downstream median U-turn lanes and the reduced ability to coordinate the signals along the corridor. Based on discussion, the Corridor Study Team determined that this was the best concept for this location because it would provide cross access and improved ability to accommodate pedestrians and bicyclists.

In addition to the Lake Pine Drive intersection design, a signalized pedestrian crossing is included in the plan slightly west of the U-turn movement located west of Lake Pine Drive. This location will improve pedestrian access to the library and to Apex Community Park. The development of the plans for the pedestrian connections to this crossing will be undertaken by the Town of Apex Planning Department.

Autopark Boulevard

The intersection of US 64 and Autopark Boulevard is an existing unsignalized three-leg intersection. The preferred solution at this location was determined to be a Superstreet with Direct Major Street Left-turn. However, due to the close proximity to Mackenan Drive/Chalon Drive intersection, and the public's desire to maintain the aesthetics and minimize the amount of construction, the U-turn movement to US 64 westbound is not included immediately downstream of the Autopark Boulevard intersection and the U-turn movements would have to occur as a part of the Mackenan Drive/Chalon Drive intersection. Because this location is a three-leg intersection the Superstreet with Indirect Major Street Left-turns configuration is not reasonable because it would move the left turn from US 64 to a U-turn movement which would serve the same traffic, requiring the same amount of construction and potentially adding an additional signal. The Median U-turn design is not feasible at this location because of the three-leg configuration.

Mackenan Drive/Chalon Drive

The intersection of US 64 and Mackenan Drive/Chalon Drive is an existing signalized intersection. The main concern at this location is the safety of pedestrians and bicyclists and the aesthetics and connectivity related to the residential neighborhoods in the area. Three short-term concepts were evaluated for this location and the potential benefits and drawbacks are summarized as follows:

- Superstreet with Direct Major Street Left-turns – The potential safety issues for pedestrian and bicyclists associated with this configuration were of concern as well as the inability to provide for cross access. The roadway also serves as a connection to the businesses along Mackenan Drive. Based on discussion, the Corridor Study Team determined that this was the most reasonable solution at this location because it balanced the access to and from both the residential area to the north of US 64 and the commercial area to the south of US 64.

- Superstreet with Indirect Major Street Left-turns – This configuration would improve safety for pedestrians and bicyclists by providing additional pedestrian refuge areas in the median, would provide for additional green space and would be more aesthetically pleasing than the option with direct major street left-turns. The traffic operations would be slightly reduced due to left-turning vehicles for US 64 to Lake Pine Drive that would be required to use the downstream median U-turn lanes. Additionally, there would not be any cross access between Mackenan Drive and Chalon Drive and there would be reduced access to the roadways because they would operate as right-in/right-out intersections. Based on discussion, the Corridor Study Team determined that this configuration was acceptable, but not the best configuration for this location because it would have too substantial a negative affect on the businesses along Mackenan Drive that rely on more direct access.

- Median U-turn Crossover – This concept would also improve safety for pedestrians and bicyclists by providing additional pedestrian refuge areas in the median; however, it would still require a two-stage crossing to provide for adequate traffic operations. This configuration would also allow for through movements between Mackenan Drive and Chalon Drive, which is a relatively small movement. The traffic operations would be reduced slightly due to the left-turning vehicles for US 64 to Mackenan Drive/Chalon Drive that would be required to use the downstream median U-turn lanes. Based on discussion, the Corridor Study Team determined that this configuration was not reasonable at this location because the major benefit of providing cross access for vehicles is a very minor movement at this location.

In addition to the Mackenan Drive/Chalon Drive intersection design, a signalized pedestrian crossing is included in the plan slightly west of the U-turn movement located west of Mackenan Drive/Chalon Drive. This location will provide improved pedestrian access to Apex Community Park and will be the location where the future Swift Creek Greenway will cross US 64. The development of the plans for the pedestrian connections to this crossing will be undertaken by the Town of Cary Parks and Recreation Department.

Gregson Drive

The intersection of US 64 and Gregson Drive is an existing signalized three-leg intersection. The primary concerns at this location are providing adequate access to the businesses on the south side of US 64 in a convenient manner. Three short-term concepts were evaluated for this location and the potential benefits and drawbacks are summarized as follows:

- Superstreet with Direct Major Street Left-turns – The potential safety issues for pedestrian and bicyclists associated with this configuration were of minor concern because there is not a roadway on the north side of US 64 to cross to and this configuration would provide the best access for businesses on the south side of US 64. Based on discussion, the Corridor Study Team determined that this configuration was the best solution at this location because it provided the best access and traffic operations and little concern related to pedestrian crossings.

- Superstreet with Indirect Major Street Left-turns – This configuration would improve safety for pedestrians and bicyclists by providing additional pedestrian refuge areas in the median; however, without a roadway on the north side of US 64 this is not likely to be a likely location for pedestrian crossings. The traffic operations would be substantially reduced due to left-turning vehicles for US 64 to Gregson Drive that would be required to use the downstream median U-turn lanes. Additionally, there would a reduction in direct access to the businesses along Gregson Drive due to requiring the U-turn movements. Based on discussion, the Corridor Study Team determined that this configuration was not reasonable at this location.

- Median U-turn Crossover – This concept would not be applicable at this location because there is no minor street through movements at a three-leg intersection.

Edinburgh Drive

The intersection of US 64 and Edinburgh Drive is an existing signalized four-leg intersection with residential neighborhoods north of US 64 and commercial and office use to the south of US 64. The main concern at this location is the safety of pedestrians and bicyclists, the aesthetics and connectivity related to the residential neighborhoods north of US 64, and providing suitable access to the businesses south of US 64. Three short-term concepts were evaluated for this location and the potential benefits and limitations are summarized as follows:

- Superstreet with Direct Major Street Left-turns – The potential safety issues for pedestrian and bicyclists associated with this configuration were of concern as well as the inability to provide cross access. This configuration does provide for good access to both the residential area to the north of US 64 and the commercial area to the south of US 64. Based on discussion, the Corridor Study Team determined that this configuration was the best solution for this location due to the high left turn volumes into the office park.

- Superstreet with Indirect Major Street Left-turns – This configuration is not feasible from a design standpoint because it would require a U-turn intersection east of the Edinburgh Drive intersection. The U-turn crossover is not feasible because the distance between the US 1 interchange ramps and Edinburgh Drive is approximately 1000 feet. This distance is not adequate for providing a U-turn movement due to the conflicts it would create for the signalized intersections at the US 1 ramps to US 64; therefore this configuration was eliminated.

- Median U-turn Crossover – This concept would also require a U-turn intersection east of the Edinburgh Drive intersection; therefore, for the same reasons as the Superstreet with Indirect Major Street left-turns, this configuration was eliminated.

3.3.5 Determination of Final Draft Short-term Solution Recommendations

The results of the short-term corridor evaluation for the intersections within Wake County were presented to a select group of stakeholders for review and comment at the stakeholder meeting held on October 22, 2009. Comments on the short-term solutions included the following:

- Implement the recommended design at Laura Duncan Road and Lake Pine Drive
- Ensure improved pedestrian walkability for crossing US 64, especially to businesses
- Do not focus on through mobility at the expense of local access
- Maintain medians for safety and aesthetics
- Re-open Fern Valley Lane access point as full movement intersection
- Add additional through lanes to US 64 in the median from Autopark Boulevard to US 1 and maintain traditional intersections instead of a superstreet
- Do not implement the superstreet at Edinburgh Drive
- Lower speed limit to 45 miles per hour east of railroad bridges
- Hold off implementing Superstreets as long as possible
- Address safety at Laura Duncan now
- Make Gregson a superstreet with indirect left turns to minimize pavement
- Consider a pedestrian bridge at Apex High School
- Consider the superstreet and aesthetics as it relates to community feel and look
- Abandon short-term solutions (as there is not need) except at Laura Duncan and Lake Pine
- Hold-off on doing anything from US 1 to east of Lake Pine until NC 540 and the additional lane on US 64 are in place and operating so that effects can be measured
- Safety is more important than mobility and should be the primary concern
- Look at parallel routes to US 64 and improve them to increase safety
- Sign US 64 along US 1 and NC 540 and convert existing roadway to US 64 Business/Tryon Road
- Lower speed limit to 45 miles per hour east of Kellyridge Roadandinclude design features that signal to the driver that the context of the corridor has changed
- Delay the conversion of Kellyridge Road to right-in/right-out and consider a signal due to access concerns
- Purchase land in southeast quadrant of Laura Duncan intersection and see if it could be used to improve the intersection
- Take immediate measures to improve safety at the Laura Duncan Road pedestrian crossing

Based on the comments and discussion at the stakeholder meeting, the Corridor Study Team met and developed the Draft Final Recommendations for the Short-term Solution. The only design change to the short-term solutions that were recommended prior to the stakeholder meeting was to combine the u-turn to eastbound US 64 for Mackenan Drive/Chalon Drive with the direct left turn to Autopark Boulevard. This design change will provide more green space in the median, but will result in a slightly longer travel distance for drivers utilizing the u-turn.

The short-term solution at Laura Duncan Road was also discussed and the Corridor Study Team agreed that the short-term and long-term solution should be the tight interchange, but also decided that if development in the area occurs prior to the implementation of the interchange, that making a private entity pay for the interchange would be difficult. If development in the vicinity of Laura Duncan Road would cause a negative effect to traffic operations, the Corridor Study Team agreed that construction of a Median U-turn Crossover by a private developer would be an adequate means of mitigating the effects. The Median U-turn Crossover concept may also help facilitate the construction of the future interchange. The design of the Median U-turn Crossover for this location is included in Appendix D.

3.3.5.1 Summary of Final Draft Short-term Solution Recommendations

A summary of the Final Draft Short-term Solution Recommendations is included in Table 3.3.

Table 3.3: Final Draft Short-term Solution Recommendations

Intersection/Interchange	Final Draft Short-term Solution
Firefox Trace	Superstreet with Direct Major Street Left Turn
Mt. Gilead Church/Pea Ridge Road	Superstreet with Direct Major Street Left Turn
Big Woods/Seaforth Road	Superstreet with Direct Major Street Left Turn
Farrington/Beaver Creek Road	Superstreet with Direct Major Street Left Turn
NC 751/New Hill Road	Superstreet with Direct Major Street Left Turn
Jenks Road	Superstreet with Direct Major Street Left Turn
Kellyridge Road	Left-in/Right-in/Right-out
Kelly Road	No change from configuration constructed as part of NC 540 project
NC 540	No change from configuration constructed as part of NC 540 project
Green Level Church Road	No change from configuration constructed as part of NC 540 project
NC 55	No change from existing configuration
Fern Valley Lane	No change from existing configuration
Davis Drive	No change from existing configuration
Laura Duncan Road	Tight Interchange (Modern Roundabout Configuration Preferred) as long-term solution that will be implemented as soon as possible. Note: Interim solution may include Median U-turn Crossover if privately funded
Knollwood Drive	Left-in/Right-in/Right-out
Lake Pine Drive	Median U-turn Crossover
Autopark Boulevard	Left-in/Right-in/Right-out
Mackenan/Chalon	Superstreet with Direct Major Street Left Turn with U-turn to eastbound US 64 at Autopark Boulevard
Gregson Drive	Superstreet with Direct Major Street Left Turn
Edinburgh Drive	Superstreet with Direct Major Street Left Turn
US 1 Interchange	No change from existing configuration

The detailed design of the Final Draft Short-term Solution Recommendations is presented in Section 3.5.

In addition to the detailed recommendations on the design of the short-term solution, recommendations are being made for the corridor by the Corridor Study Team and are included in Section 4.2.4.

3.3.6 Short-term Solution Traffic Volumes and Traffic Operations

The goal of the Short-term Solution is to improve traffic operations along the corridor and extend the lifespan of the existing corridor until the long-term solutions are needed and can be implemented. Based on this, the goal of the short-term solutions is to provide for adequate traffic operations until the year 2025.

3.3.6.1 Future Traffic Volume Projections

The determination of the future traffic volumes for 2025 are based on interpolating the traffic volumes for the 2007 existing conditions and 2035 no-build traffic developed in Section 2.3.2. A summary of the 2025 Short-term Solution traffic volumes for each of the major roadways along the corridor is shown in Figure 3.1. As noted previously, one of the main factors affecting the traffic operations along the corridor is the high volume of left turns (especially from the minor streets) at many of the intersections. Table 3.4 shows several of the major intersections along the corridor and the percentage of the volumes at the intersection that are making left turns.

Table 3.4: Percent of Vehicles Making Left Turns

Intersection	Intersection Approach	Percent of Vehicles Making Left Turns
US 64 at Farrington Road/Beaver Creek Road	US 64 Eastbound	5.0%
	US 64 Westbound	6.7%
	Beaver Creek Road Northbound	19.4%
	Farrington Road Southbound	59.6%
US 64 at Jenks Road	US 64 Eastbound	23.3%
	Jenks Road Southbound	50.0%
US 64 at Laura Duncan Road	US 64 Eastbound	13.7%
	US 64 Westbound	5.5%
	Laura Duncan Road Northbound	35.7%
	Laura Duncan Road Southbound	32.8%
US 64 at Lake Pine Drive	US 64 Eastbound	11.8%
	US 64 Westbound	9.0%
	Lake Pine Drive Northbound	11.1%
	Lake Pine Drive Southbound	40.0%
US 64 at Gregson Drive	US 64 Westbound	18.7%
	Gregson Drive Northbound	34.5%
US 64 at Edinburgh Drive	US 64 Eastbound	1.6%
	US 64 Westbound	13.5%
	Edinburgh Drive Northbound	21.0%
	Edinburgh Drive Southbound	58.8%

Figure 3.1: 2025 Short-term Solution Daily Traffic Volumes

LEGEND

2025 Short-term Solution Daily Traffic Volumes

2025

Short-term Design

2025 Short-term Solution

Daily Traffic Volumes

US 64 Corridor Study
Wake & Chatham Counties

3.3.6.2 Short-term Solution Level of Service

The LOS for the major intersections along the corridor was evaluated based on the 2025 traffic volumes for the Short-term Solution design. A summary of the LOS for each intersection is included in Table 3.5 and shown on Figure 3.2.

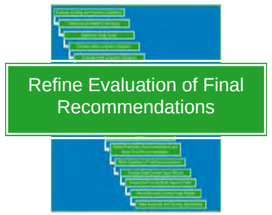


Table 3.5: 2025 Short-term Solution Level of Service Analysis

Signalized Intersections	Signal Location	2025 AM/PM Peak Hour LOS
US 64 at Mt. Gilead Church Road/N. Pea Ridge Road	US 64 U-turn East of Mt. Gilead Church Road[1]	C/C
	US 64 U-turn West of Mt. Gilead Church Road	B/B
	US 64 Eastbound at Mt. Gilead Church Road	B/A
	US 64 Westbound at Mt. Gilead Church Road	B/B
US 64 at Big Woods Road/Seaforth Road	US 64 U-turn East of Big Woods Road	A/A
	US 64 U-turn West of Big Woods Road	B/B
	US 64 Eastbound at Big Woods Road	A/A
	US 64 Westbound at Big Woods Road	C/C
US 64 at Farrington Road	US 64 U-turn East of Farrington Road	C/B
	US 64 U-turn West of Farrington Road	B/B
	US 64 Eastbound at Farrington Road	C/B
	US 64 Westbound at Farrington Road	B/C
US 64 at NC 751/New Hill Road	US 64 U-turn East of NC 751	C/B
	US 64 U-turn West of NC 751	C/C
	US 64 Eastbound at NC 751	C/B
	US 64 Westbound at NC 751	C/D
US 64 at Jenks Road	US 64 U-turn West of Jenks Road	C/C
	US 64 Westbound at Jenks Road	D/D
US 64 at Lake Pine Drive	US 64 U-turn East of Lake Pine Drive	B/E
	US 64 U-turn West of Lake Pine Drive	D/F
	US 64 at Lake Pine Drive	F/F
US 64 at Mackenan Drive/Chalon Drive	US 64 U-turn East of Chalon Drive	A/C
	US 64 U-turn West of Chalon Drive(at Autopark Blvd.)	C/A
	US 64 Eastbound at Chalon Drive	F/E
	US 64 Westbound at Chalon Drive	B/C
US 64 at Gregson Drive	US 64 U-turn East of Gregson Drive	B/F
	US 64 Eastbound at Gregson Drive	F/D
US 64 at Edinburgh Drive	US 64 U-turn West of Edinburgh Drive	A/E
	US 64 Eastbound at Edinburgh Drive	F/F
	US 64 Westbound at Edinburgh Drive	D/F
US 64 at US 1 Southbound Ramps	US 64 Eastbound at US 1 SB Ramp	C/F
	US 64 Westbound at US 1 SB Ramp	F/E
Unsignalized Intersections	**Turn Location**	**2025 AM/PM Peak Hour LOS**
US 64 at Firefox Trace	US 64 U-turn East of Firefox Trace	C/C
	US 64 U-turn West of Firefox Trace	C/C
	US 64 Eastbound at Firefox Trace	F/F
	US 64 Westbound at Firefox Trace	E/F
US 64 at Kellyridge Road		F/F
US 64 at Knollwood Drive		F/F
US 64 at Shepherds Vineyard Drive		F/F

Notes: 1 – This intersection operates acceptably as an unsignalized intersection

The analysis indicates that 11 of the 32 signalized intersections and 5 of the 7 unsignalized are projected to be operating at an unacceptable LOS E or F in 2025. For those intersections operating at LOS E or F, upgrading to the long-term solutions should be considered. The timeframe for implementation for the short-term and long-term solutions is included in Chapter 4.

