

**GLEN LENNOX REDEVELOPMENT
TRAFFIC IMPACT STUDY**

EXECUTIVE SUMMARY



Prepared for:

The Town of Chapel Hill
Engineering Department

Prepared by:

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NCBELS License #: C-1554

October 2013

HNTB

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MIXED-USE REDEVELOPMENT
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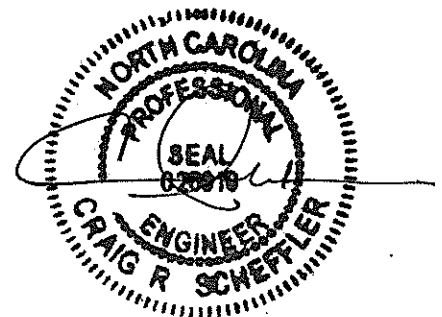
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Project Overview

A redevelopment of the existing Glen Lennox neighborhood in Chapel Hill, located along NC 54 (Raleigh Road) and US 15-501 (Fordham Boulevard), is being proposed by Grubb Properties. **Figure ES-1** shows the general location of the site, which currently comprises approximately 400 acres of development. The project is to be constructed in phases over a 20 year projected time frame. This report analyzes three phased build-out scenarios for the years 2018, 2023 and 2028, the no-build scenario for those three years, as well as 2013 base year traffic conditions.



The proposed site concept plan maintains four existing access points to NC 54 (Raleigh Road), a new access connection along US 15-501, and the existing access point on US 15-501 at Brandon Road. All local street access to the north and east is proposed to remain the same as current conditions. The plans also propose additional internal circulation streets that would provide connectivity to surface parking lots and structured parking that are similar to the existing roadway network within the Glen Lennox property. **Figure ES-2** displays the preliminary concept plan of Glen Lennox and nearby land uses and roadways.

Existing Conditions

Study Area

The site is located in the eastern portion of Chapel Hill with frontage along US 15-501 (Fordham Boulevard) and NC 54 (Raleigh Road). The study area contains all major signalized intersections along US 15-501 (Fordham Boulevard) from Manning Drive to Ephesus Church Road and along NC 54 (Raleigh Road) from South Drive/Country Club Road to E. Barbee Chapel Road. It also includes two intersections along Estes Drive west of US 15-501 and several local intersections in the vicinity of neighborhoods surrounding Glen Lennox to the north and east. 15 of the 30 existing study area intersections are currently signalized and the remaining intersections are either two-way or four-way stop-controlled or yield-controlled.

Site traffic is primarily expected to use either the major existing access points along NC 54 (Raleigh Road) or the new proposed access point along US 15-501. Consideration was made for a small percentage of site traffic to utilize local streets from the neighborhoods surrounding Glen Lennox. Existing internal local streets are expected to remain part of the development plan and provide access to the commercial and residential land uses and parking areas.

US 15-501 (Fordham Boulevard) and NC 54 (Raleigh Road) are major principal arterials providing connectivity between downtown Chapel Hill, the UNC Main Campus, the I-40 corridor and other areas of Chapel Hill. The remaining study area network roadways are either minor arterial facilities providing connectivity throughout Chapel Hill, suburban collector streets or local neighborhood/commercial access streets.



Site Traffic Generation

With the addition of new peak hour trips during the weekday AM, noon, and PM peak hours, there are potential site traffic impacts to the study area transportation system. Appropriate reductions for internally captured trips (between land uses within the Glen Lennox Redevelopment site), and “pass-by” type trips for the retail component of the redevelopment were assumed to occur, given the nature of the proposed land uses that comprise the Glen Lennox redevelopment plan. Internal capture trip rates, by redevelopment phase, are summarized in **Table ES-1**. Trip reductions for the effects of transit were also included for this study, using ITE methodologies, existing data from Chapel Hill Transit, and data from the Transportation Research Board (TRB) Transit Cooperative Research Program (TCRP) *Report 128 – Effects of Transit-Oriented Development on Housing, Parking, and Travel* (Arrington and Cervero, 2008). **Table ES-2** highlights projected transit trip estimates for each redevelopment phase using the methodologies listed above. **Table ES-3** shows site trip generation details, with rates taken from the *ITE Trip Generation Manual, Volume 9* and adjusted for the internal and transit trip reductions. The table lists total driveway trips, which include pass-by trip estimates, and total trips added to the study area network (where the pass-by trips do not have an effect).

Table ES-1. Summary Internal Capture Rates By Redevelopment Phase

Phase	Daily Trips*	AM Peak Hour	Noon Peak Hour	PM Peak Hour
1	10%*	9%	22%	26%
2	10%*	6%	14%	12%
3	10%*	10%#	10%#	10%#
Composite Total	10%*	7%	16%	18%

* - No Specific ITE Calculation Available for Daily Trips

- Phase 3 Has Only One Land Use, but was assumed to contribute to overall internal trips

Table ES-2. Total Transit Trip Generation Estimates By Phase

Phase	Daily Ridership			AM Peak Hour Trips			Noon Peak Hr Trips			PM Peak Hour Trips		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
1	542	542	1,083	46	37	83	24	24	48	60	68	128
2	990	990	1,980	114	53	166	28	28	57	63	112	175
3	392	392	783	8	31	39	10	12	22	32	17	49
SUM	1,923	1,923	3,847	167	121	288	62	65	127	155	197	352

Background Traffic

Background traffic growth for the future 2018, 2023, and 2028 analysis years is expected to be a combination of ambient regional traffic growth and specific development-related traffic growth. With numerous on-going and planned development sites located in or near the large project study area for Glen Lennox, and varying time frames for completion of specific projects, background traffic for the three analysis years was estimated through the use of the latest version of the Triangle Region Travel Demand Model (TRM). The TRM utilizes estimates of existing and future socio-economic data (dwelling units, employment) to generate, distribute and assign traffic flows throughout the region. Comparisons of base year (2010) and future year (2040) model results allow a composite calculation of per-year background traffic growth specific to the Glen Lennox project study area. This growth rate is estimated to be approximately 1.4 percent per year and was applied to initial estimates of 2018, 2023, and 2028 peak hour traffic volumes.



Table ES-3.
Weekday Peak Hour Vehicle Trip Generation Summary
Glen Lennox Redevelopment

Total External Vehicle Trips (Driveway Volumes)

Phase	24 Hour Volumes			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
1	5,100	5,100	10,200	268	178	445	265	252	518	288	324	612
2	3,664	3,664	7,328	630	224	855	301	294	594	260	601	861
3	886	886	1,772	24	131	155	89	111	200	130	64	195
TOTALS	9,651	9,651	19,300	923	533	1,455	655	656	1,312	678	989	1,668

Total External Vehicle Trips Added to Adjacent Streets

Phase	24 Hour Volumes			AM Peak Hour Trips			Noon Peak Hour Trips			PM Peak Hour Trips		
	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
1	4,013	4,013	8,026	268	178	445	221	208	430	241	277	516
2	3,379	3,379	6,759	630	224	855	288	281	568	242	583	825
3	886	886	1,772	24	131	155	89	111	200	130	64	195
TOTALS	8,279	8,279	16,557	923	533	1,455	598	599	1,198	613	924	1,536



Impact Analysis

Peak Hour Intersection Level of Service

Existing traffic operations at most study area intersections are acceptable during all three peak hours analyzed. The projected ambient and background development traffic growth will increase impacts for each successive analysis time period, necessitating mitigation recommendations at each build-out phase. To make consistent recommendations through the project redevelopment process, it was assumed that recommended mitigation improvement made for one analysis year would remain in place for the successive analysis years.

A summary of the traffic operations for each intersection, related to vehicular delays (overall intersection average if signalized, critical movement if stop-controlled) and the corresponding Level-of-Service (LOS) is shown in **Table ES-4** on the following page.

Access Analysis

Vehicular site access is to be accommodated by the proposed site driveway along US 15-501, existing site driveways and Hamilton Road along NC 54, and local street connections to neighborhoods to the north and east of the Glen Lennox site. Due to the need to maintain traffic flow (and improve congested conditions) along US 15-501, several modifications to full access points are recommended to convert the US 15-501 corridor to a superstreet design concept. In addition, high traffic volumes, and the number of conflict points with driveways and street connections on NC 54 along the Glen Lennox site frontage lead to the following recommendations: 1) close driveway access points, 2) provide adequate intersection capacity at the signalized NC 54/Hamilton Road intersection and 3) provide adequate traffic flow in the vicinity of the US 15-501 existing interchange ramps.

Access for pedestrians is currently adequate in the project study area. Sidewalks are present on both sides NC 54 (Raleigh Road) throughout the study area and connectivity is available on at least one side of the street along many facilities in the project study area that connect to the NC 54. US 15-501 has limited pedestrian facilities and access along site frontage, especially across US 15-501 between the NC 54 interchange and Estes Drive. Crosswalks do exist across US 15-501 at Estes Drive and along NC 54 below the US 15-501 (Fordham Boulevard) overpass. Most internal Glen Lennox streets and neighborhood streets connecting to Glen Lennox to the north and east have a sidewalk on at least one side of the street.

Access for bicyclists is currently adequate in the project study area, though several limitations exist due to the absence of bicycle provisions along the high volume NC 54 corridor. No specific bicycle amenities are present within the Glen Lennox site itself, though the low volume/low speed grid street network is not prohibitive to cycling activities. No details are shown on the Glen Lennox concept plans regarding external improvements for pedestrian or bicycle access to/from the site. All recommended roadway improvements to facility segments or intersections should make accommodations, where appropriate, to provide adequate access for non-motorized transportation.