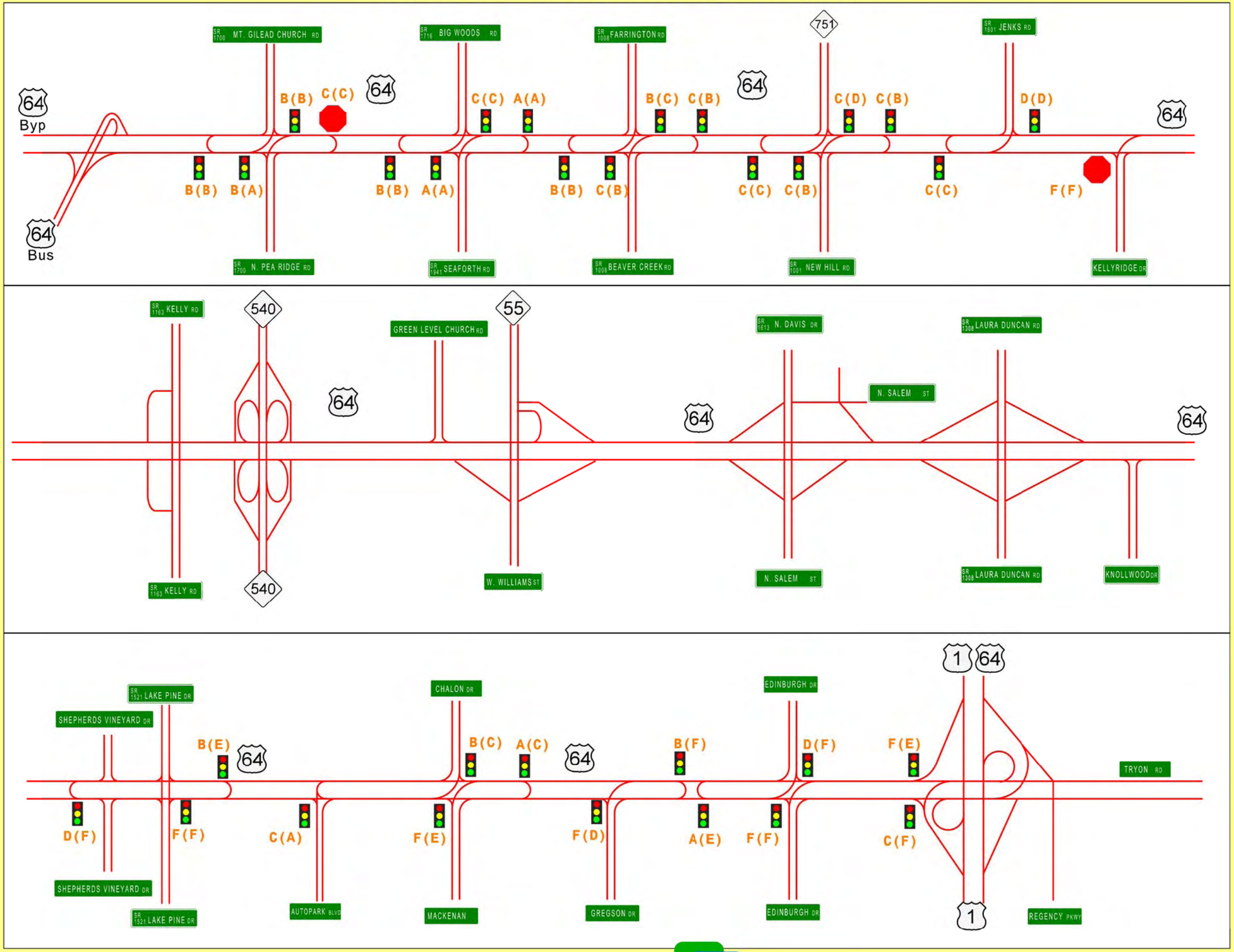
An additional measure to show the traffic operations along the corridor is through the use of travel time. Table 3.6 shows the approximate travel time for the 19-mile US 64 corridor from the US 64 Bypass west of Pittsboro to the US 1 interchange in Cary for each direction of US 64 in the AM and PM peak periods.

Table 3.6: 2025 Short-term Solution Travel Time Summary

Roadway	2025 Short-term AM/PM Travel Time
US 64 Eastbound	39 minutes/31 minutes
US 64 Westbound	28 minutes/36 minutes

.

Figure 3.2: 2025 Short-term Solution Level of Service Summary



LEGEND

Unsignalized Intersection

Signalized Intersection

C(C) Level of Service - AM(PM)

Short-term Solution
2025 Build

Level of Service

US 64 Corridor Study
Wake & Chatham Counties

3.3.7 Short-term Solution Concerns and Unresolved Issues

The concerns the public voiced about the initial short-term solution have been considered and accommodated in the recommended short-term solution to the greatest extent possible. It is understood that not all comments and concerns could be completely addressed by the design. At each intersection, the Corridor Study Team attempted to balance the effects to provide a solution that would best address the goals for the corridor and the public's concerns.

There were still some concerns that remain unresolved with regard to the short-term solution and will require additional analysis. The additional analysis of the following concerns is needed prior to implementing the short-term solutions but is considered outside the scope of this study.

- There is a need to determine a safe method of travel for advanced bicyclists at the superstreet intersections. It is understood that advanced bicyclists do not desire to dismount their bicycle and act as pedestrians at the superstreet intersection, which is the preferred method for crossing at a superstreet intersection. There needs to be additional evaluation of the superstreet concept to determine how to best allow bicyclists to act as vehicles and navigate the intersection in a safe manner.

- There is a need to determine a safe method for crossing a superstreet intersection where it is likely that the enforcement of the pedestrian crossing pattern will not be properly adhered to. This is of concern at locations in the vicinity of schools where students have exhibited crossing patterns that are in violation of the accepted crossing pattern.

3.4 LONG-TERM SOLUTION

The goal of the long-term solution for the corridor is to enhance mobility, safety and pedestrian accessibility along US 64 for the design year 2035. The process used to select a recommended long-term solution is described in this section.

The following terms are used in the discussion of the long-term solution:

- **Concept** – refers to the different types of freeways and expressways described in Section 3.2.3 and 3.2.4.
- **Scenario** – Five different general combinations of the freeway and expressway concepts were initially evaluated. These combinations were described as Scenarios A, B, C, D and E.
- **Initial Long-term Concept** – Scenarios A, B, C, D and E are also referred to as Initial Long-term Concepts.
- **Alternative** – Three of the initial scenarios were included in a more detailed preliminary study. The scenarios carried forward are called Alternative 1, 2 and 3.
- **Preliminary Long-term Solution** – is the label given to Alternatives 1, 2 and 3.
- **Preliminary Recommended Long-term Solution** - As the study progressed, elements of these three alternatives were combined to create Alternative 4, also known as the "Preliminary Recommended Long-term Solution.
- **Recommended Draft Long-term Solution** – Following further comment and consideration the alternatives and concepts were re-evaluated. The resulting recommendation from that analysis is referred to as the Draft Recommended Long-term Solution.
- **Final Draft Recommended Long-term Solution**– The Recommended Draft Long-term Solution was presented in a stakeholder meeting. One change was made and the resulting solution is called the Final Draft Recommended Long-term Solution. This solution is the ultimate recommendation included in this report which the public will have the opportunity to review.
- **Recommended Long-term Solution** – will be the title given to the solution resulting from the public review of this report.

3.4.1 Evaluation of Initial Long-term Concepts

The first step in developing the long-term solution was to develop general concepts for the corridor. These general concepts were evaluated for their potential to meet the goals for the corridor and did not include an evaluation of detailed design elements, such as the interchange configuration or detailed location of service roads. The initial evaluation of the corridor included evaluating the corridor based on the results of the *US 64 Corridor Phase I Report* which recommended a freeway from the US 64 Pittsboro Bypass to west of Jordan Lake, an expressway across Jordan Lake, a freeway from east of Jordan Lake to NC 540, and an expressway from NC 540 to US 1. The initial evaluation included five long-term scenarios that are described in the following sections.

3.4.1.1 Long-term Scenario A

The initial concept for Long-term Scenario A is shown in Figure 3.3.

<u>Freeway segment from Pittsboro to Jordan Lake:</u>

Interchanges would be provided at the following locations:

- Mt. Gilead Church Road/ North Pea Ridge Road
- Big Woods Road/ Seaforth Road

The current access to US 64 from Fire Fox Trace would be closed and traffic would access US 64 from US 64 Business. A service road would provide access from the parcels north of US 64 between the Pittsboro Bypass and the Haw River that connects to Eubanks Road. East of the Haw River, the south side of US 64 as well as a small portion of the north side would be re-routed on service roads that connect to Mt. Gilead Church Road and North Pea Ridge Road. A service road is also included along the south side of US 64 that connects to Seaforth Road.

<u>Expressway segment across Jordan Lake:</u>

Due to the environmental and regulatory constraints in the vicinity of Jordan Lake, an expressway would be included that would have right-in right-out access with direct major street left-turns (commonly referred to as left-overs) at the three access points near the lake.

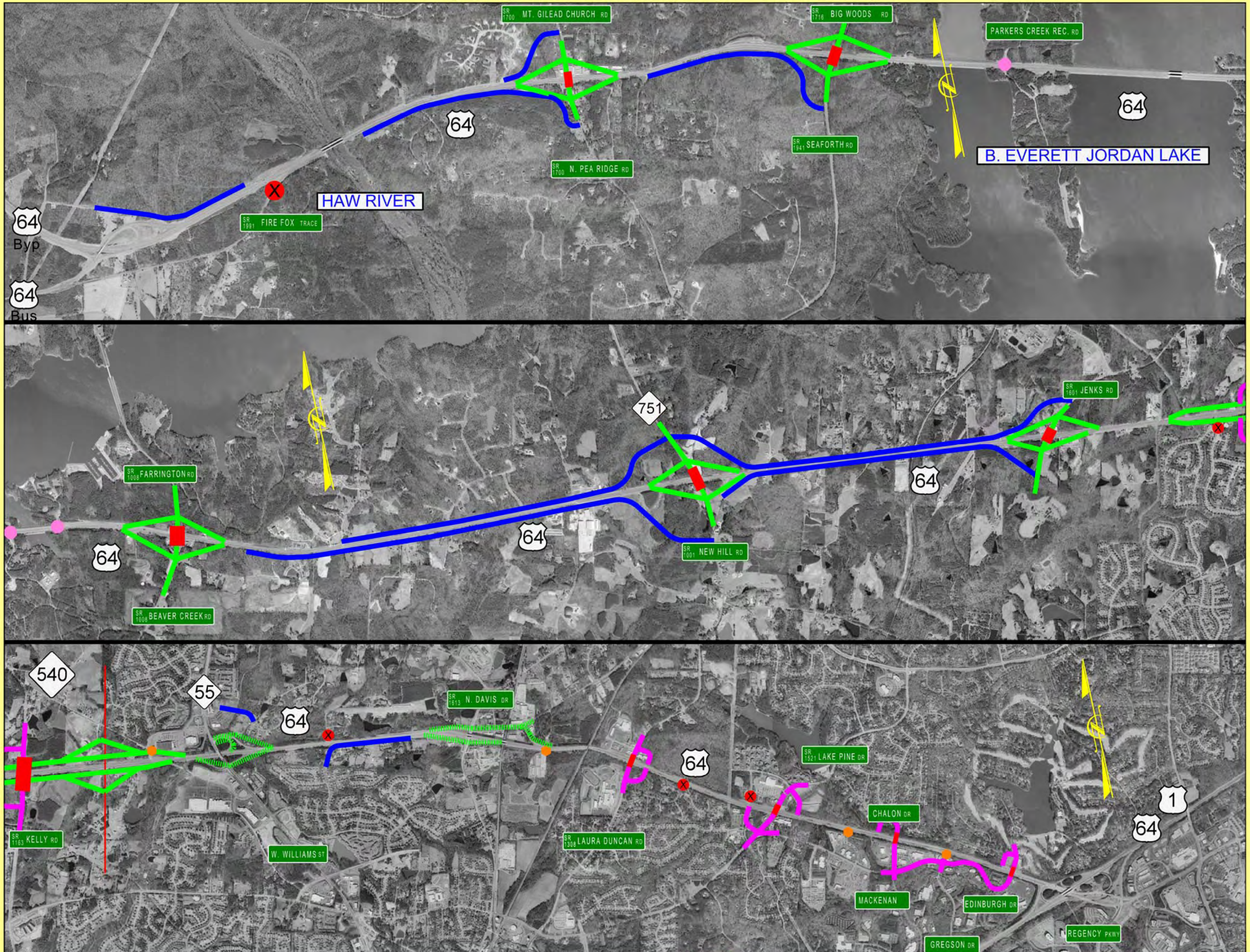
<u>Freeway segment from Jordan Lake to NC 540:</u>

Interchanges would be provided at the following intersections:

- Farrington Road/Beaver Creek Road
- NC 751/New Hill Road
- Jenks Road

The segment between Kelly Road and NC 540 is likely to have substantial operational problems in the future due to the close spacing between the NC 540 interchange and the Kelly Road Quadrant Expressway interchange (commonly referred to as "square loops"). To alleviate this problem a Collector-Distributor (C-D) roadway (a parallel roadway that separates traffic that is leaving/coming to US 64 from the through traffic) was proposed that would serve all traffic to/from Kelly Road, NC 540 and Green Level Church Road (for US 64 westbound traffic).

Figure 3.3: Initial Long-term Concept – Scenario A



LEGEND

- Cul-de-sac
- Right-in/Right-out
- Right-in/Right-out with Major Street Lefts
- Service Road
- Freeway/Interchange
- Existing Freeway/Interchange
- Expressway/Quadrant Interchange
- Bridge

Initial Long-term Concept

Scenario A

US 64 Corridor Study
Wake & Chatham Counties

This segment also includes nearly continuous service roads on both the north and south sides of US 64 from Farrington Road to Kelly Road to provide access to the parcels and roadways that currently have access that would be severed. The service roads connect back to each of the interchange roadways to provide access.

The existing connection to US 64 from Kellyridge Road would be removed and access from the subdivision would be relocated to Kelly Road due to the close proximity of the access point to the Kelly Road square loop roadways.

Expressway segment from NC 540 to US 1/64:

This segment would retain the existing interchanges at NC 55 and Davis Drive/North Salem Street. The existing connection to US 64 from Fern Valley Lane would be removed and access would be relocated to NC 55 by extending the subdivision road. The parcels that currently access US 64 on the south side, between NC 55 and Davis Drive, would be accessed by a service road. The existing connection to a commercial facility and the Trackside North development on the south side of US 64, opposite the exit to North Salem Street would be maintained as a right-in/right-out intersection due to its location between the railroad tracks.

Quadrant Interchanges are proposed at both Laura Duncan Road and Lake Pine Drive, while the existing access points from Knollwood Road and Shepherds Vineyard Road would be closed and re-routed to existing access points. The existing full movement intersection to Autopark Boulevard would be converted to a right-in/right-out intersection.

The section of US 64 from Mackenan Drive/Chalon Drive to Edinburgh Drive would be converted to a pair of Quadrant Interchanges with Mackenan Drive/Chalon Drive and Edinburgh Drive converted to grade separations. A new connection between US 64 and Mackenan Drive/Chalon Drive is proposed to provide access to/from Chalon Drive. A second new connection between US 64 and Edinburgh Drive on the north side of US 64 is proposed to provide access to Edinburgh Drive and the MacGregor Downs subdivision. On the south side of US 64, Gregson Drive would be converted to a right-in/right-out intersection and Old Raleigh Road would provide access via the right in/right out intersections at Autopark Boulevard and Gregson Drive.

The interchange at the split of US 1/US 64 would also be improved to remove the signalized intersection where the US 1 ramps connect to US 64. The range of improvements for this interchange would be examined further during the detailed design phase of the study.

3.4.1.2 Long-term Scenario B

The initial concept for Long-term Scenario B is shown in Figure 3.4.

Freeway segment from Pittsboro to Jordan Lake:

This segment is identical to Scenario A.

Expressway segment across Jordan Lake:

This segment is identical to Scenario A.

Freeway segment from Jordan Lake to NC 540:

This segment is identical to Scenario A with the exception of not providing an interchange at NC 751/New Hill Road due to the presence of a historic property on the south side of US 64. This scenario includes more extensive service roads on the south side of US 64.

Expressway segment from NC 540 to US 1/64:

This segment is similar to Scenario A in that it maintains the existing interchanges at NC 55 and Davis Drive, closes Fern Valley Lane, Knollwood Drive and Shepherds Vineyard Road access points, has the same access roads and provides Quadrant Interchanges at Laura Duncan Road and Lake Pine Drive.

The major difference in Scenario B is the area between Autopark Boulevard and Edinburgh Drive. Under Scenario B; traffic on westbound US 64 destined for Edinburgh Drive, Gregson Drive, Mackenan Drive/Chalon Drive and Autopark Boulevard would exit onto a parallel roadway within the US 1/64 interchange that is bridged over the US 64 westbound entrance ramp. The roadway would be a one-way roadway westbound to Edinburgh Drive, which would be a right-in/right-out intersection, where it would become a two-way roadway. The roadway would then rise vertically and have a three-leg intersection where Gregson Drive would be grade separated over US 64. Continuing to the west, the service road would have a right-in/right-out intersection with Chalon Drive and to the west would again become a one-way roadway, re-entering US 64 westbound. In the eastbound direction Old Raleigh Road would be utilized as a service road and Mackenan Drive and Edinburgh Drive would be converted to right-in/right-out intersections.

3.4.1.3 Long-term Scenario C

The initial concept for Long-term Scenario C is shown in Figure 3.5.

Freeway segment from Pittsboro to Jordan Lake:

This segment is identical to Scenario A, except it would provide a Quadrant Expressway Interchange with Big Woods Road/Seaforth Road to minimize the footprint near Jordan Lake.

Expressway segment across Jordan Lake:

This segment is identical to Scenario A

Freeway segment from Jordan Lake to NC 540:

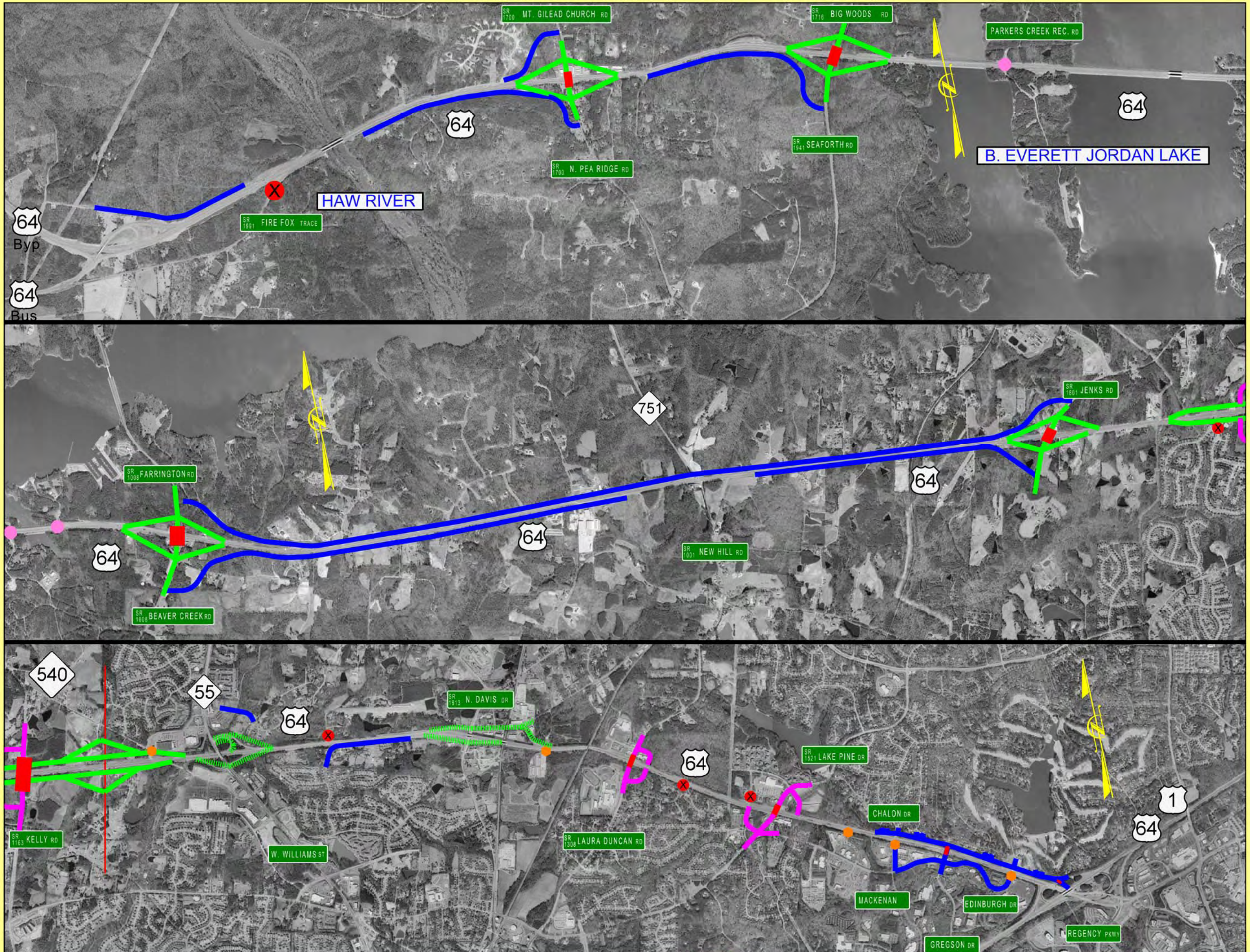
This segment is identical to Scenario A with the exception of the interchange at Farrington Road/Beaver Creek Road being changed to a Quadrant Expressway Interchange.

Expressway segment from NC 540 to US 1/64:

This segment is similar to Scenario A in that it maintains the existing interchanges at NC 55 and Davis Drive, closes Fern Valley Lane and Knollwood Drive access points, has the same access roads and provides a quadrant interchange at Laura Duncan Road.

The major difference in Scenario C is the area from Lake Pine Drive to Edinburgh Drive. Under Scenario C, Lake Pine Drive would become an urban interchange and the Autopark Boulevard intersection would be converted from a full movement intersection to a right-in/right-out interchange. The connections to US 64 from Mackenan Drive and Chalon Drive would become a grade separation due to the close proximity to Gregson Drive, which would become a three-leg diamond interchange. The intersections at Edinburgh Drive would become right-in/right-out. U-turns along this portion of the corridor would be provided at the interchanges.

Figure 3.4: Initial Long-term Concept – Scenario B



LEGEND

- Cul-de-sac
- Right-in/Right-out
- Right-in/Right-out with Major Street Lefts
- Service Road
- Freeway/Interchange
- Existing Freeway/Interchange
- Expressway/Quadrant Interchange
- Bridge

Initial Long-term Concept

Scenario B

US 64 Corridor Study
Wake & Chatham Counties

Figure 3.5: Initial Long-term Concept – Scenario C

LEGEND

- Cul-de-sac
- Right-in/Right-out
- Right-in/Right-out with Major Street Lefts
- Service Road
- Freeway/Interchange
- Existing Freeway/Interchange
- Expressway/Quadrant Interchange
- Bridge

Initial Long-term Concept

Scenario C

US 64 Corridor Study
Wake & Chatham Counties

3.4.1.4 Long-term Scenario D

The initial concept for Long-term Scenario D is shown in Figure 3.6.

Freeway segment from Pittsboro to Jordan Lake:

This segment is identical to Scenario A.

Expressway segment across Jordan Lake:

This segment is identical to Scenario A

Freeway segment from Jordan Lake to NC 540:

This segment is identical to Scenario A.

Expressway segment from NC 540 to US 1/64:

This segment is similar to Scenario A in that it maintains the existing interchanges at NC 55 and Davis Drive; closes Fern Valley Lane, Knollwood Drive and Shepherds Vineyard Road access points; has the same access roads and provides Quadrant Interchanges at Laura Duncan Road and Lake Pine Drive.

The major difference in Scenario D is that the Autopark Boulevard intersection would be closed and the Mackenan Drive/Chalon Drive, Gregson Drive and Edinburgh Drive intersections would all be converted to right-in/right-out intersections. To provide for the U-turn movements, two Grade Separated U-turn Bridges would be provided, with one having bridges over Edinburgh Drive.

3.4.1.5 Long-term Scenario E

The initial concept for Long-term Scenario E is shown in Figure 3.7.

Freeway segment from Pittsboro to Jordan Lake:

This segment is identical to Scenario A.

Expressway segment across Jordan Lake:

This segment is identical to Scenario A

Freeway segment from Jordan Lake to NC 540:

This segment is identical to Scenario A.

Expressway segment from NC 540 to US 1/64:

This segment would create a system of parallel, one-way, frontage roads that run adjacent to US 64 on the north and south side with slip ramps (roadways connecting the frontage road to the main roadway) connecting the mainline of US 64 to frontage roads. In order to provide full movement between the frontage roads and US 64, the following roadways would include grade separations: NC 55, Davis Drive, Laura Duncan Road, Lake Pine Drive, Autopark Boulevard, Mackenan Drive/Chalon Drive, Gregson Drive and Edinburgh Drive. Examples of this is are common in Texas and on the Long Island Expressway.

3.4.1.6 Initial Long-term Solution Scenario Analysis

After an initial analysis of the scenarios, it was determined that three would be carried forward for further study. The major difference amongst the scenarios was at the eastern end of the corridor, therefore the analysis has been broken into segments. An overall evaluation of the scenarios from Pittsboro to the NC 540 portion is presented and then the individual scenarios for the NC 540 to US 1 portion are evaluated individually. The results of the evaluation are included as follows:

Freeway segment from Pittsboro to Jordan Lake:

It was determined that interchanges would be provided at the following locations for the development of all alternatives:

- Mt. Gilead Church Road/ North Pea Ridge Road
- Big Woods Road/ Seaforth Road

The Town of Pittsboro stated that they may be opposed to closing access at Firefox Trace and it was determined that alternatives would be examined that provide connectivity for Firefox trace to US 64 Business as this was located in the freeway portion of the study. It was also determined that the Scenario C option to provide a Quadrant Expressway Interchange with Big Woods Road/Seaforth Road was not in keeping with the desire for a freeway facility and would be eliminated from further consideration.

Expressway segment across Jordan Lake:

Due to the environmental and regulatory constraints in the vicinity of Jordan Lake, an expressway would be included that would include right-in/right out access with direct major street left-turns at the three access points near the lake. There was also concern that, due to the high traffic volumes along US 64, the direct major street left-turns may eventually create a safety concern and that alternatives should be developed with and without the direct major street left-turns.

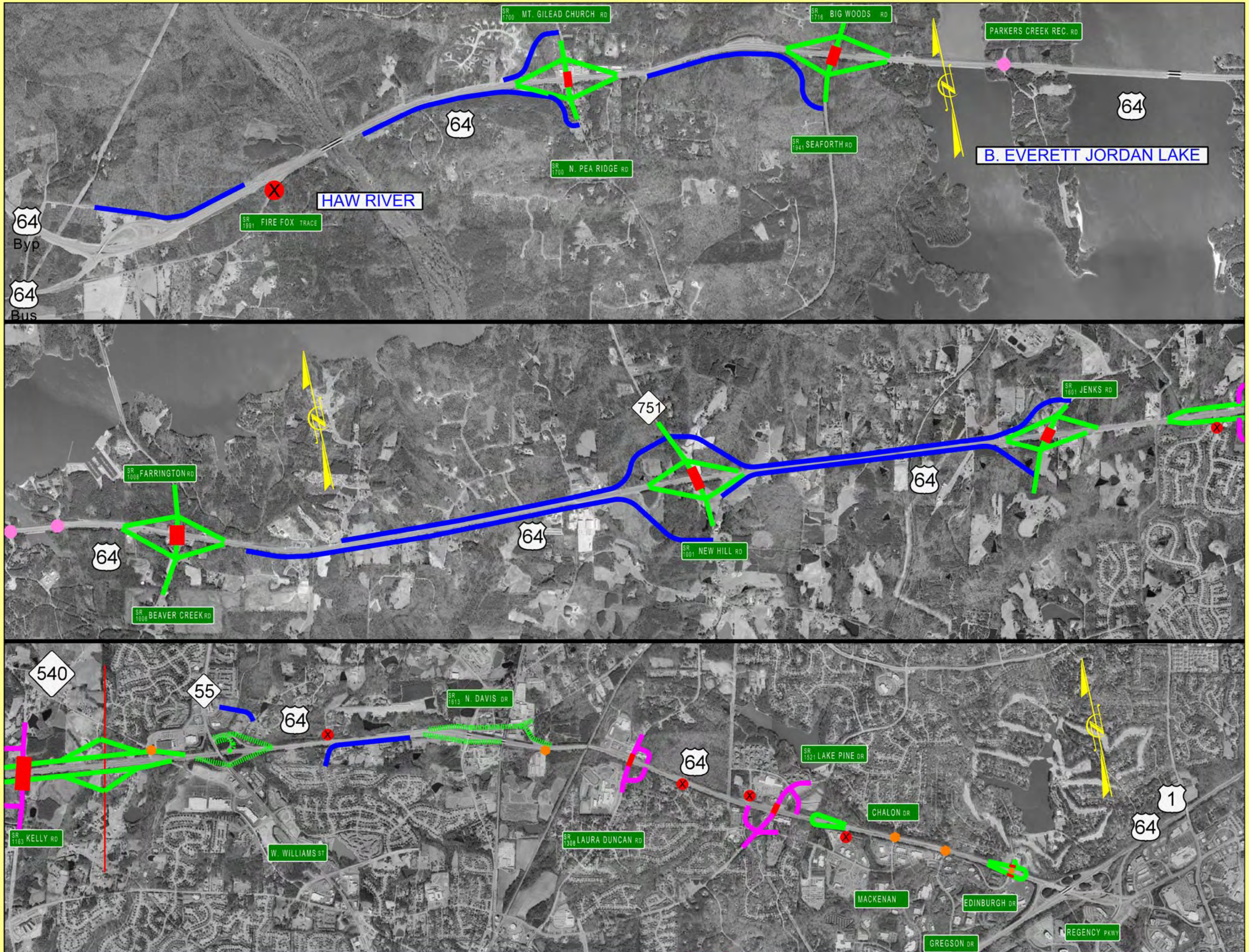
Freeway segment from Jordan Lake to NC 540:

It was determined that interchanges would be provided at the following locations for the development of all alternatives:

- Farrington Road/Beaver Creek Road
- NC 751/New Hill Road
- Jenks Road

Additionally, it was determined that a C-D roadway would be used to serve all traffic to/from Kelly Road, NC 540 and Green Level Church Road (for US 64 westbound traffic). At the request of the Corridor Study Team, it was also decided that the C-D in the eastbound direction should be designed to allow a right-in/right-out intersection at Kellyridge Road. It was also determined that at least one alternative should investigate extending the C-D through the NC 55 interchange, at least in the westbound direction. It was determined that the interchange at NC 751/New Hill Road was needed in all alternatives and that the removal of the interchange as proposed in Scenario B was not feasible. It was also determined that the Scenario C option to provide a Quadrant Expressway Interchange with Farrington Road was not in keeping with the desire for a freeway facility and would be eliminated from further consideration.