Table ES-4. Glen Lennox Redevelopment Peak Hour LOS Summary

ID	Intersection Name	LOS			LOS For No-Build Scenario / Build Scenario / Mitigated Scenario								
		2013 Existing Conditions			2018 Analysis Year			2023 Analysis Year			2028 Analysis Year		
		AM	Noon	PM	AM	Noon	PM	AM	Noon	PM	AM	Noon	PM
1	US 15-501 Bypass (Fordham Blvd) & Ephesus Church Road	D	D	D	D/D/-	D/D/-	D/D/-	D/D/-	D/D/-	D/D/-	D/D/D	D/D/D	E/E/D
2	US 15-501 Bypass (Fordham Blvd) & Elliot Road	B	C	B	A/A/-	B/B/-	B/B/-	C/C/-	C/C/-	C/C/-	C/C/-	C/C/-	C/C/-
3	US 15-501 Bypass (Fordham Blvd) & Willow Drive	B	C	C	B/B/-	C/C/-	B/B/-	B/B/-	C/C/-	C/C/-	B/B/-	C/C/-	C/C/-
4	US 15-501 Bypass (Fordham Blvd) & Estes Drive	C	C	C	C/C/-	C/C/-	C/C/-	C/C/-	C/C/-	C/D/-	C/C/-	C/C/-	D/D/-
5	US 15-501 Bypass (Fordham Blvd) & Cleland Road [@]	F	F	F	F/F/A	F/F/A	F/F/A	A/A/-	A/A/-	B/B/-	A/A/-	A/A/-	B/B/-
6	US 15-501 Bypass (Fordham Blvd) & Brandon Road [@]	E	F	E	F/F/A	F/F/A	F/F/A	A/A/-	A/A/-	B/B/-	A/A/-	A/A/-	B/B/-
7	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Rd) Interchange Ramps (North) [@]	D#	D#	F#	E# / F#/-	E# / F#/-	F# / F#/-	C/C/-	B/B/-	C/C/-	D/D/C%	B/B/B%	E/E/C%
8	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Rd) Interchange Ramps (South) [@]	C	C	D	C/C/-	C/C/-	D/D/-	C/C/-	C/C/-	E/E/-	C/C/-	C/C/-	F/F/-
9	US 15-501 / NC 54 Bypass (Fordham Blvd) & Old Mason Farm Road	F	D	E	F/F/D	D/D/B	D/D/B	E/E/C	B/C/C	B/C/C	E/E/C	C/C/C	D/D/B
10	US 15-501 / NC 54 Bypass (Fordham Blvd) & Manning Drive	E	C	D	D/D/B	C/C/B	D/D/C	B/B/-	B/B/-	C/C/-	C/C/-	B/B/-	D/D/-
11	South Road / Raleigh Road & Country Club Drive	C	D	D	D/D/-	D/D/-	D/D/-	D/D/-	D/D/-	D/D/-	D/D/-	D/D/-	D/D/-
12	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Road) Interchange Ramps (West) [@]	C	B	D	C/C/-	C/C/-	F/F/-	C/E/A	C/C/A	F/F/B	B/B/-	A/A/-	C/C/-
13	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Road) Interchange Ramps (East) [@]	C	B	C	C/C/-	C/B/-	C/C/-	C/C/-	B/C/-	C/C/-	C/C/-	C/C/-	C/C/-
14	NC 54 (Raleigh Road) & Glen Lennox Shopping Center Driveway #1 (Eastbound Left-Over) [@]	C	B	C	C/C/-	B/B/-	C/C/-	N/A	N/A	N/A	N/A	N/A	N/A
15	NC 54 (Raleigh Road) & Glen Lennox Shopping Center Driveway #2 (RIRO) [@]	B	B	B	C/C/-	B/B/-	B/C/-	C/C/-	C/C/-	C/C/-	C/D/-	C/C/-	C/D/-
16	NC 54 (Raleigh Rd) & Hamilton Road	C	B	C	C/C/-	B/C/-	C/C/-	C/E/D	C/C/C	C/E/D	D/D/-	C/C/-	D/D/-
17	NC 54 (Raleigh Road) & Audley Lane [@]	B	B	B	B/B/-	B/B/-	B/C/-	N/A	N/A	N/A	N/A	N/A	N/A
18	NC 54 (Raleigh Road) & Burning Tree Drive / Finley Golf Course Road	A	A	B	A/A/-	A/A/-	B/B/-	B/B/-	B/B/-	B/B/-	B/B/-	B/B/-	C/C/-
19	NC 54 (Raleigh Road) & W. Barbee Chapel Road	B	B	C	B/B/-	B/B/-	C/C/-	B/C/-	B/B/-	C/C/-	C/C/-	C/C/-	C/C/-
20	NC 54 (Raleigh Road) & Meadowmont Lane / Friday Center Drive	C	C	D	C/C/-	B/B/-	D/D/-	C/C/-	C/C/-	D/D/-	C/C/-	C/C/-	D/D/-
21	NC 54 (Raleigh Road) & E. Barbee Chapel Road / Barbee Chapel Road Extension	D	B	C	D/D/-	B/B/-	C/C/-	D/E/D	B/B/B	C/C/C	E/E/D	B/B/B	D/D/C
22	E. Franklin Street & Estes Drive	D	D	E	D/D/D	D/D/D	E/E/D	D/D/D	D/D/D	E/E/D	D/D/-	D/D/-	D/D/-
23	Willow Drive & Estes Drive	B	B	B	B/B/-	B/B/-	B/B/-	B/B/-	B/B/-	B/B/-	C/C/-	B/B/-	B/B/-
24	Cleland Road & Hayes Drive [@]	A	A	B	A/A/-	A/A/-	B/B/-	A/A/-	A/A/-	B/B/-	B/B/-	A/A/-	B/B/-
25	Cleland Road & Hamilton Road [@]	A	A	C	A/A/-	A/A/-	D/D/-	A/A/-	A/A/-	D/D/-	A/A/-	A/A/-	E/E/-
27	Cleland Drive & Burning Tree Drive [@]	A	A	A	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-
28	Pinehurst Drive & Burning Tree Drive [@]	B	A	B	B/B/-	A/A/-	B/B/-	B/B/-	B/B/-	B/B/-	B/B/-	B/B/-	B/B/-
29	Brandon Road & Hayes Road [@]	A	A	A	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-
30	Beckley Road & Oakwood Drive [@]	A	A	A	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-
31	US 15-501 Bypass (Fordham Boulevard) & Proposed Site Entrance	N/A	N/A	N/A	N/A/A/A	N/A/A/A	N/A/A/A	A/A/-	A/A/-	A/B/-	A/A/-	A/A/-	B/B/-
91	US 15-501 Bypass (Fordham Boulevard) & Median U-Turn #1	N/A	N/A	N/A	N/A/N/A/C	N/A/N/A/A	N/A/N/A/A	C/D/-	A/A/-	A/A/-	E/E/B	A/A/A	B/B/B
92	US 15-501 Bypass (Fordham Boulevard) & Median U-Turn #2	N/A	N/A	N/A	N/A/N/A/A	N/A/N/A/A	N/A/N/A/A	A/B/-	A/A/-	A/B/-	A/A/-	A/A/-	B/B/-
61	US 15-501 Bypass (Fordham Boulevard) & Median U-Turn #3	N/A	N/A	N/A	N/A/N/A/A	N/A/N/A/A	N/A/N/A/A	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-	A/A/-