Figure 3.6: Initial Long-term Concept – Scenario D



LEGEND

- Cul-de-sac
- Right-in/Right-out
- Right-in/Right-out with Major Street Lefts
- Service Road
- Freeway/Interchange
- Existing Freeway/Interchange
- Expressway/Quadrant Interchange
- Bridge

US 64 Corridor Study
Wake & Chatham Counties

Initial
Long-term Concept

Scenario D

Figure 3.7: Initial Long-term Concept – Scenario E

LEGEND

- Cul-de-sac
- Right-in/Right-out
- Right-in/Right-out with Major Street Lefts
- Service Road
- Freeway/Interchange
- Existing Freeway/Interchange
- Expressway/Quadrant Interchange
- Bridge

Initial Long-term Concept

Scenario E

US 64 Corridor Study
Wake & Chatham Counties

Expressway segment from NC 540 to US 1/64:

The scenarios were evaluated individually for this segment. The results are summarized as follows:

Scenario A

It was determined that Scenario A would have more substantial impacts than the other alternatives, especially due to the quadrant ramps at Mackenan Drive/Chalon Drive and at Edinburgh Drive. Additionally the alternative did not provide a substantial increase in the overall capacity along the corridor and there were concerns it would not provide for adequate traffic operations. Therefore, Scenario A was eliminated from further study.

Scenario B

It was determined that Scenario B would be carried forward for additional studies, although NCDOT raised concerns with the safety of the frontage road on the north side of US 64 including both one-way and two-way traffic.

Scenario C

It was determined that Scenario C would be carried forward for additional studies with a few modifications. It was decided that Laura Duncan Road would be an interchange, Autopark Boulevard would become a cul-de-sac and Edinburgh Drive would become a grade separation.

Scenario D

It was determined that Scenario D would have substantial visual effects and that it did not meet the aesthetic vision for the area. Therefore, Scenario D was eliminated from further study.

Scenario E

It was determined that Scenario E would be carried forward for additional studies, although the Town of Cary raised concerns with the width of the roadway and how it may affect residences and development along the corridor.

3.4.2 Development of Preliminary Long-term Solution (Alternatives 1, 2 and 3)

Following the evaluation of the initial five concepts, three of the scenarios were carried forward for additional detailed study. The three scenarios were labeled as Preliminary Long-term Solutions, given the names Alternative 1, 2 and 3, and detailed design layouts were developed for presentation to the public at Workshop #1. The following is a summary of each of the Preliminary Long-term Solutions.

3.4.2.1 Alternative 1

The design of Alternative 1, shown in Figure 3.8, includes the following features:

- US 64 west of the Haw River would be upgraded to a freeway facility by removing the existing direct access, including the closing of Firefox Trace and the access road opposite Firefox Trace. Access would be redirected to US 64 Business and Eubanks Road.
- The intersection with Mt. Gilead Church Road and North Pea Ridge Road would be converted to a partial cloverleaf interchange with all ramps and loops on the western side of Mt. Gilead Church/N. Pea Ridge. The existing Mt. Gilead Church Road/N. Pea Ridge Road would be relocated slightly to the west and grade separated over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64.
- The intersection with Big Woods Road and Seaforth Road would be converted to a partial cloverleaf interchange with all ramps and loops on the western side of Big Woods/Seaforth. The configuration would not impact the USACE property or the North Carolina Department of Forest Resources Demonstration Forest Area with existing Big Woods Road/Seaforth Road being relocated slightly to the west and grade separated over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64.
- The section of US 64 in the vicinity of Jordan Lake originally was to be upgraded to an expressway facility by converting the existing full movement intersections to right-in/right-out intersections with major street direct left-turn movements from US 64 to the minor street. Following discussion with the Corridor Study Team and consideration of the traffic volumes and safety concerns, it was decided that the major street left-turns would not be included in any of the build alternatives. The ability to make u-turns would be accommodated at the interchange with Big Woods Road/Seaforth Road to the west and Farrington Road/Beaver Creek Road to the east.
- The intersection with Farrington Road and Beaver Creek Road would be converted to a compressed diamond interchange with US 64 being constructed over Farrington Road/Beaver Creek Road due to the existing location of Farrington Road and the narrow right-of-way through the USACE property. Service roadways would also be constructed to eliminate the existing direct access to US 64. The ability to connect the service roads to the east of the interchange back to Farrington Road was evaluated and determined not to be feasible, because it would require crossing USACE property to make the connection. On the south side of US 64, the service road is continuous from Beaver Creek Road to New Hill Road.
- The intersection with NC 751 and New Hill Road would be converted to a compressed diamond interchange. Due to the presence of a historic property on the south side of US 64, the interchange would need to be constructed with US 64 being relocated to the north and constructed over NC 751/New Hill Road. Service roadways would also be constructed to eliminate the existing direct access to US 64.
- The intersection with Jenks Road would be converted to an interchange and would include a future extension of Jenks Road to the south of US 64 creating a four-leg interchange. The interchange would be a combination of a diamond interchange and a partial clover interchange with two diamond ramps on the north side of US 64 and a partial clover configuration with a ramp and loop in the southwest quadrant. Jenks Road would be relocated slightly to the west and would have Jenks road crossing over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64.
- The section of US 64 in the vicinity of Kelly Road, NC 540 and Green Level Church Road would be upgraded beyond the improvements proposed under the Triangle Expressway project being constructed by the NC Turnpike Authority. The proposed design includes introducing a two-lane C-D roadway in both directions beginning between Jenks Road and Kelly Road. The C-D roadway in the eastbound direction would include a right-in/right-out intersection with Kellyridge Road, would reconnect to the quadrant interchange at Kelly Road, would tie to the NC 540 cloverleaf interchange and re-enter US 64 prior to the bridge carrying Creekside Landing Drive over US 64. In the westbound direction, the C/D would begin between NC 55 and Green Level Church Road and would include a right-in/right out intersection with Green Level Church, would reconnect to the NC 540 cloverleaf interchange and the Kelly Road quadrant interchange before re-entering US 64 east of Jenks Road. Also a service road connection to Jenks Road would be constructed to provide access to properties along US 64 to the west of Kelly Road.
- The section of US 64 from the existing NC 55 interchange through the existing Davis Drive interchange would be upgraded to provide a higher level of access control as an expressway facility. US 64 to the west

Figure 3.8: Preliminary Long-term Solution – Alternative 1

LEGEND

- Proposed Pavement
- Proposed Bridges and Islands
- Existing Bridges to Remain
- Pavement Constructed Under NC 540 Project

Preliminary Long-term Solution

Alernative 1

US 64 Corridor Study
Wake & Chatham Counties

of NC 55 would be expanded to include an auxiliary lane between NC 55 and the C-D roadway proposed. The interchange at NC 55 would maintain its existing configuration but would be upgraded to include additional through lanes in the southbound and northbound directions, additional turn lanes along NC 55 and additional turn lanes on the ramps. An auxiliary lane is included between NC 55 and Fern Valley Drive (north of US 64) and Blackburn Road (south of US 64). Both intersections would be converted to right-in/right-out intersections by removing the median opening. The auxiliary lane would then continue to the east to the Davis Drive interchange. The Davis Drive interchange would maintain its existing configuration but would be expanded to a seven-lane section through the interchange and include additional turn lanes on Davis Drive and the ramps. A service road parallel to US 64 on the south side is proposed to eliminate direct connections to US 64 such that the existing interchanges, the auxiliary lanes and the right-in/right-out intersections can operate acceptably.

- The section of US 64 in the vicinity of the Laura Duncan Road intersection would be converted to an expressway by providing a Quadrant Expressway Interchange. Laura Duncan Road would be relocated slightly to the east and grade separated over US 64, resulting in the relocation of the business in the northeast quadrant. The relocation is to allow for construction to occur without closing the roadway. Quadrant ramps are proposed in the northeast and southeast quadrants to provide access to Laura Duncan Road. Additionally, the existing intersection at Merchant Drive would be utilized as a connection to Laura Duncan Road via Laura Village Road.

- The section of US 64 from Knollwood Drive to the US 1 interchange includes upgrading the facility to an expressway. Knollwood Drive would be converted to a right-in/right-out intersection with an auxiliary lane from Laura Duncan Road to the west and Shepherds Vineyard Road to the east. The Lake Pine Drive intersection would become a grade separated quadrant interchange with the right-in/right-out access occurring to the west of the intersection at Shepherds Vineyard Drive, where the existing median opening would be closed.

- Continuing along US 64 in the eastbound direction, the roadway access would be converted to a series of right-in/right-out intersections with access to US 64 westbound being provided by a grade separation at Gregson Drive. The intersections at Autopark Boulevard, Mackenan Drive and Edinburgh South Drive would be converted to right-in/right-out intersections and are connected by a continuous auxiliary lane. Old Raleigh Road would act as a two-way service road connecting the intersections. The grade separation at Gregson Drive would carry US 64 over Gregson Drive in order to minimize impacts.

- US 64 in the westbound direction would have a parallel service road that provides access to the roadways and properties on the north side of US 64. A service road would begin at the convergence of the two-lane ramp from US 1 southbound with a ramp connection from westbound Tryon Road. The one-way service road would merge from three-lanes to two-lanes prior to reaching Edinburgh Drive where a right-in/right-out intersection would be included. At Edinburgh Drive the service road would become a two-way service road with two-lanes in the westbound direction and one lane in the eastbound direction. The eastbound lane would terminate as a left-turn onto Edinburgh Drive and would be controlled by a raised concrete island. The service road would continue west to the Gregson Road underpass allowing for access to the roadways and properties on the south side of US 64. Further to the west, the service road would intersect with Chalon Drive as an intersection that would include a left turn onto the eastbound service road, beginning the roadway in the eastbound direction. From Chalon Drive, the two-lane service road would again be a one-way roadway and would merge onto US 64 at a location opposite Autopark Boulevard.

- The US 1 interchange would be upgraded to provide for adequate traffic operations and remove the signal for westbound Tryon Road traffic crossing US 64 eastbound to access the US 1 southbound ramp. To provide additional traffic capacity and improved route continuity at the US 1 interchange, the ramp from US 1/64 southbound to US 64 westbound would be improved to provide a two-lane exit via a shared through/right lane along US 1. The ramp from US 64 eastbound to US 1/64 northbound would also be improved to accommodate a two-lane ramp, requiring additional widening on US 1/64 northbound to accept three ramp lanes entering. The third ramp lane would be tapered out prior to the Cary Parkway interchange. In order to eliminate the existing signal at the US 1 southbound ramp, an elevated left-turn bridge in the median is proposed. The bridge would exit from Tryon Road, under the US 1 bridges, and would begin to elevate after passing beyond the US 1 bridges. The lane would rise in elevation as either a bridge or through the use of retaining walls, before turning to the south and crossing over US 64 eastbound along a curved bridge. The bridge would continue to the south and eventually tie back to the existing ramp location where it would combine with traffic from US 64 eastbound before merging with US 1 south.

3.4.2.2 Alternative 2

The design of Alternative 2, shown in Figure 3.9, includes the following features:

- The section of US 64 west of the Haw River would be identical to Alternative 1.

- The intersection with Mt. Gilead Church Road and North Pea Ridge Road would be converted to a tight urban diamond interchange. The existing Mt. Gilead Church Road/N. Pea Ridge Road would be relocated slightly to the west and grade separated over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64.

- The intersection with Big Woods Road and Seaforth Road would be similar to the configuration for Alternative 1, due to the constraints of the USACE property. However, for Alternative 2, Big Woods/Seaforth Road was relocated further to the west to avoid the New Hope Rural Archeological Historic District.

- The section of US 64 in the vicinity of Jordan Lake would be identical to Alternative 1.

- The intersection with Farrington Road and Beaver Creek Road would be converted to an interchange that would be a combination of a compressed diamond configuration and a partial cloverleaf interchange. The north side of US 64 would have diamond ramps located in each quadrant and the south side of US 64 would have a ramp and loop in the southeast quadrant of the interchange. Due to the existing location of Farrington Road and the narrow right-of-way through the USACE property, the interchange would need to be constructed with US 64 being constructed over Farrington Road/Beaver Creek Road. Service roadways would also be constructed to eliminate the existing direct access to US 64. The ability to connect the service roads to the east of the interchange back to Farrington Road was evaluated and determined not to be feasible because it would require crossing USACE property to make the connection. On the south side of US 64, the service road is continuous from Beaver Creek Road to New Hill Road.

- The intersection with NC 751 and New Hill Road would be converted to a standard diamond interchange in order to accommodate future loops with NC 751/New Hill Road being relocated slightly to the east and constructed over US 64. Due to the presence of a historic property on the south side of US 64, the interchange is designed such that an avoidance alternative to impacting the property (Alternative 1) could be constructed in the event that the property still maintains its historic designation when the project moves forward into the detailed environmental analysis phase. Service roadways will also be constructed to eliminate the existing direct access to US 64. Access to the west will be provided along parallel service roads and access to the east is provided by continuous service roads that parallel US 64 between NC 751/New Hill Road and Jenks Road.

- The intersection with Jenks Road would be converted to an interchange and would include a future extension of Jenks Road to the south of US 64, creating a four-leg interchange. The interchange would be a partial clover interchange with all of the ramps and loops on the west side of Jenks Road. Jenks Road would be relocated slightly to the west to provide the ability to maintain access to the road during construction and would have Jenks road crossing over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64.

Figure 3.9: Preliminary Long-term Solution – Alternative 2

LEGEND

- Proposed Pavement
- Proposed Bridges and Islands
- Existing Bridges to Remain
- Pavement Constructed Under NC 540 Project

Preliminary Long-term Solution

Alernative 2

US 64 Corridor Study
Wake & Chatham Counties

- The section of US 64 in the vicinity of Kelly Road, NC 540 and Green Level Church Road would be upgraded beyond the improvements proposed under the Triangle Expressway project being constructed by the NC Turnpike Authority and is very similar to Alternative 1. The main difference would be that, in the westbound direction, the C-D roadway would begin east of the NC 55 interchange, extend through the NC 55 interchange, include Green Level Church Road as a right-in/right out intersection, would reconnect to the NC 540 cloverleaf interchange and the Kelly Road quadrant interchange before re-entering US 64 east of Jenks Road.

- The section of US 64 from the NC 55 interchange to Davis Drive would be similar to Alternative 1, with the main difference being that the ramps connecting to westbound US 64 would be along the C-D roadway. An auxiliary lane is included between the C-D to the west of NC 55 and the Davis Drive interchange. The Davis Drive interchange would maintain its existing configuration but would be expanded to provide additional through lanes and include additional turn lanes on Davis Drive and the ramps.

- The existing connections to US 64 from Fern Valley Drive and Blackburn Road would be eliminated. A service road from Thorn Hollow drive to NC 55 would provide the access to the property that currently accesses US 64 via Fern Valley Drive, while the properties that access US 64 via Blackburn Road have access to NC 55 via existing roadways. An additional service road parallel to US 64 on the north and south side, west of Davis Drive, is proposed to eliminate direct connections to US 64 such that the existing interchanges, the auxiliary lanes and the right-in/right-out intersections can operate acceptably.

- The Laura Duncan Road intersection would be converted to a tight urban diamond interchange and would operate essentially as a freeway section. In order to minimize impacts along Laura Duncan road and to facilitate the construction, US 64 would be reconstructed over Laura Duncan Road which would remain in its existing location. Due to the interchange proposed for Laura Duncan Road, the existing CSX Railroad bridge over US 64 would need to be replaced due to the additional horizontal clearance required under the structure. In order to reconstruct the bridge and maintain train traffic, a new bridge parallel to the existing bridge would be required, along with the relocation of the track on each side of the bridge.

- The section of US 64 from Knollwood Drive to the US 1 interchange includes the upgrading of the facility to what is essentially a freeway. The connection to US 64 from Knollwood Drive would be removed and an auxiliary lane would be constructed in both directions between the Laura Duncan Road and Lake Pine Drive. The Lake Pine Drive intersection would become a tight urban diamond interchange configuration with access to Shepherds Vineyard Drive being closed. In order to minimize impacts along Lake Pine Drive and to facilitate construction, US 64 would be reconstructed over Lake Pine Drive which would remain in its existing location. Continuing to the west, the intersection at Autopark Boulevard would be removed, the intersection at Mackenan Drive/Chalon Drive would be converted to a grade separation over US 64 and auxiliary lanes along US 64 in each direction would be provided. The existing intersection at Gregson Drive would be converted to a three-leg tight-urban diamond interchange, again with US 64 being reconstructed over Gregson Drive and auxiliary lanes would be provided to the US 1 interchange. The existing intersection at Edinburgh Drive would be converted to a grade separation similar to the separation at Mackenan Drive/Gregson Drive, with a grade separation over US 64. Access to and from the north side of US 64 would be accomplished by utilizing Old Raleigh Road as a local street with access to US 64 provided at the Gregson Drive interchange and the Lake Pine Drive interchange. The existing intersection between Old Raleigh Road and Gregson Drive would become a roundabout.

- The US 1 interchange configuration would be identical to Alternative 1 except the two lane ramp from US 1 southbound would merge directly into US 64 westbound as opposed to merging onto the service road.

3.4.2.3 Alternative 3

The design of Alternative 3, shown in Figure 3.10, includes the following features:

- The section of US 64 from the US 64 Pittsboro Bypass to NC 751/New Hill Road would be identical to Alternative 1.

- The intersection with NC 751 and New Hill Road would be converted to a partial cloverleaf interchange with the ramps and loops located to the west of NC 751/New Hill Road. Due to the presence of a historic property on the south side of US 64, the interchange would need to be constructed with NC 751/New Hill Road relocated to the west and constructed over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64.

- The intersection with Jenks Road would be converted to an interchange and would include a future extension of Jenks Road to the south of US 64, creating a four-leg interchange. The interchange would be a partial clover interchange with a pair of ramps and loops in the northeast and southwest quadrants and a ramp in the northwest quadrant. Jenks Road would be relocated slightly to the west to provide the ability to maintain access to the road during construction and would have Jenks road crossing over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64.

- The section of US 64 in the vicinity of Kelly Road, NC 540 and Green Level Church Road would be upgraded beyond the improvements proposed under the Triangle Expressway project being constructed by the NC Turnpike Authority. The proposed design includes introducing a set of parallel one-way frontage roads in each direction along US 64. The one-way frontage roads would typically be two-lanes in each direction and would connect to the mainline of US 64 via slip ramp connections. The parallel frontage roads would continue from west of Kelly Road to Edinburgh Drive.

- In the vicinity of Kelly Road, NC 540 and Green Level Church Road; the proposed design is very similar to the C-D roadway proposed in Alternatives 2 and 3. The two-lane frontage road begins in both directions between Jenks Road and Kelly Road. The frontage road in the eastbound direction would include a right-in/right-out intersection with Kellyridge Road, would reconnect to the quadrant interchange at Kelly Road, would tie to the NC 540 cloverleaf interchange, continue east under the bridge carrying Creekside Landing Drive over US 64 and continue east toward the NC 55 interchange. In the westbound direction, the frontage road would extend through the NC 55 interchange, include Green Level Church Road as a right-in/right out intersection, and would reconnect to the NC 540 cloverleaf interchange and the Kelly Road quadrant interchange before re-entering US 64 east of Jenks Road. A service road connection to Jenks Road would be constructed to provide access to properties along US 64 to the west of Kelly Road.

- The section of US 64 from the existing NC 55 interchange through the existing Davis Drive interchange would we upgraded to accommodate the parallel frontage road concept with two-lanes in each direction. The interchange at NC 55 would also include a pair of slip ramps within the interchange area that provide access from the eastbound frontage road to eastbound US 64 and from westbound US 64 to the westbound frontage road. The interchange at NC 55 would maintain its existing configuration; however, the bridge on NC 55 over US 64 would need to be replaced to allow for the wider cross section along US 64. In addition to the bridge, the interchange would be upgraded to include additional through lanes in the southbound and northbound directions, additional turn lanes along NC 55 and additional turn lanes on the ramps.

- Between the NC 55 interchange and the Davis Drive interchange, the existing connections to Fern Valley Drive and Blackburn Road would be maintained with access to the frontage roads. To the east of Fern Valley Drive and Blackburn Road a pair of slip ramps are included that provide access from eastbound US 64 to the eastbound frontage road and from the westbound frontage road to westbound US 64.

- The Davis Drive interchange would maintain its existing configuration but would be expanded to include additional through lanes on Davis Drive through the interchange, would require new bridges along US 64 to carry the frontage road traffic, and include additional turn lanes on Davis Drive and the ramps.

Figure 3.10: Preliminary Long-term Solution – Alternative 3

LEGEND

- Proposed Pavement
- Proposed Bridges and Islands
- Existing Bridges to Remain
- Pavement Constructed Under NC 540 Project

Preliminary Long-term Solution

Alernative 3

US 64 Corridor Study
Wake & Chatham Counties

- Due to the wider typical section for the parallel frontage roads, the existing US 64 bridges over the CSX Railroad are not adequate and would require new bridges parallel to the existing bridges to carry the frontage roads. Additionally, the CSX Railroad bridge over US 64 would need to be replaced due to the additional horizontal clearance required under the structure. In order to reconstruct the bridge and maintain train traffic, a new bridge parallel to the existing bridge would be required, along with the relocation of the track on each side of the bridge.

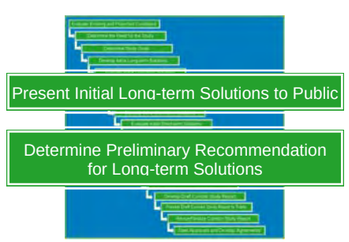
- The section of US 64 in the vicinity of the Laura Duncan Road intersection would maintain the frontage road concept through the intersection. Due to the impacts associated with carrying Laura Duncan Road over US 64 the design includes US 64 being reconstructed over Laura Duncan Road for the US 64 through movements. The existing connection at Merchant Road would be maintained and would tie to the westbound frontage road.

- The section of US 64 from Knollwood Drive to the US 1 interchange would maintain the frontage road concept to the west through the intersection with Edinburgh Drive. The connection to US 64 from Knollwood Drive would be maintained and would tie to the eastbound frontage road. A pair of slip ramps are included in the design between Knollwood Drive and Lake Pine Drive that allow access from the eastbound frontage road to eastbound US 64 and from westbound US 64 to the westbound frontage road. The existing connections to Shepherds Vineyard Drive on each side of US 64 would be maintained with connections to the frontage roads. Due to the impacts associated with carrying Lake Pine Drive over US 64, the design includes US 64 being reconstructed over Lake Pine Drive for the US 64 through movements. Continuing to the east, two pairs of slip ramps are included that provide access to and from the frontage roads in each direction and occur prior to the existing connection to Autopark Boulevard. The Autopark Boulevard connection would be maintained as a right-in/right-out intersection onto the eastbound frontage road. To the east of the intersection at Autopark Boulevard, the major street through traffic on US 64 would cross over Mackenan Drive/Chalon Drive on new bridges constructed over Mackenan/Chalon in the same fashion as those at Laura Duncan Road and Lake Pine Drive. Between Mackenan Drive/Chalon Drive and Gregson Drive, a pair of slip ramps that provide access from US 64 eastbound to the eastbound frontage road and from the westbound frontage road to westbound US 64 are included in the design. The existing intersection at Gregson Drive would be reconfigured with US 64 being reconstructed over Gregson Drive similar to the previous three intersections. To the east of Gregson Drive, the final set of slip ramps that provide access from the eastbound frontage road to eastbound US 64 and from westbound US 64 to the westbound frontage road, are included in the design. The frontage road system continues to the east and terminates at Edinburgh Drive, which would be reconstructed over US 64 slightly to the west of the existing intersection.

- The US 1 interchange configuration would be identical to Alternative 2 except for the westbound Tryon Road traffic crossing under a flyover bridge from the US 1 southbound ramp which would create the US 64 mainline in the median of US 64.

3.4.3 Development of Preliminary Recommended Long-term Solution (Alternative 4)

Using the Preliminary Long-term Solutions developed by the Corridor Study Team, the design plans for the three alternatives were completed and the results were presented to the public at Workshop #1 on May 19-20, 2008. Based on comments received at the workshop and during the comment period following the workshop, a list of public concerns with the Long-term Solutions were developed by the Corridor Study Team and included the following concerns:



- Many of the comments focused on a concern for access, impacts to property and the affects on property values in the study area.
- Access concerns focused on opposition to individual neighborhoods being blocked for emergency vehicles, school buses and public buses. Some participants did not like the service road system.
- There was concern about providing better pedestrian and bike facilities and access to/from public facilities.
- There were concerns that the proposed study was not in line with locally adopted plans.
- There were concerns with safety along the corridor, especially at Apex High School.
- There were concerns with noise and air pollution as a result of the implementation of the study goals.
- There were concerns that the study did not include the implementation of mass transit.
- There were concerns with routing through traffic along US 64 through the developed areas in Cary and Apex instead of along NC 540.
- Out of 47 comments, only 13 people clearly stated a preference to the proposed alternatives: Alternative 2 received eight supporters, Alternative 3 had three supporters and two favored Alternative 1.

Following Workshop #1 the Corridor Study Team met and discussed the public comments and developed a Preliminary Recommendation for the Long-term Solution, which was a combination of elements from all three of the Preliminary Long-terms Solution Alternatives as well as a variation of Alternative 3 that reduced the magnitude of the design in the residential areas through Cary and Apex. Because the Preliminary Recommended Alternative was a hybrid of the previous alternatives, it was named Alternative 4. A detailed description of the Alternative 4 design, shown in Figure 3.11, is included as follows:

- The section of US 64 west of the Haw River would be upgraded to a freeway facility by removing the existing direct access including the closing of Firefox Trace and the access road opposite Firefox Trace with the access being redirected to US 64 Business and Eubanks Road. This was the configuration proposed for Alternatives 1, 2 and 3.

- The intersection with Mt. Gilead Church Road/North Pea Ridge Road would be converted to a tight urban diamond interchange. The existing Mt. Gilead Church Road/N. Pea Ridge Road would be relocated slightly to the west and grade separated over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64. This was the configuration proposed in Alternative 2.

- The intersection with Big Woods Road/Seaforth Road would be converted to a partial clover leaf interchange configuration with all ramps and loops on the western side of Big Woods/Seaforth Road. The configuration was determined to be the optimal configuration because it did not impact the USACE property or the North Carolina Department of Forest Resources Demonstration Forest Area. However, the interchange would impact the New Hope Rural Historic Archeological District. It was determined by NCDOT that the impact was not likely to be considered an impact to a resource identified as resource under Section 4(f) of the US Code Title 23 Section 138 that protects historic resources. The existing Big Woods Road/Seaforth Road will be relocated slightly to the west and grade separated over US 64. Service roadways will also be constructed to eliminate the existing direct access to US 64. This was the configuration proposed for Alternative 1.

- The section of US 64 in the vicinity of Jordan Lake originally would have been upgraded to an expressway facility by converting the existing full movement intersections to right-in/right-out intersections, due to the traffic volumes and safety concerns associated with the existing full movement intersections. The ability to make u-turns would be accommodated at the interchange with Big Woods Road/Seaforth Road to the west and Farrington Road/Beaver Creek Road to the east. This was the configuration proposed for Alternatives 1, 2 and 3.

Figure 3.11: Preliminary Recommended Long-term Solution – Alternative 4

- The intersection with Farrington Road/Beaver Creek Road would be converted to a compressed diamond interchange with US 64 being constructed over Farrington Road/Beaver Creek Road due to the existing location of Farrington Road and the narrow right-of-way through the USACE property. Service roadways would also be constructed to eliminate the existing direct access to US 64. The ability to connect the service roads to the east of the interchange back to Farrington Road was evaluated and determined not to be feasible because it would require crossing USACE property to make the connection. On the south side of US 64, the service road is continuous from Beaver Creek Road to New Hill Road. This was the configuration proposed for Alternative 1.

- The intersection with NC 751/New Hill Road would be converted to a standard diamond interchange in order to accommodate future loops if future traffic volumes increase substantially with NC 751/New Hill Road being relocated slightly to the east and constructed over US 64. Due to the presence of a historic property on the south side of US 64, the interchange is designed such that an avoidance alternative to impacting the property could be constructed in the event that the property still maintains its historic designation when the project moves forward into the detailed environmental analysis phase. Service roadways will also be constructed to eliminate the existing direct access to US 64. Access to the west will be provided along parallel service roads and access to the east is provided by continuous service roads that parallel US 64 between NC 751/New Hill Road and Jenks Road. This was the configuration proposed for Alternative 2.

- The intersection with Jenks Road would be converted to an interchange and would include a future extension of Jenks Road to the south of US 64 creating a four-leg interchange. The interchange would be a combination of a diamond interchange and a partial clover interchange with two diamond ramps on the north side of US 64 and a partial clover configuration with a ramp and loop in the southwest quadrant and a ramp in the southeast quadrant. Jenks Road would be relocated slightly to the west and would have Jenks road crossing over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64. This is a variation of the configuration proposed for Alternative 1.

- The section of US 64 in the vicinity of Kelly Road, NC 540 and Green Level Church Road would be upgraded beyond the improvements proposed under the Triangle Expressway project being constructed by the NC Turnpike Authority. The proposed design includes introducing a two-lane C-D roadway in both directions beginning between Jenks Road and Kelly Road. The C-D roadway in the eastbound direction would include a right-in/right-out intersection with Kellyridge Road, would reconnect to the quadrant interchange at Kelly Road, would tie to the NC 540 cloverleaf interchange and re-enter US 64 prior to the bridge carrying Creekside Landing Drive over US 64. In the westbound direction, the C-D roadway would begin east of the NC 55 interchange, extend through the NC 55 interchange, include Green Level Church Road as a right-in/right out intersection, would reconnect to the NC 540 cloverleaf interchange and the Kelly Road quadrant interchange before re-entering US 64 east of Jenks Road. Also a service road connection to Jenks Road would be constructed to provide access to properties along US 64 to the west of Kelly Road. This was the configuration proposed for Alternative 2.

- The interchange at NC 55 would maintain its existing configuration with several improvements including adding additional through lanes on NC 55 and turn lanes. The existing connections to US 64 from Fern Valley Drive would be eliminated and a service road from Thorn Hollow Drive to NC 55 would provide the access to the property that currently accesses US 64 via Fern Valley Drive. The connection to Blackburn Road would be maintained as a right-in/right-out intersection with a continuous auxiliary lane between the NC 55 interchange and the Davis Drive interchange. This is a variation of the configuration proposed for Alternative 2.

- The section of US 64 in the vicinity of the Davis Drive interchange would be upgraded to provide a higher level of access control as an expressway facility. An auxiliary lane is included between the C-D to the west of NC 55 and the Davis Drive interchange. The Davis Drive interchange would maintain its existing configuration but would be expanded to include additional through lanes on Davis drive through the interchange and additional turn lanes would be provided. Due to the width of the existing bridge opening along Davis Drive, under US 64 it is likely that the bridges would need to be reconstructed. An additional service road parallel to US 64 on the north and south side, west of Davis Drive, is proposed to eliminate direct connections to US 64 such that the existing interchanges and the auxiliary lanes can operate safely. This was the configuration proposed for Alternative 1.

- The Laura Duncan Road intersection would be converted to a tight urban diamond interchange configuration, and US 64 would be reconstructed over Laura Duncan Road, which would remain in its existing location. Due to safety concerns; the connection from US 64 to the Villages of Apex development would be closed, the connection to US 64 from Knollwood Drive would be removed and an auxiliary lane would be constructed in both directions between the Laura Duncan Road and Lake Pine Drive. Due to the interchange proposed for Laura Duncan Road the existing CSX Railroad bridge over US 64 would need to be replaced due to the additional roadway width required under the structure. In order to reconstruct the bridge and maintain train traffic, a new bridge parallel to the existing bridge would be required, along with the relocation of the track on each side of the bridge. This was the configuration proposed for Alternative 2.

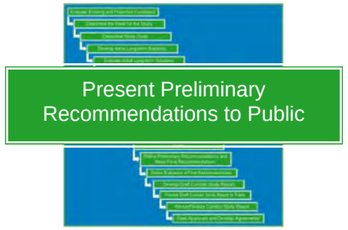
- The section of US 64 in the vicinity of Lake Pine Drive includes upgrading the facility to an expressway. The Lake Pine Drive intersection would become a grade separated quadrant interchange with the right-in/right-out access occurring to the west of the intersection at Shepherds Vineyard Drive and Merchant Drive, where the existing median opening would be closed. Existing Lake Pine Drive would be grade separated over US 64 at its current location. A quadrant ramp movement in the northeast quadrant is included that connects to the local frontage road that extends to the east. This is a variation of the configuration proposed for Alternative 1.