N/A – Not Applicable, i.e. movement is non-existent or no improvements made
% - LOS For Downstream Weaving Segment on US 15-501 Southbound
@ - Unsignalized Intersection, LOS/Delay Values Correspond to Worst-Case Critical Movement

BOLD/ITALICS – Movement or Overall Intersection is over capacity as defined by Town of Chapel Hill TIS Standards
- Estimated LOS/Delay For Yield-Controlled Movement Based on HCM Stop-Controlled Methodology
% - LOS For Downstream Weaving Segment on US 15-501 Southbound
BLUE = New/Proposed Intersections



Signal Warrant Analysis

Based on projected Phase 1 - 2018 traffic volumes and current/proposed access plans, the only unsignalized intersections in the project study area that warrant the installation of a traffic signal, based on the peak hour warrant methodology found in the *2009 Manual on Uniform Traffic Control Devices (MUTCD)*, are the following intersections:

- US 15-501 (Fordham Boulevard) & Cleland Road
- US 15-501 (Fordham Boulevard) & Proposed Site Access Road
- US 15-501 (Fordham Boulevard) Southbound Off-Ramp & NC 54 (Raleigh Road) Eastbound

The Peak Hour signal warrant analysis is used as verification that projected traffic volumes meet peak hour warrants as a precursor to a more extensive analysis of conditions via additional data collection for 4-Hour and 8-Hour warrant analyses. Projected queue lengths for the US 15-501 southbound off-ramp intersection indicated that, though warranted in 2018, this intersection may not require signalization until 2023.

Crash Analysis

Data from the NCDOT Traffic Safety Unit was provided for the three-year period from 6/1/2010 to 5/31/2013 for segments of US 15-501 (Fordham Boulevard) and NC 54 (Raleigh Road) in the vicinity of the proposed site and for all existing major study area intersections. 77 crashes along the US 15-501 (Fordham Boulevard) study area corridor between Old Mason Farm Road and Cleland Road were reported over the three year period. 60 crashes were reported along NC 54 (Raleigh Road) between the US 15-501 interchange and Burning Tree Drive/Finley Golf Course Road. Primary crash types included rear end crashes, sideswipes, and left-turn crashes.

Overall, the number and severity of crashes along both the US 15-501 and NC 54 corridors in the project study area is lower than state-wide averages for similar facilities. Intersection crash data comparisons for all study area network roadways show the highest overall crash rates at intersections along US 15-501 north of Estes Drive and along Estes Drive at E. Franklin Street and Willow Drive.

Other Transportation-Related Analyses

Other transportation-related analyses relevant to the 2001 Town of Chapel Hill Guidelines for the preparation of Traffic Impact Studies were completed as appropriate. The topics listed in **Table ES-5** on the following page are germane to the scope of this study.

Mitigation Measures/Recommendations

Planned Improvements

The Town of Chapel Hill, in coordination with the North Carolina Department of Transportation, has two recently completed planning studies and an additional potential improvement project whose recommendations may impact study area facilities within the analysis time frame of 2013 to 2028.

- The 2011 *Ephesus Church Road/Fordham Boulevard Small Area Plan* has several intersection and local connectivity improvements that affect the study area intersections of US 15/501 with Ephesus Church Road and Elliott Road, including a new extension of Elliott Road to the east of US 15-501.



Table ES-5. Other Transportation-Related Analyses

Analysis	Comment
Generalized Daily V/C Analysis	<p>Daily Volume/Capacity Ratio analyses were conducted for existing year (2013 data) and 2040 Long Range Planning horizons (No-Build and Build). Existing roadway segment V/C's are acceptable throughout most of the study area. In 2040, multiple study area roadway segments approach or exceed their daily estimated model capacity. These include segments of US 15-501 between Manning Drive and Estes Drive as well as NC 54 between US 15-501 and E. Barbee Chapel Road.</p> <p>The 2040 TRM model used for the daily V/C analysis already includes growth in the traffic analysis zone (TAZ) where Glen Lennox development would be located. To account for future No-Build and Build conditions with the redevelopment scenario proposed in this study, the model growth estimates were removed from No-Build calculations, and daily traffic estimates from the redevelopment scenario were added to the No-Build condition and distributed through the study area network for the Build condition.</p>
Turn Lane Storage Requirements	Storage bay lengths at study area intersections were analyzed using Synchro and HCS 95 th percentile (max) queue length estimates for the Build Scenarios. Recommendations for improvements to storage bays were made in cases where intersections exhibited deficient peak hour LOS and required improvements to existing storage bay lengths. In some cases, new auxiliary lanes are proposed to either meet capacity needs or improve safety on major thoroughfares.
Appropriateness of Acceleration/Deceleration Lanes	The site concept plan shows no specifics related to acceleration/deceleration lanes. The capacity analyses conducted for the study include recommendations for right-turn deceleration lanes and auxiliary lanes where appropriate to provide additional capacity or improved weaving operations. No other specific acceleration/deceleration lane issues were analyzed in the project study area.
Sight Distance Analysis	In general, sight distance issues entering and exiting the Glen Lennox site would be minimal, considering the fact that both NC 54 and US 15-501 have no horizontal curvature in the vicinity of the proposed project, and vertical curvature is currently minimal.
Pedestrian and Bicycle Analysis	<p>Existing pedestrian and bicycle access and connectivity exists in the project study area but is limited in some areas. Sidewalks exist along several major thoroughfares and into several neighborhoods/commercial areas. Bicycle facilities are also present in some areas. Several crosswalks with pedestrian signals exist across NC 54 and US 15-501 and provide connectivity and access to the Glen Lennox site.</p> <p>To achieve the goals of current Town pedestrian and bicycle plans and standards, it is recommended that improvements to the NC 54 and US 15-501 corridors necessary for vehicular capacity also include sidewalk and bicycle amenities to connect to existing ped/bike facilities.</p>
Public Transportation Analysis	Public transportation service to the study area and proposed site is excellent. Additional study and coordination is necessary to implement additions and modifications to existing transit service to provide local and express bus service to/from Glen Lennox site, due to increased future demand.