- The section of US 64 from east of Lake Pine Drive to the US 1 interchange includes upgrading the facility by separating local traffic from US 64 through traffic and is a variation of the parallel frontage road with slip ramp concept contained in Alternative 3. To accomplish the separation of through and local traffic, a pair of one-way local frontage roads would merge and diverge from the through US 64 traffic. The US 64 through traffic would be accommodated along an elevated roadway along the median of US 64 and would cross over Mackenan Drive/Chalon Drive and Edinburgh Drive before entering an upgraded interchange at US 1. The local frontage roadway in the eastbound direction would serve Autopark Boulevard (Right-in/Right-out), Mackenan Drive/Chalon Drive (Full-Movement), Gregson Drive (Right-in/Right-out) and Edinburgh Drive (Full Movement) before tying to existing eastbound Tryon Road. Traffic entering the eastbound frontage road destined for northbound US 1 would take the existing US 64 eastbound ramp, and a ramp to southbound US 1 would be provided in the vicinity of the existing location. The westbound local frontage road would begin at a point slightly west of the US 1 bridges, where westbound Tryon Road would split into two roadways: one serving US 64 through traffic and one serving local traffic. The local traffic along the westbound frontage road would also include a slip ramp merging from the US 1 southbound ramp, with the frontage road continuing west and serving Edinburgh Drive (Full Movement), Mackenan Drive/Chalon Drive (Full-Movement) and the quadrant ramp to Lake Pine Drive; before merging back into US 64 slightly west of Lake Pine Drive. The upgraded interchange at US 1 would provide a high-speed freeway to freeway connection between US 64 and US 1. The US 1 southbound to US 64 westbound ramp would be upgraded to grade separate the ramp over westbound Tryon Road traffic and making it the major through movement by carrying the lanes into the median of US 64. To provide a more direct connection between US 64 eastbound and US 1 northbound a new flyover ramp would be constructed over US 1 and would merge with US 1 northbound at the location of the existing merge point. The US 64 eastbound lanes would also include an exit with a bridge over the eastbound frontage road/Tryon Road to US 1 southbound, providing a direct connection to the south.

In addition to the improvements described in this section, the corridor was evaluated for bicycle and pedestrian accommodations. These accommodations are discussed in detail for the Final Draft Long-term Solution Recommendations in Chapter 5.

3.4.4 Further Detailed Evaluation of Long-term Concepts

Following discussions with the Corridor Study Team and the determination of the Preliminary Recommended Long-term Solution, the design plans and traffic capacity analysis were completed for Alternative 4 and the results were presented to the public at Workshop #2 on April 27-28, 2009. A Community Meeting was held on July 16, 2009 to further discuss the long-term and short-term solutions for the corridor. From the comments received at Workshop #2, comments received following the workshop and the comments received during the Community Meeting; the Corridor Study Team developed the following list of public concerns with the Long-term Concept (described from the public's perspective):



- Aesthetics along the corridor would be negatively affected by the Long-term Solution.
- The Long-term Solution would create negative effects due to noise, especially for the residential areas.
- The Long-term Solution would not preserve the community along the corridor and would divide the communities on the north and south side of the highway.
- The Long-term Solution will not fit the scale and context of the corridor and will create a "Berlin Wall" affect.
- Connectivity across US 64 would be negatively affected, especially to Apex Community Park.
- US 64 is a local road and should be treated more like a street and less like a highway.
- The Long-term Solution would have negative effects on access to neighborhoods and businesses.
- The Long-term Solution would not be safe due to the traffic patterns and higher speeds.
- There is no need for the improvements.
- The Long-term Solution would have a negative effect on access to the library.
- The Long-term solution would not provide adequate connections to greenways and pedestrian facilities.
- The proposed NC 540 Triangle Expressway and US 1 would provide a bypass of the area in Cary and Apex and US 64 wouldn't require the magnitude of changes proposed.
- Access to Jordan Lake would be negatively affected and an expressway across Jordan Lake would create a bottleneck.
- The Long-term Solution did not include enough consideration for mass transit.
- The cost of implementing the Long-term Solution will be too high and is not a good investment.
- The size of the interchange at NC 751 is concerning.
- The Long-term Solution does not allow for safe bicycle travel along US 64 or for bicyclists crossing US 64.
- The Long-term Solution would not adequately address pedestrians crossing US 64.
- An interchange at Laura Duncan Road would compromise the safety of students crossing US 64 from Apex High School.
- The Long-term Solution is confusing and would be difficult for young drivers to understand.
- The Long-term Solution would not be safe for school buses.
- The Long-term Solution would reduce property values in the area.

3.4.5 Recommended Draft Long-term Solution Evaluation

Following the Community Meeting, the Corridor Study Team decided to re-evaluate the corridor for both the short-term and long-term solution based on the community input. The Corridor Study Team evaluated the US 64 corridor on an intersection by intersection basis to determine the most appropriate long-term solution. For each location, the unique circumstances and context of the intersection were evaluated and a preferred method selected. The Corridor Study Team determined that, based on the potential impacts associated with freeway and expressway facilities, signalized intersection alternatives could be considered, where appropriate, as a means to minimize the effects on the adjacent areas. The Corridor Study Team determined that the only location where a signalized intersection alternative may be appropriate is the section of US 64 from east of Lake Pine Drive to the US 1 interchange. A description of the design of the Recommended Draft Long-term Solution is presented in the following sections.

West of Haw River

The intersection of US 64 from the US 64 Pittsboro Bypass to the bridges over the Haw River would be converted to a freeway with the intersection at Firefox Trace being closed and new service roads being constructed, re-routing access to US 64 Business. This was the configuration proposed for Alternative 4.

Mt. Gilead Church Road/North Pea Ridge Road Intersection

The intersection with Mt. Gilead Church Road/North Pea Ridge Road would be converted to a compressed urban diamond interchange. The existing Mt. Gilead Church Road/North Pea Ridge Road would be relocated slightly to the west and grade separated over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64. This was the configuration proposed in Alternative 4.

Big Woods Road/Seaforth Road Intersection

The intersection with Big Woods Road/Seaforth Road would be converted to a partial cloverleaf interchange configuration with all ramps and loops on the western side of Big Woods/Seaforth Road. The configuration was determined to be the optimal configuration because it did not impact the USACE property or the North Carolina Department of Forest Resources Demonstration Forest Area. However, the interchange would impact the New Hope Rural Historic Archeological District. It was determined by NCDOT that the impact was not likely to be considered an impact to a resource identified as resource under Section 4(f) of the US Code Title 23 Section 138 that protects historic resources. The existing Big Woods Road/Seaforth Road will be relocated slightly to the west and grade separated over US 64. Service roadways will also be constructed to eliminate the existing direct access to US 64. This was the configuration proposed for Alternative 4.

Jordan Lake Area

The section of US 64 in the vicinity of Jordan Lake would be upgraded to an expressway facility by converting the existing full movement intersections to right-in/right-out intersections due to the traffic volumes and safety concerns associated with the existing full movement intersections. The ability to make U-turns would be accommodated at the interchange with Big Woods Road/Seaforth Road to the west and Farrington Road/Beaver Creek Road to the east. The concerns with this location becoming a bottleneck were considered and it was determined that, with adequate acceleration and deceleration lanes at the right-in/right-out intersections, the traffic operations would be adequate. This was the configuration proposed for Alternative 4.

Farrington Road/Beaver Creek Road Intersection

The intersection with Farrington Road/Beaver Creek Road would be converted to a compressed diamond interchange with US 64 being constructed over Farrington Road/Beaver Creek Road due to the existing location of Farrington Road and the narrow right-of-way through the USACE property. Service roadways would also be constructed to eliminate the existing direct access to US 64. The ability to connect the service roads to the east of the interchange back to Farrington Road was evaluated and determined not to be feasible because it would require crossing USACE property to make the connection. On the south side of US 64, the service road would be continuous from Beaver Creek Road to New Hill Road. This was the configuration proposed for Alternative 4.

NC 751/New Hill Road Intersection

The intersection with NC 751/New Hill Road was discussed by the Corridor Study Team due to comments on Alternative 4 and concerns that the footprint of the interchange was too large. It was determined that the recommended configuration would be a tight urban diamond interchange. Due to the presence of a historic property on the south side of US 64, the interchange would need to be constructed with US 64 being relocated to the north and constructed over NC 751/New Hill Road. Service roadways would also be constructed to eliminate the existing direct access to US 64. Access to the west would be provided along parallel service roads and access to the east would be provided by continuous service roads that parallel US 64 between NC 751/New Hill Road and Jenks Road. This was the configuration proposed for Alternative 1.

The configuration at this location was selected because it would avoid a historic property protected by federal law. A different configuration would likely have been recommended if the historic property were not protected. The law does not protect the property from private development. Prior to the approval of any development in this area that could affect the historic designation of this property; the Corridor Study Team recommends coordination and a detailed analysis to determine the optimal interchange based on the new circumstances.

Jenks Road Interchange

The intersection with Jenks Road would be converted to an interchange and would include a future extension of Jenks Road to the south of US 64, creating a four-leg interchange. The interchange would be a combination of a diamond interchange and a partial cloverleaf interchange with two diamond ramps on the north side of US 64 and a partial cloverleaf configuration with a ramp and loop in the southwest quadrant and a ramp in the southeast quadrant. Jenks Road would be relocated slightly to the west and would have Jenks road crossing over US 64. Service roadways would also be constructed to eliminate the existing direct access to US 64. This is the configuration proposed for Alternative 4.

Kelly Road/NC 540/Green Level Church/NC 55 Area

The section of US 64 in the vicinity of Kelly Road, NC 540 and Green Level Church Road would be upgraded beyond the improvements proposed under the Triangle Expressway project being constructed by the NC Turnpike Authority. The proposed design includes introducing a two-lane C-D roadway in both directions beginning between Jenks Road and Kelly Road. The C-D roadway in the eastbound direction would include a right-in/right-out intersection with Kellyridge Road, would reconnect to the quadrant interchange at Kelly Road, would tie to the NC 540 cloverleaf interchange and re-enter US 64 prior to the bridge carrying Creekside Landing Drive over US 64. In the westbound direction, the C-D roadway would begin east of the NC 55 interchange, extend through the NC 55 interchange, include Green Level Church Road as a right-in/right out intersection, and reconnect to the NC 540 cloverleaf interchange and the Kelly Road quadrant interchange before re-entering US 64 east of Jenks Road. Also, a service road connection to Jenks Road would be constructed to provide access to properties along US 64 to the west of Kelly Road. The interchange at NC 55 would maintain its existing configuration with several improvements, including, adding additional through lanes on NC 55 and turn lanes. The existing connections to US 64 from Fern Valley Drive would be eliminated and a service road from Thorn Hollow drive to NC 55 would provide the access to the property that currently accesses US 64 via Fern Valley Drive. The connection to Blackburn Road would be maintained as a right-in/right-out intersection with a continuous auxiliary lane between the NC 55 interchange and the Davis Drive interchange. This was the configuration proposed for Alternative 4.

Davis Drive Interchange Area

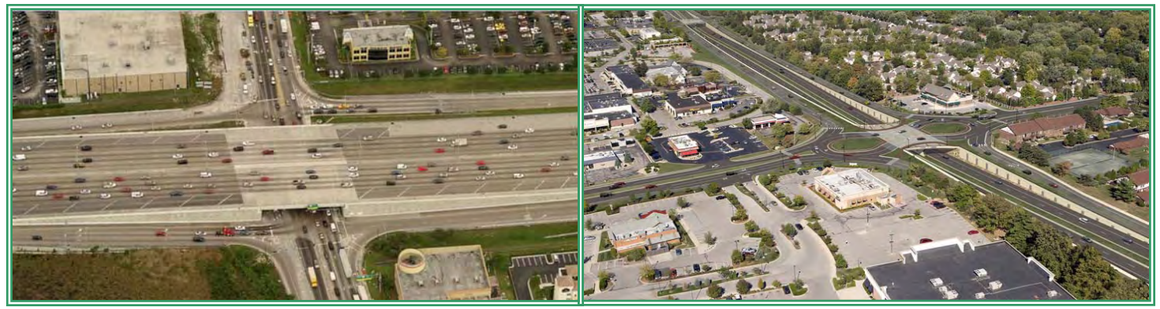
The section of US 64 in the vicinity of the Davis Drive interchange would be upgraded to provide a higher level of access control as an expressway facility. An auxiliary lane is included between the C-D to the west of NC 55 and the Davis Drive interchange. The Davis Drive interchange would maintain its existing configuration but would be expanded to include additional through lanes on Davis Drive through the interchange and additional turn lanes would be provided. Due to the width of the existing bridge opening along Davis Drive, under US 64 the bridges would need to be reconstructed. An additional service road parallel to US 64 on the north and south side, west of Davis Drive, is proposed to eliminate direct connections to US 64 such that the existing interchanges and the auxiliary lanes can operate safely. This was the configuration proposed for Alternative 4.

The Corridor Study Team also discussed the existing right-in/right-out intersection at the Villages of Apex that was to be closed as a part of the Alternative 4 design. This location was identified by the public, Town of Apex staff and elected officials as a major concern. NCDOT had concerns with safety due to the speeds and limited sight distance in the area. It was determined that the Recommended Long-term Solution would not definitively show the location closed but would include a note that the location would be subject to closure or turn restrictions (eliminating right turn out) if safety problems arise. If a pattern of accidents develops in the future, a more detailed review of access options will be completed, including an auxiliary lane on US 64 eastbound from Davis Drive to Laura Duncan Road in the event that the railroad bridge over US 64 is eventually replaced.

Laura Duncan Road Intersection

The Long-term solution at the intersection with Laura Duncan Road was discussed extensively by the Corridor Study Team based on the numerous concerns expressed by the public. The main concerns related to the safety of the roadway in close proximity to Apex High School and the crossing of US 64 by pedestrians for both the high school and Apex Community Park. The Corridor Study Team concluded that the safest way to accommodate pedestrians would be by creating a grade separation between Laura Duncan Road and US 64, thus eliminating the conflict with US 64 through traffic for pedestrians crossing US 64. Access to and from Apex High School is essential to the corridor; therefore a grade separation alone at this location (with no connections between the roadways) is not feasible, and an interchange must be included to provide access. Including an appropriately designed interchange at this location would provide for a pedestrian crossing of US 64 that is substantially safer than the existing crossing and would improve traffic operations to an adequate level. The most appropriate interchange type for this location was discussed by the Corridor Study Team and would require additional analysis beyond what can be developed at this time. The recommended long-term solution for this intersection will be to provide a tight interchange with a configuration to be determined at a later date after additional design, analysis and public input. The ability to potentially lower the US 64 roadway was discussed by the Corridor Study Team and, based on the depth of the groundwater and rock layers at this location, it was concluded that it was possible to lower US 64, but would need to be more fully evaluated as a part of a future study to determine with certainty. The most likely interchange configurations (with samples

shown below) at this location are likely to be a Tight-Urban Diamond configuration (left), similar to the Alternative 4 configuration or a Modern Roundabout Interchange (right) similar to the concept developed in Carmel, Indiana. The modern roundabout configuration would be the preferred design at this stage.



Lake Pine Drive Intersection

The long-term solution at the intersection with Lake Pine Drive was also discussed extensively by the Corridor Study Team because of the numerous concerns expressed by the public. The main concerns were related to crossing of US 64 by bicyclists and pedestrians, especially to Apex Community Park; to the safety of the roadway in close proximity to the library and to the barrier and negative effects on business that would be created. Similar to Laura Duncan Road, the Corridor Study Team concluded that the safest way to accommodate pedestrians and the projected future traffic would be by creating an appropriately designed interchange at this location. The most appropriate interchange type for this location was discussed by the Corridor Study Team, but would require additional analysis beyond what can be developed at this time. The recommended long-term solution for this intersection would be to provide a tight interchange with a configuration to be determined at a later date, after additional design, analysis and public input. The ability to potentially lower the US 64 roadway was also discussed for this location and, based on the depth of the groundwater and rock layers at this location, it was concluded that it was possible to lower US 64, but would need to be more fully evaluated as a part of a future study to determine with certainty. The most likely interchange configurations at this location are likely to be a Tight-Urban Diamond configuration or a modern roundabout interchange similar to those shown above for Laura Duncan Road, with the modern roundabout interchange being the preferred configuration at this stage. The inclusion of an interchange at Lake Pine Drive would potentially result in the intersection of US 64 with Shepherds Vineyard being closed; however, this will need to be evaluated as a part of the future study.

East of Lake Pine Drive to US 1 Interchange

The section of the project from east of Lake Pine Drive to the US 1 interchange was the most controversial and generated the most comments and concerns from the public. This portion of the corridor was evaluated by the Corridor Study Team both on an intersection by intersection basis and as a system of closely related intersections (due to their proximity to one another). Many of the concerns from the community for this portion of the corridor are very similar and have a common theme of balancing the desire for mobility with other community desires. This section is characterized by residential neighborhoods on the north side of US 64 and commercial development on the south side of US 64. The Corridor Study Team decided that the entire range of solutions would be considered along this stretch of US 64, including expressway, freeway and signalized intersection concepts. The following section includes a description of the potential solutions discussed by the Corridor Study Team for this section and the results of the evaluation of each concept. Following the description of the alternatives, a comparison table of the feasible options is included.

Signalized Intersection Concepts

- Recommended Short-term Solution with Widening – This alternative would include utilizing the configuration for the Recommended Short-term Solution and providing an additional through lane in each direction of US 64 to accommodate the future increase in traffic volumes with the widening most likely occurring outside the existing lanes.