- The 2010 *NC 54/I-40 Corridor Study – Transportation-Land Use Master Plan* includes a wide range of potential improvements to the NC 54 corridor in the project study area between the US 15-501 interchange and E. Barbee Chapel Road. These include intersection capacity improvements, conversion of specific sections to a superstreet concept, additional pedestrian and bicycle amenities, and transit route modifications.



- The NCDOT STIP U-5304 project is currently listed in the draft 2013-2023 STIP work program as being scheduled for a feasibility study of the US 15-501 (Fordham Boulevard) corridor from NC 86 (South Columbia Street) to Eastowne Drive/Lakeview Drive. Potential improvements along this six mile corridor may include a conversion of corridor segments to a superstreet concept with sidewalks, wide outside lanes and transit accommodations. In addition, a study of a potential interchange with Manning Drive and intersection improvements at Ephesus Church Road are listed as part of the project.

None of the potential improvements from the studies/projects listed above were considered to be constructed by a specific analysis year. However, if intersections in the project study area fell below acceptable operating thresholds for either No-Build or Build Scenarios for a given analysis year, recommendations from these planning studies were considered as a mitigation option on a case-by-case basis.

Background Committed Improvements

Per information from the Town of Chapel Hill, there are no specific committed background improvements expected to be completed by the 2018, 2023, or 2028 analysis years.

Applicant Committed Improvements

Based on the concept plan provided, there are no specific transportation-related improvements shown external to the site property, except for the delineation of a new full access connection to US 15-501 between the NC 54 interchange and Brandon Road. One of the purposes of this traffic impact study was to provide guidance in determining appropriate access strategies and intersection improvements for areas adjacent to the site, as well as determining site traffic impacts for the general project study area beyond the immediate Glen Lennox site parcel. The following Necessary Improvements section details recommended improvements to maintain adequate transportation operations within the project study area over the phased development process.

Necessary Improvements

Project Study Area Roadway Network Improvements

Based on traffic capacity analyses for the 2018, 2023, and 2028 analysis years, and analyses of existing study area turning bay storage lengths and site access, the following improvements, listed in **Table ES-6**, are recommended as being necessary for adequate transportation network operations for the specific analysis year scenarios. **Figure ES-3** displays recommended 2018 improvements. **Figure ES-4** displays recommended 2023 improvements. **Figure ES-5** displays recommended 2028 improvements. All improvements are based on the assumption that improvements recommended by a previous phase are in place by each successive analysis year.

Table ES-6 and the corresponding figures also detail improvements that are the responsibility of the Applicant. The delegation of responsibility is related to whether or not a recommended improvement directly involves access to the Glen Lennox site, along with whether or not the need for improvement is based on existing study area network deficiencies, or deficiencies that might arise in the future, whether or not the Glen Lennox site is redeveloped.



Transit Improvements

Based on preliminary trip generation and mode split data (see **Section II.C.ii.b** of this report for details), additional transit capacity will be necessary to accommodate projected transit ridership to/from the Glen Lennox Redevelopment.

Initial estimates of peak hour demand indicate that 288 AM peak hour, 127 noon peak hour and 352 PM peak hour trips (boardings or alightings) are estimated in the 2028 Phase 3 full build-out scenario. Given that fixed route service is provided through Glen Lennox on the G Route, with two AM, one noon, and two PM peak hour buses, and adjacent to Glen Lennox along NC 54 by the S and V Routes (eight AM and PM peak hour and three noon peak hour buses total), the total transit capacity provided by existing service may need to be increased to meet future demand. No specific analysis of existing available capacity was conducted for this study, so additional study is necessary to determine appropriate headway adjustments to these three routes once the redevelopment project proceeds.

To better accommodate transit operations along the high volume westbound NC 54 corridor, it is recommended that a bus pull-out area be constructed immediately to the west of the NC 54 intersection with Hamilton Road. Additional improvements for transit operations along US 15-501 may also be considered as part of the superstreet concepts recommended in this study.

Pedestrian and Bicycle Improvements

Improvements to pedestrian and bicycle facilities, as recommended in *the NC 54/I-40 Corridor Study*, should be implemented in coordination with proposed roadway improvements to NC 54 between the US 15-501 interchange and Hamilton Road as recommended in this analysis. This would include additional crosswalks, bicycle lane striping and modifications to existing bridge abutments under the US 15-501 overpass as displayed in the NC 54/I-40 Corridor Study.

Superstreet recommendations for the US 15-501 corridor made in this report should also include the provision for pedestrian signalization and crossings of US 15-501 at appropriate locations – particularly Manning Drive, Old Mason Farm Road, and at the proposed new site access location along US 15-501 south of Brandon Road.



Table ES-6. Recommended Improvements Matrix
(Refer to Figures ES-3, ES-4 and ES-5 for Additional Details)

ID	Intersection Name	Recommended Improvements		
		2018 Phase 1	2023 Phase 2	2028 Phase 3
1	US 15-501 Bypass (Fordham Blvd) & Ephesus Church Road	N/A	<ul style="list-style-type: none"> Modify Intersection Per 2020 SAP Plan Construct WB Dual LT Lanes with 250' storage Retime Signal 	<ul style="list-style-type: none"> Construct EB RT Lane with 150' Storage
2	US 15-501 Bypass (Fordham Blvd) & Elliot Road	N/A	<ul style="list-style-type: none"> Modify Intersection Per 2020 SAP Plan Construct New WB Elliot Drive Approach with Dual WB LT Lanes with 225' Storage, WB Through Lane, and WB RT Lane with 125' Storage Construct EB Elliot Drive RT Lane with 275' Storage 	N/A
4	US 15-501 Bypass (Fordham Blvd) & Estes Drive	<ul style="list-style-type: none"> Allow NB Left-Turn U-Turn Movements 	N/A	N/A
5	US 15-501 Bypass (Fordham Blvd) & Cleland Road	<ul style="list-style-type: none"> Construct Superstreet- Limit Side Streets to Right-Turns & Signalize Intersection Construct NB and SB Right-Turn Deceleration Lanes with 150' storage 	N/A	<ul style="list-style-type: none"> Extend SB LT Storage Bay to 300'
6	US 15-501 Bypass (Fordham Blvd) & Brandon Road	<ul style="list-style-type: none"> Construct Superstreet- Limit Side Streets to Right-Turns & Signalize Intersection Construct NB and SB Right-Turn Deceleration Lanes with 150' storage Extend Existing NB and SB Left-Turn Lanes for 250' storage 	N/A	N/A
7	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Rd) Interchange Ramps (North)	<ul style="list-style-type: none"> Construct 1,050' NB Auxiliary Lane From Existing On-Ramp to Proposed Site Access Driveway 	N/A	<ul style="list-style-type: none"> Remove Traffic Signal and Convert Dual EB RT Lanes to Single Free-Flow Add Lane
8	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Rd) Interchange Ramps (South)	N/A	N/A	<ul style="list-style-type: none"> Construct 3rd SB Through Lane on US 15-501, Provide SB RT Decel Lane onto Ramp with 250' Storage
9	US 15-501 / NC 54 Bypass (Fordham Blvd) & Old Mason Farm Road	<ul style="list-style-type: none"> Construct Superstreet- Remove all LT and Thru Movements 	<ul style="list-style-type: none"> Convert NB RT Lane to Thru/RT Lane and extend 3rd Through Lane to US 15-501 Interchange 	<ul style="list-style-type: none"> Construct 3rd SB Through Lane on US 15-501 and Convert SB RT Lane to Through/RT Lane
10	US 15-501 / NC 54 Bypass (Fordham Blvd) & Manning Drive	<ul style="list-style-type: none"> Construct Superstreet- Remove US 15-501 LTs and Manning Drive Through Movements Convert Existing Outside LT Lane to Through Lane to Drop at Downstream U-Turn Intersection (#91) 	N/A	N/A
12	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Road) Interchange Ramps (West)	N/A	<ul style="list-style-type: none"> Signalize NB Stop-Controlled Approach if Meets Signal Warrants 	N/A
13	US 15-501 Bypass (Fordham Blvd) & NC 54 (Raleigh Road) Interchange Ramps (East)	<ul style="list-style-type: none"> Construct EB Exclusive RT Deceleration Lane with 250' storage 	N/A	N/A
14	NC 54 (Raleigh Road) & Glen Lennox Shopping Center Driveway #1 (Eastbound Left-Over)	<ul style="list-style-type: none"> Close Access Point 	N/A	N/A
15	NC 54 (Raleigh Road) & Glen Lennox Shopping Center Driveway #2 (RIRO)	<ul style="list-style-type: none"> Construct RT Deceleration Lane with 150' storage 	N/A	N/A

N/A – Not Applicable, i.e. no recommended improvements for the intersection and scenario

RED – Necessary Improvements Required by Applicant



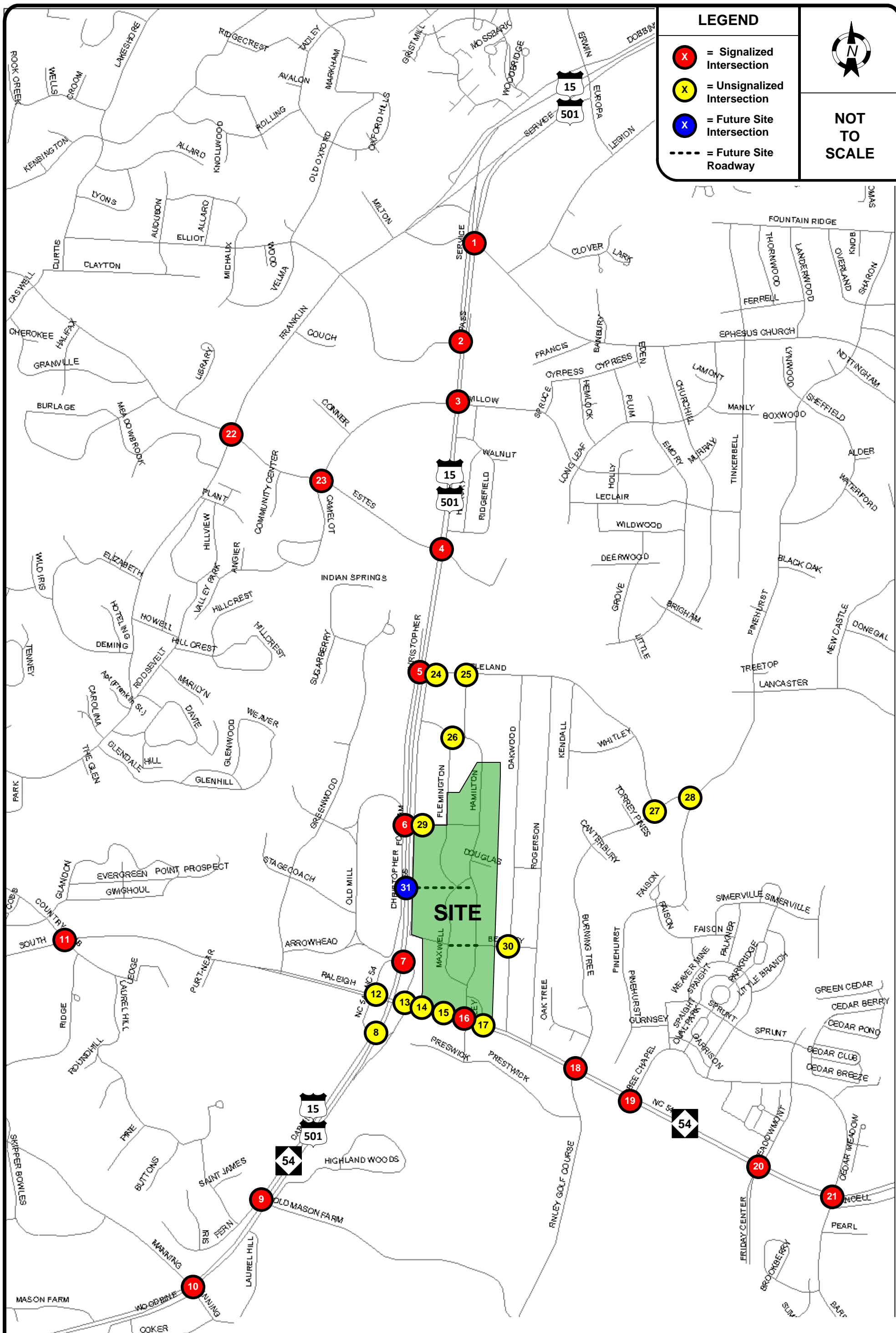
Table ES-6 (Continued). Recommended Improvements Matrix
(Refer to Figures ES-3, ES-4 and ES-5 for Additional Details)