Expressway Concepts

- Grade Separation of Minor Streets with Right-in/Right-Out Connections – This scenario would include grade separating some of the minor streets over or under US 64. Under this scenario, some of the minor streets would become grade separations and some would be maintained as right-in/right-out intersections. For this scenario to be feasible, parallel roadways would be needed that connect each of the minor streets. This is a viable concept south of US 64 because Old Raleigh Road provides the connectivity; however, to the north of US 64, a service road would be needed. This concept is generally what was included in Alternative 1 and was revisited by the Corridor Study Team to determine if modifications could be made to allow it to function adequately and address the community's concerns. The Corridor Study Team evaluated the corridor to see if it would be possible to function without a parallel frontage road on the north side of US 64, and concluded that it would not be feasible. The team also evaluated which minor streets could be converted to grade separations, and evaluated if the US 64 roadway could be depressed below its existing grade, allowing for the minor streets to remain at their existing elevation. Based on the elevation of the groundwater in the area, it was concluded that US 64 at the intersection with Gregson Drive could be lowered, while it was not feasible to lower US 64 at the intersections with Mackenan Drive/Chalon Drive and Edinburgh Drive. Edinburgh Drive also was problematic in crossing over US 64 because the elevation on the south side is much lower that the north side, which would result in a substantial amount of the roadway on the south side that would need to be elevated. This increase in length and height would sever the access to the shopping center and the hotel at the intersection. The conclusion of the evaluation was that the only non-signalized scenario that was feasible at Edinburgh Drive would be for US 64 to be grade separated over Edinburgh Drive. For these reasons, the Corridor Study Team decided that this concept was not reasonable and feasible and it was therefore eliminated from further consideration.

- Parallel Frontage Road Concept – This scenario was discussed in general. It would include constructing parallel frontage roads along US 64 to serve local traffic and grade separating the US 64 through movements to create a vertical bypass of the section. This concept is generally what was included in Alternative 4, which was not well received by the community. The concept was re-evaluated to determine if changes could be made to improve the concept and address the concerns raised. The Corridor Study Team discussed the possibility of depressing the US 64 traffic below the existing grade, which would improve the aesthetics and noise impacts over the elevated US 64 roadway in Alternative 4. Like the concept above, the US 64 roadway could only be lowered at Gregson Drive, making this suggestion not feasible. After further efforts to improve or minimize the negative effects, it was determined by the Corridor Study Team that no major revisions could be made to the design. While this concept is feasible and meets the overall goals of the study it was determined by the Corridor Study Team to be unreasonable due to the public concerns. Because it was determined to be feasible it was included in the evaluation in the following section as a means of comparison.

- Elevated Roundabout with Frontage Roads – In an effort to seek an unconventional solution to the complex constraints along the corridor, the Corridor Study Team considered a technique used in Vail, Colorado that includes a roundabout interchange that connects directly to a parallel frontage road system along the highway (shown at right). The concept was discussed, and a variation with a single larger roundabout, similar to a rotary interchange, emerged for consideration. Upon further discussion, the Corridor Study Team determined that it would likely require a very large footprint, have aesthetic effects and would have difficulty accommodating the turning volumes at the intersections along the corridor. The Corridor Study Team concluded that this configuration was neither reasonable nor feasible and it was eliminated from further consideration.

Freeway Concepts

- Freeway with Tight Urban Diamond Interchange – This scenario would include converting US 64 to a freeway with one or more of the minor streets becoming a Tight Urban Diamond Interchange. This concept is generally what was included in Alternative 2, where it included an interchange at Gregson Drive. The three main minor streets were evaluated to determine if they would be good candidates for an interchange. The intersection with Edinburgh Drive was determined to not be feasible due to the close proximity to the US 1 interchange. The intersection with Gregson Drive would be a candidate for an interchange and with the groundwater level being more than 25 feet below the existing elevation of US 64, it would allow the through traffic on US 64 to be depressed and the interchange constructed at the elevation of the existing roadway. The intersection with Mackenan Drive/Chalon Drive is a potential location for an interchange but US 64 could not be lowered due to the groundwater elevation and would require US 64 to be elevated over Mackenan Drive/Chalon Drive. Based on this, the most likely location for an interchange would be at Gregson Drive; however, the concept would still require that US 64 cross over both Mackenan Drive/Chalon Drive and Edinburgh Drive, which would not address many of the public concerns. While this concept is feasible and meets the overall goals of the study, it was determined by the Corridor Study Team to be unreasonable due to the public concerns. Because it was determined to be feasible it was included in the evaluation in the following section as a means of comparison.

- Freeway with Modern Roundabout Interchange – This scenario would include converting US 64 to a freeway with one or more of the minor streets being converted to modern roundabout interchanges. The evaluation of this concept by the Corridor Study Team resulted in a nearly identical analysis to that of the Tight Urban Diamond Interchange, with the exception that the modern roundabout would most likely be more aesthetic. While this concept is feasible and meets the overall goals of the study, it was determined by the Corridor Study Team to be unreasonable due to the public concerns. Because it was determined to be feasible, it was combined with the tight urban diamond concept into a single alternative due to the common features and included in the evaluation in the following section as a means of comparison.

Comparison of Concepts from East of Lake Pine Drive to US 1

A summary of the concepts discussed above is shown in Table 3.7. Each of the three concepts that were considered to be feasible were compared across the following attributes:

- Aesthetics
- Noise
- Community Preservation
- Scale/Footprint (property required to construct concept)
- Cross Connectivity
- Access
- Safety
- Bicycle/Pedestrian
- Construction Cost
- Traffic Operations

The table provides a description of the potential benefits and potential limitations for each concept, as well as a qualitative rating for how well it addresses each individual attribute. The qualitative rating system includes the following measures:

★★★★★ - Favorable
★★★★ - Slightly Favorable
★★★ - Average
★★ - Slightly Unfavorable
★ - Unfavorable

It should also be noted that these qualitative evaluations are for each individual attribute and that the weight of each of the attributes is not equal. Different individuals are likely to prioritize certain attributes higher than other individuals would. For example, a property owner who lives in close proximity to US 64 may prioritize noise with much greater weight, while a commuter may prioritize traffic operations. The challenge in evaluating the concepts and developing a solution is that a balanced approach must be taken as no one concept is superior for all attributes. When applied to the US 64 corridor, it is important that the individual context for each location be considered when evaluating the potential options.

Table 3.7: Comparison of Concepts from East of Lake Pine Drive to US 1

Concept Type		Short-term Solution with Widening	Parallel Frontage Road Concept	Freeway with Urban Interchanges
Aesthetics		★★★★	★	★
	Potential Benefits	Most similar to the existing roadway	Aesthetics treatments could be incorporated in design	Aesthetics treatments could be incorporated in design
	Potential Limitations	May result in some trees being removed	Includes substantial change in elevation of US 64	Includes substantial change in elevation of US 64
Noise		★★★★	★	★★
	Potential Benefits	Construction will not increase elevation of roadway	Noise walls may be provided to reduce noise impacts	Noise walls may reduce noise impacts and smaller footprint moves noise further away
	Potential Limitations	May remove some trees and noise walls not likely to be provided	Increased elevation may increase noise impacts	Increased elevation may increase noise impacts
Community Preservation		★★★★	★★	★
	Potential Benefits	Maintains the existing access with some re-routing of traffic	Provides for access to all existing access points	Maintains existing access with substantial re-routing of traffic
	Potential Limitations	Cross access and minor street access is reduced	Scale may have negative effect on community	Scale may have negative effect on community
Scale/ Footprint		★★★★	★	★★★★★
	Potential Benefits	Compact footprint will likely fit within existing right-of-way	None	Narrower footprint than Frontage Road concept
	Potential Limitations	Wider than the existing roadway	Substantially wider footprint and increased elevation of roadway	Wider footprint than existing and increased elevation of roadway
Cross Connectivity		★	★★★★	★★
	Potential Benefits	None	Provides cross access except at Gregson Drive	Provides grade separated crossings at minor streets
	Potential Limitations	Does not provide direct cross connectivity	Does not provide cross access at Gregson Drive	Only provides direct cross access to US 64 at Gregson Drive
Access		★★★★	★★★★	★
	Potential Benefits	Provides access to all existing roadways	Provides access to all locations with minor re-routing of traffic	Provides access to all locations with re-routing of traffic
	Potential Limitations	Re-routes minor street through and left turn movements	Re-routes left turn to and from Gregson Drive	Re-routes traffic substantially from existing routes
Safety		★★★	★★★★	★★★★
	Potential Benefits	Reduces conflict points from existing configuration	Reduces conflict points substantially	Reduces conflict points substantially
	Potential Limitations	Signalized intersections still create moderate number of conflict points	None	None
Bicycle/ Pedestrian		★★	★★★★★	★★★★★
	Potential Benefits	Provides crossing without direct vehicle conflicts	Provides safe crossings and separates out through movements	Provides safe crossings and separates out through movements
	Potential Limitations	Two-stage crossing and does not separate through traffic. Concerns with bicycles	None	None
Construction Cost		★★★★★	★	★★
	Potential Benefits	Low cost solution	None	None
	Potential Limitations	None	High cost due to compact footprint	High cost due to compact footprint
Traffic Operations		★★	★★★★★	★★★
	Potential Benefits	Improves traffic operations over existing configuration	Improves traffic operations substantially	Improves US 64 operations substantially, but increase traffic on parallel routes
	Potential Limitations	Limited by capacity of signalized intersections	None	Parallel routes may become overloaded

Based on the comparison in Table 3.7 and the discussion above, the Corridor Study Team determined that the recommended long-term solution for the section of US 64 from east of Lake Pine Drive to US 1 would be the short-term solution with widening to six through lanes (three in each direction) on US 64. The Corridor Study Team still had some concerns with the ability of the recommended solution to accommodate the future traffic volumes and determined that, in the event the Recommended Long-term Solution is not able to operate at an acceptable level in the future additional studies will be undertaken to determine the appropriate solution.

3.4.6 Determination of Final Draft Long-term Solution Recommendations

The results of the long-term corridor evaluation for the intersections within Wake County were presented to a select group of stakeholders at the Stakeholder Meeting held on October 22, 2009 for review and comment. Comments on the long-term solution included the following:

- Implement the recommended design at Laura Duncan Road and Lake Pine Drive
- Ensure improved pedestrian walkability for crossing US 64, especially to businesses
- Do not focus on through mobility at the expense of local access
- Maintain medians for safety and aesthetics
- Re-open Fern Valley Lane access point as full movement intersection
- Add additional through lanes to US 64 in the median from Autopark Boulevard to US 1 and maintain traditional intersections instead of a superstreet
- Do not implement the superstreet at Edinburgh Drive
- Lower speed limit to 45 miles per hour east of railroad bridges
- Hold off implementing Superstreets as long as possible
- Make Gregson a superstreet with indirect left turns to minimize pavement
- Consider the superstreet and aesthetics as it relates to community feel and look
- Safety is more important than mobility and should be the primary concern
- Look at parallel routes to US 64 and improve them to increase safety
- Sign US 64 along US 1 and NC 540 and convert existing roadway to US 64 Business/Tryon Road
- Lower speed limit to 45 miles per hour east of Kellyridge Road and include design features that signal to the driver that the context of the corridor has changed
-
- Consider a pedestrian bridge for future greenway at Mackenan/Chalon
- Consider a ramp from US 1 directly into the back side of the MacGregor office park
- Design aesthetically pleasing structures for the long-term solution
- Further consider transit and other options for the long-term solution

Based on the comments and discussion at the Stakeholders Workshop, the Corridor Study Team met and developed the Draft Final Recommendations for the Long-term Solution. The only design change that was implemented following the Stakeholder Meeting was to remove the connection to NC 55 via Thorn Hollow and include a new connection to Old Jenks Road by extending Sandy Hill Court as is shown in the Apex Transportation Plan. In addition to the new connection to Old Jenks Road, the Corridor Study Team decided to extend the westbound C-D roadway further east and maintain the existing connection to Fern Valley Lane as a right-in/right-out intersection onto the C-D.

3.4.6.1 Summary of Final Draft Long-term Solution Recommendations

A summary of the Final Draft Long-term Solution Recommendations is included in Table 3.8.

Table 3.8: Final Draft Long-term Solution Recommendations

Intersection/Interchange	Final Draft Long-term Solution
Firefox Trace	Access Closed and new roadway constructed to provide access to Hanks Chapel Road and US 64 Business
Mt. Gilead Church/Pea Ridge Road	Compact Diamond Interchange
Big Woods/Seaforth Road	Partial Cloverleaf Interchange with ramps and loops on west side of Big Woods/Seaforth Road
Farrington/Beaver Creek Road	Compact Diamond Interchange
NC 751/New Hill Road	Tight Diamond Interchange with US 64 relocated to the north
Jenks Road	Partial Cloverleaf Interchange with loop in southwest quadrant
Kellyridge Road	Right-in/Right-out connecting to eastbound collector-distributor road
Kelly Road	Configuration constructed as part of NC 540 project with revised connections to collector-distributor roads in both directions along US 64
NC 540	Configuration constructed as part of NC 540 project with revised connections to collector-distributor roads in both directions along US 64
Green Level Church Road	Configuration constructed as part of NC 540 project with revised connections to westbound collector-distributor road
NC 55	Improvements to NC 55, new bridge over US 64, improvements to US 64 ramps and connects to westbound collector-distributor road
Fern Valley Lane	Right-in/Right-out connecting to westbound collector-distributor road and new connection to Old Jenks Road by extending Sandy Hill Court
Davis Drive	Improvements to Davis Drive and US 64 Ramps
Laura Duncan Road	No change from Short-term (Tight Interchange)
Knollwood Drive	Right-in/Right-out subject to interchange design at Laura Duncan Road and Lake Pine Drive
Lake Pine Drive	Tight Interchange with modern roundabout configuration preferred
Autopark Boulevard	6-lane US 64 and Left-in/Right-in/Right-out
Mackenan/Chalon	6-lane US 64 and Superstreet with Direct Major Street Left Turn with U-turn to eastbound US 64 at Autopark Boulevard
Gregson Drive	6-lane US 64 and Superstreet with Direct Major Street Left Turn
Edinburgh Drive	6-lane US 64 and Superstreet with Direct Major Street Left Turn
US 1 Interchange	No change from existing configuration except for additional lane on ramp from US 1/64 Southbound

The detailed design of the Final Draft Long-term Solution Recommendations is presented in Section 3.6. In addition to the detailed recommendations on the design of the long-term solution, recommendations are being made for the corridor by the Corridor Study Team and are included in Section 4.2.4.

3.4.7 Long-term Solution Traffic Volumes and Traffic Operations

3.4.7.1 Future Traffic Volume Projections

The determination of the future traffic volumes for the Final Draft Long-term Solution Recommendations in 2035 were developed by using the Triangle Regional Travel Demand Model and the data collected for the 2007 existing conditions. The proposed changes to US 64 were included in the travel demand model, including upgrading portions of the corridor to a freeway and included each of the proposed interchanges. The model results showed an increase in traffic volumes for the 2035 Long-term Solution Build versus the 2035 No-Build volumes presented in Section 2.3.2. The reason for the increase in volumes for the build alternative, is due to the facility having adequate capacity to allow for traffic to flow more freely. The 2035 No-Build volumes showed that the US 64 corridor would have a substantial level of congestion, causing drivers to take alternate routes. For the 2035 Build scenario those vehicles that originally would have taken US 64, but were diverted, return to their natural path along US 64, thus increasing the traffic volumes. A summary of the 2035 Long-term Solution traffic volumes for each of the major roadways along the corridor is shown in Figure 3.12.

3.4.7.2 Long-term Solution Level of Service

The analysis of traffic operations for the long-term solution included evaluating the LOS for the unsignalized and signalized intersections, as well as for the freeway elements of the design. The LOS for freeway elements includes; basic freeway segments, which are the area of freeway between interchanges; ramp junctions, which are the point where ramps tie to the freeway; and weaving segments, which are where two or more traffic streams are required to cross each other along a freeway. The LOS is defined with letter designations from A to F as shown in Table 3.9. LOS A represents the best operating conditions along a road or at an intersection, while LOS F represents the worst conditions. The LOS results for the long-term solution are shown on Figure 3.13 and in Table 3.10.

Table 3.9: Level of Service Definitions

Level of Service	Signalized Intersections	Road Segment/Ramps
A	Very low delay (<10.0 seconds per vehicle). Most vehicles do not have to stop at all.	Free flow. Individuals are unaffected by other vehicles and operations are constrained only by roadway geometry and driver preferences. Maneuverability is good. Comfort level and convenience are excellent.
B	10.0-20.0 second delay. Good progression and short cycle length.	Free flow, but the presence of other vehicles begins to be noticeable. Average travel speeds are the same as in LOS A, but there is a slight decline in freedom to maneuver and level of comfort.
C	20.1 to 35.0 second delay. Fair progression and/or longer cycles. The number of vehicles stopping is significant.	Influence of traffic density on operations becomes marked. The ability to maneuver within the traffic stream is clearly affected by other vehicles. Minor disruptions can cause serious local deteriorations and queues will form behind any significant traffic disruption.
D	35.1 to 55.0 second delay. Many vehicles stop. Individual cycle failures are noticeable.	The ability to maneuver is severely restricted due to traffic congestion. Travel speed is reduced by the increasing volume. Only minor disruptions can be absorbed without extensive queues forming and service deteriorating.
E	55.1 to 80.0 second delay. Individual cycle failures are frequent.	Operating conditions at or near the capacity level, usually unstable. Vehicles are operating with the minimum spacing for maintaining uniform flow. Disruptions cannot be dissipated readily.
F	Delay in excess of 80.0 seconds. Considered unacceptable to most drivers.	Breakdown flow. Traffic is over capacity at points. Queues form behind such locations, which are characterized by extremely unstable stop-and-go waves. Travel speed within queues are generally less than 30 mph.

Figure 3.12: 2035 Long-term Solution Daily Traffic Volumes

LEGEND

2035 Long-term Solution Daily Traffic Volumes

2035

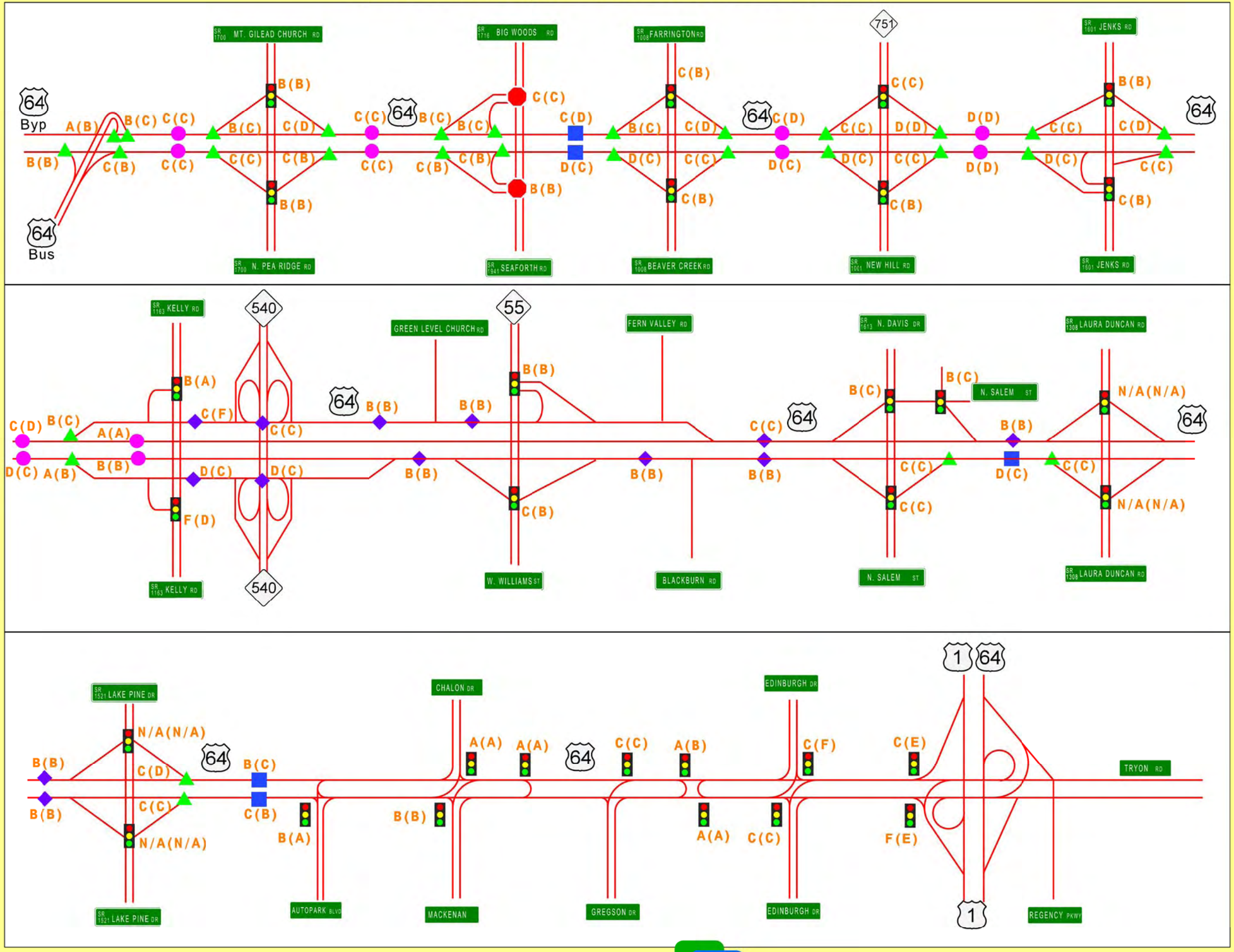
Long-term Solution Design

2035 Long-term Solution

Daily Traffic Volumes

US 64 Corridor Study
Wake & Chatham Counties

Figure 3.13: 2035 Long-term Solution Level of Service Summary



LEGEND

- Basic Freeway Segment
- Freeway Ramp Junction
- Freeway Weaving Segment
- Multilane Highway Segment
- Unsignalized Intersection
- Signalized Intersection
- C(C) Level of Service - AM(PM)

Long-term Solution
2035 Build

Level of Service

US 64 Corridor Study
Wake & Chatham Counties

Table 3.10: Long-term Solution Level of Service Summary

Basic Freeway Segments	2035 Long-term Solution AM/PM Peak Hour LOS
US 64 EB - US 64 Business to Mt. Gilead Church Road	C/C
US 64 WB - Mt. Gilead Church Road to US 64 Business	C/C
US 64 EB - Mt. Gilead Church Road to Big Woods Road	C/C
US 64 WB - Big Woods Road to Mt. Gilead Church Road	C/C
US 64 EB - Farrington Road to NC 751	D/C
US 64 WB - NC 751 to Farrington Road	C/D
US 64 EB - NC 751 to Jenks Road	D/D
US 64 WB - Jenks Road to NC 751	D/D
US 64 EB - Jenks Road to NC 540 C/D Roadway	D/C
US 64 WB - NC 540 C/D Roadway to Jenks Road	C/D
US 64 EB - Within the NC 540 C/D Roadway	B/B
US 64 WB -Within the NC 540 C/D Roadway	A/A
US 64 EB - Exit to US 64 Business	B/B
US 64 EB - Enter from US 64 Business	C/B
US 64 WB - Enter from US 64 Business	A/B
US 64 WB - Exit to US 64 Business	B/C
US 64 EB - Exit to Mt. Gilead Church Road	C/C
US 64 EB - Enter from Mt. Gilead Church Road	C/B
US 64 WB - Enter from Mt. Gilead Church Road	B/C
US 64 WB - Exit to Mt. Gilead Church Road	C/D
US 64 EB - Exit to Big Woods Road	C/B
US 64 EB - Enter from Big Woods Road	C/B
US 64 WB - Enter from Big Woods Road	B/C
US 64 WB - Exit to Big Woods Road	B/C
US 64 EB - Exit to Farrington Road	D/C
US 64 EB - Enter from Farrington Road	C/C
US 64 WB - Enter from Farrington Road	B/C
US 64 WB - Exit to Farrington Road	C/D
US 64 EB - Exit to NC 751	D/C
US 64 EB - Enter from NC 751	C/C
US 64 WB - Enter from NC 751	C/C
US 64 WB - Exit to NC 751	D/D
US 64 EB - Exit to Jenks Road	D/C
US 64 EB - Enter from Jenks Road	C/C
US 64 WB - Enter from Jenks Road	C/C
US 64 WB - Exit to Jenks Road	C/D
US 64 EB - Exit to NC 540 C/D Roadway	B/A
US 64 WB - Enter from NC 540 C/D Roadway	A/B
US 64 WB C/D Roadway - Exit to NC 55	B/C
US 64 EB - Enter from Davis Drive	C/C
US 64 EB - Exit to Laura Duncan Road	C/C
US 64 EB - Enter from Lake Pine Drive	C/C
US 64 WB - Exit to Lake Pine Drive	C/D
Freeway Weaving Sections	**2035 Long-term Solution AM/PM Peak Hour LOS**
US 64 EB C/D Roadway - Kelly Road to NC 540	D/C
US 64 WB C/D Roadway - NC 540 to Kelly Road	C/F
US 64 EB C/D Roadway - NC 540 Loops	D/C
US 64 WB C/D Roadway - NC 540 Loops	C/C
US 64 WB C/D Roadway - Green Level Church Road to NC 540	B/B
US 64 EB - NC 540 C/D Roadway to NC 55	B/B
US 64 WB C/D Roadway - NC 55 to Green Level Church Road	B/B
US 64 EB - NC 55 to Blackburn Road	B/B
US 64 WB - Davis Drive to NC 540 C/D Roadway	C/C
US 64 EB - Blackburn Road to Davis Drive	B/B
US 64 WB - Laura Duncan Road to N. Salem Street/Davis Drive	B/B
US 64 EB - Laura Duncan Road to Lake Pine Drive	B/B
US 64 WB - Lake Pine Drive to Laura Duncan Road	B/B
Multilane Roadways	**2035 Long-term Solution AM/PM Peak Hour LOS**
US 64 EB - Across Jordan Lake	D/C
US 64 WB - Across Jordan Lake	C/D
US 64 EB - Davis Drive to Laura Duncan Road	D/C
US 64 EB - Lake Pine Drive to Autopark Boulevard	C/B
US 64 WB - Autopark Boulevard to Lake Pine Drive	B/C
Signalized Intersections	**2035 Long-term Solution AM/PM Peak Hour LOS**
US 64 EB Ramps at Mt. Gilead Church Road	B/B
US 64 WB Ramps at Mt. Gilead Church Road	B/B
US 64 EB Ramps at Farrington Road	C/B
US 64 WB Ramps at Farrington Road	C/B
US 64 EB Ramps at NC 751	C/B
US 64 WB Ramps at NC 751	C/C
US 64 EB Exit/Entrance Ramps at Jenks Road	C/B
US 64 WB Ramps at Jenks Road	B/B
US 64 EB Kelly Road Ramp at Kelly Road	F/D
US 64 WB Kelly Road Ramp at Kelly Road	B/A
US 64 EB Ramps at NC 55	C/B
US 64 WB Ramps at NC 55	B/B

Table Continued on Page 70

US 64 EB Ramps at Davis Drive	C/C
US 64 WB Ramp/N. Salem Street at Davis Drive	B/C
US 64 WB Ramp at N. Salem Street	B/C
US 64 EB at AutoPark Boulevard	B/A
US 64 EB at Mackenan/Chalon Drive	B/B
US 64 WB at Mackenan/Chalon Drive	A/A
US 64 U-turn East of Mackenan/Chalon Drive	A/A
US 64 EB at Gregson Drive	C/C
US 64 U-turn East of Gregson Drive	A/B
US 64 U-turn West of Edinburgh Drive	A/A
US 64 EB at Edinburgh Drive	C/C
US 64 WB at Edinburgh Drive	C/F
US 64 EB at US 1 SB Ramp	F/E
US 64 WB at US 1/64 SB Ramp	C/E

The analysis indicates that all basic freeway segments, ramp junctions, and multi-lane segments, as well as a majority of the freeway weaving sections and signalized intersections are projected to operate at an acceptable LOS D or better in 2035. The following locations will not have a LOS of D or better in 2035:

- Kelly Road - One weaving section and one signalized intersection are projected to operate at LOS F in 2035. The North Carolina Turnpike Authority is evaluating potential solutions at this location that may be implemented in the future, as needed, to improve the operations at this location.

- Edinburgh Drive - One signalized intersection at this location is projected to operate at LOS F in 2035. The ability to improve this intersection to an acceptable level in the future would likely require grade separation and was not considered reasonable at this time.

- US 1 Interchange - Both of the signalized intersections at the US 1 southbound ramps are projected to operate at LOS E or F in 2035. It is likely that US 1, south of US 64 will require widening in the future and improvements to the US 64 interchange should be evaluated at that time to improve traffic operations.

An additional measure to show the traffic operations along the corridor is through the use of travel time. Table 3.11 shows the approximate travel time for the 19-mile US 64 corridor from the US 64 Bypass west of Pittsboro to the US 1 interchange in Cary for each direction of US 64 in the AM and PM peak periods for the 2007 existing timeframe, the 2035 No-Build scenario, the 2025 Short-term scenario and the 2035 Long-term scenario.

Table 3.11: Travel Time Summary

Roadway	2007 Existing AM/PM Travel Time	2035 No-Build AM/PM Travel Time	2025 Short-term AM/PM Travel Time	2035 Long-term AM/PM Travel Time
US 64 Eastbound	29 /26 minutes	54 /40 minutes	39/31 minutes	20/20 minutes
US 64 Westbound	27 /27 minutes	39 /51 minutes	28/36 minutes	20/23 minutes

Based on Table 3.11, it is shown that the Short-term and Long-term Solutions improve the mobility of the US 64 to a substantial degree. The implementation of the Short-term solution will provide immediate benefits by reducing the delay along the US 64 corridor. The 2025 travel time for the corridor is slightly longer than the 2007 existing conditions, but shows an improvement over the 2035 No-Build conditions. For the 2035 Long-term Solution, the implementation of the recommendations is projected to reduce the travel time along US 64 by as much as 34 minutes over the 2035 No-Build scenario.

3.4.8 Long-term Solution Concerns and Unresolved Issues

The concerns with the long-term solution that were provided by the public have been considered and accommodated in the recommendations above to the greatest extent possible. It is understood that not all comments and concerns could be completely addressed by the design. The determination of the recommended alternative was based on balancing the effects, both positive and negative, at each intersection along the corridor to provide a solution that would best address the needs of those both using and living around the corridor.

There were some concerns that were raised as a part of the public involvement process that could not be addressed in this study or included in the long-term solution, including the flowing:

- A new interchange was requested along US 1 between US 64 and Ten-Ten Road to provide additional access to the MacGregor Office Park. This recommendation was evaluated by the Corridor Study Team and determined to not be reasonable because providing the interchange would require either a C-D roadway or braided ramps (grade separation of on ramps from one interchange with off ramps from other interchange) which would have substantial negative impacts to MacGregor Downs Subdivision, the MacGregor Office Park and Waterford Green Subdivision and require the reconstruction of the US 64 interchange at US 1.

- Construction of a pedestrian bridge over US 64 at Laura Duncan Road was requested in some comments. The Corridor Study Team evaluated this recommendation and determined that the pedestrian bridge would not be a cost effective measure for improving the pedestrian crossing based on the limited funding available and recommended that the interchange be constructed as soon as possible to improve the safety at this location. If there are expansion plans developed for Apex High School, improved pedestrian amenities, including a pedestrian bridge, should be evaluated as a part of the expansion.

- It was recommended that either no improvements be made or that traditional widening to six-lanes be implemented from US 1 to Autopark Boulevard. The Corridor Study Team evaluated this recommendation and determined that the congestion and delays for these scenarios would not be reasonable for the US 64 corridor.

There were still some items that remain unresolved with regard to the long-term solution and will require additional analysis to determine the best way to address these concerns. The additional analysis of the following concerns is needed prior to implementing the long-term solutions but is considered outside the scope of this study.

- The interchange configurations at the intersections with Laura Duncan Road and Lake Pine Drive will need additional analysis and evaluation prior to determining the recommended configurations at these locations, although the modern roundabout design is the preferred design based on initial evaluation and community input.

- The determination of a safe method of travel for advanced bicyclists at the superstreet configuration is needed. It is understood that advanced bicyclists do not desire to dismount their bicycle and act as pedestrians at the superstreet intersection, which is the preferred method for crossing at a superstreet intersection. There needs to be additional evaluation of the superstreet concept to determine how to best allow bicyclists to act as vehicles and navigate the configuration in a safe manner.

- The determination of a method for crossing US 64 for the future Swift Creek Greenway in the vicinity of Mackenan Drive/Chalon Drive is needed. A grade separated pedestrian crossing should be studied at this location as a part of the planning and design for the greenway.