ID	Intersection Name	Recommended Improvements		
		2018 Phase 1	2023 Phase 2	2028 Phase 3
16	NC 54 (Raleigh Rd) & Hamilton Road	<ul style="list-style-type: none"> Lengthen SB LT Storage to 250' minimum Construct WB RT Deceleration Lane with 250' storage Provide bus bay pullout on NC 54 Immediately West of Intersection 	<ul style="list-style-type: none"> Construct Dual SB LT Lanes with 350' Storage and Exclusive RT Lane Drop Lane Construct EB Dual Left-Turn Lanes with 300' Storage Provide Minimum 4-Lane Cross-Section on Hamilton Road into the Site 	N/A
17	NC 54 (Raleigh Road) & Audley Lane	<ul style="list-style-type: none"> Close Access Point 	N/A	N/A
20	NC 54 (Raleigh Road) & Meadowmont Lane / Friday Center Drive	N/A	<ul style="list-style-type: none"> Extend Marriott Way to Reduce Traffic Volumes Per NC 54/I-40 Corridor Study 	N/A
21	NC 54 (Raleigh Road) & E. Barbee Chapel Road / Barbee Chapel Road Extension	N/A	<ul style="list-style-type: none"> Extend Marriott Way to Reduce Traffic Volumes Per NC 54/I-40 Corridor Study 	<ul style="list-style-type: none"> Construct Additional NB LT Lane to Create Dual NB LT Lanes with 500' Storage
22	E. Franklin Street & Estes Drive	<ul style="list-style-type: none"> Construct Dual EB LT lanes with 250' storage and SB RT Lane with 200' storage 	<ul style="list-style-type: none"> Construct Additional EB Through Lane 	N/A
29	Brandon Road & Hayes Road	<ul style="list-style-type: none"> Restrict NB and SB Connections on Hayes Road to RIRO Intersections to Protect US 15-501 & Brandon Road Intersection WB Approach Vicinity 	N/A	N/A
31	US 15-501 Bypass (Fordham Boulevard) & Proposed Site Entrance	<ul style="list-style-type: none"> Construct Dual SB LT Lanes with 300' storage & Signalize Intersection Construct Dual WB RT Lanes with 300' Storage (Driveway Throat Length) Provide Two Inbound Travel Lanes Prohibit Connection to Existing Hayes Road 	N/A	N/A
91	US 15-501 Bypass (Fordham Boulevard) & Median U-Turn #1 (Between Manning Drive & Old Mason Farm Road)	<ul style="list-style-type: none"> Construct Superstreet Design with Median U-Turn Lanes (NB U-Turn Drop Lane From Manning Drive/250' SB U-Turn Storage) and Signalize Intersection 	N/A	<ul style="list-style-type: none"> Construct 3rd NB Through Lane on US 15-501 (Fordham Blvd)
92	US 15-501 Bypass (Fordham Boulevard) & Median U-Turn #2 (North of Old Mason Farm Road)	<ul style="list-style-type: none"> Construct Superstreet Design with NB Left-Turn/U-Turn (250' Storage) Connect NB Left-Turn to Connect with St. Thomas More Driveway and Signalize Intersection 	<ul style="list-style-type: none"> Construct 3rd NB Through Lane on US 15-501 (Fordham Blvd) 	<ul style="list-style-type: none"> Construct 3rd SB Through Lane on US 15-501 (Fordham Blvd)
61	US 15-501 Bypass (Fordham Boulevard) & Median U-Turn #3 (Between Brandon Road & Cleland Road)	<ul style="list-style-type: none"> Construct Superstreet Design with Median U-Turn Lanes (200' Storage NB and SB) and Signalize Intersection 	N/A	N/A

N/A – Not Applicable, i.e. no recommended improvements for the intersection and scenario


RED – Necessary Improvements Required by Applicant

BLUE – New Intersections Proposed in Corridor Superstreet Concept – Not Specifically Required by Applicant



LEGEND

- X = Signalized Intersection
- X = Unsignalized Intersection
- X = Future Site Intersection
- = Future Site Roadway


NOT TO SCALE



Glen Lennox Redevelopment
Traffic Impact Study
PROJECT STUDY AREA

DATE: October 2013
FIGURE ES-1



NOT TO SCALE



Phase 1: (1-5yrs)

- 460 Residential Units
- 86,500 SF Retail
(includes 20,948 existing)
- 100,000 SF Office
(includes 5,084 existing)
- 150 Hotel Rooms

Phase 2: (6-10 yrs)

- 460 Residential Units
- 21,500 SF Retail
- 500,000 SF Office

Phase 3: (11-15 yrs)

- 320 Residential Units

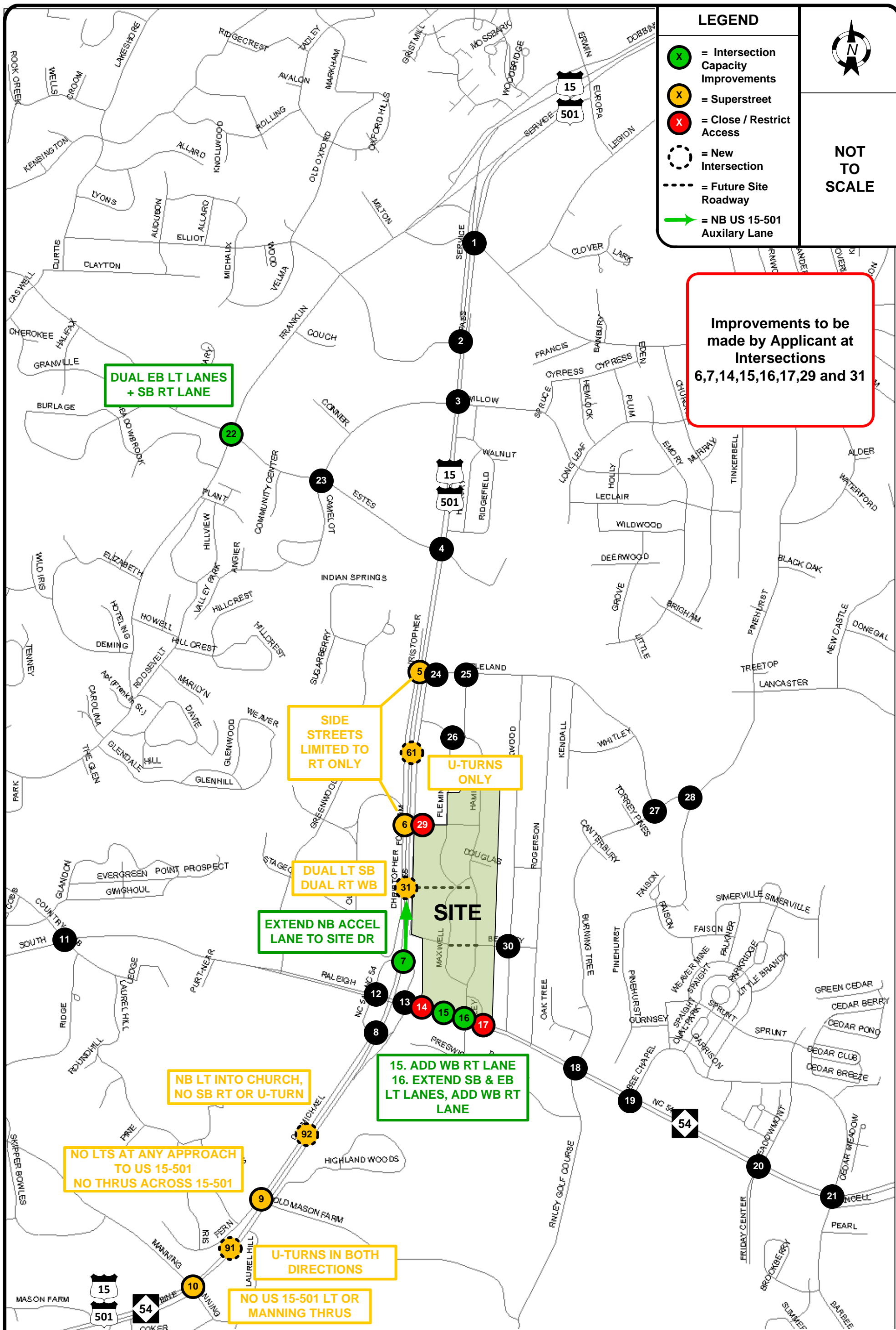
Phase 4: (Over 20 yrs)

- 118 Existing Residential Units Renovated
- 33 Residential Units in same scale as existing units

Total Land Use:

- 1,391 Residential Units
- 108,000 SF Retail
- 600,000 SF Office
- 150 Hotel Rooms

SOURCE: Grubb Properties (Applicant) May 2013



LEGEND

- X = Intersection Capacity Improvements
- X = Superstreet
- X = Close / Restrict Access
- = New Intersection
- = Future Site Roadway
- = NB US 15-501 Auxiliary Lane

N

NOT TO SCALE

Improvements to be made by Applicant at Intersections 6, 7, 14, 15, 16, 17, 29 and 31

DUAL EB LT LANES + SB RT LANE

SIDE STREETS LIMITED TO RT ONLY

U-TURNS ONLY

DUAL LT SB DUAL RT WB

EXTEND NB ACCEL LANE TO SITE DR

15. ADD WB RT LANE
16. EXTEND SB & EB LT LANES, ADD WB RT LANE

NB LT INTO CHURCH, NO SB RT OR U-TURN

NO LTS AT ANY APPROACH TO US 15-501
NO THRU ACROSS 15-501

U-TURNS IN BOTH DIRECTIONS

NO US 15-501 LT OR MANNING THRU

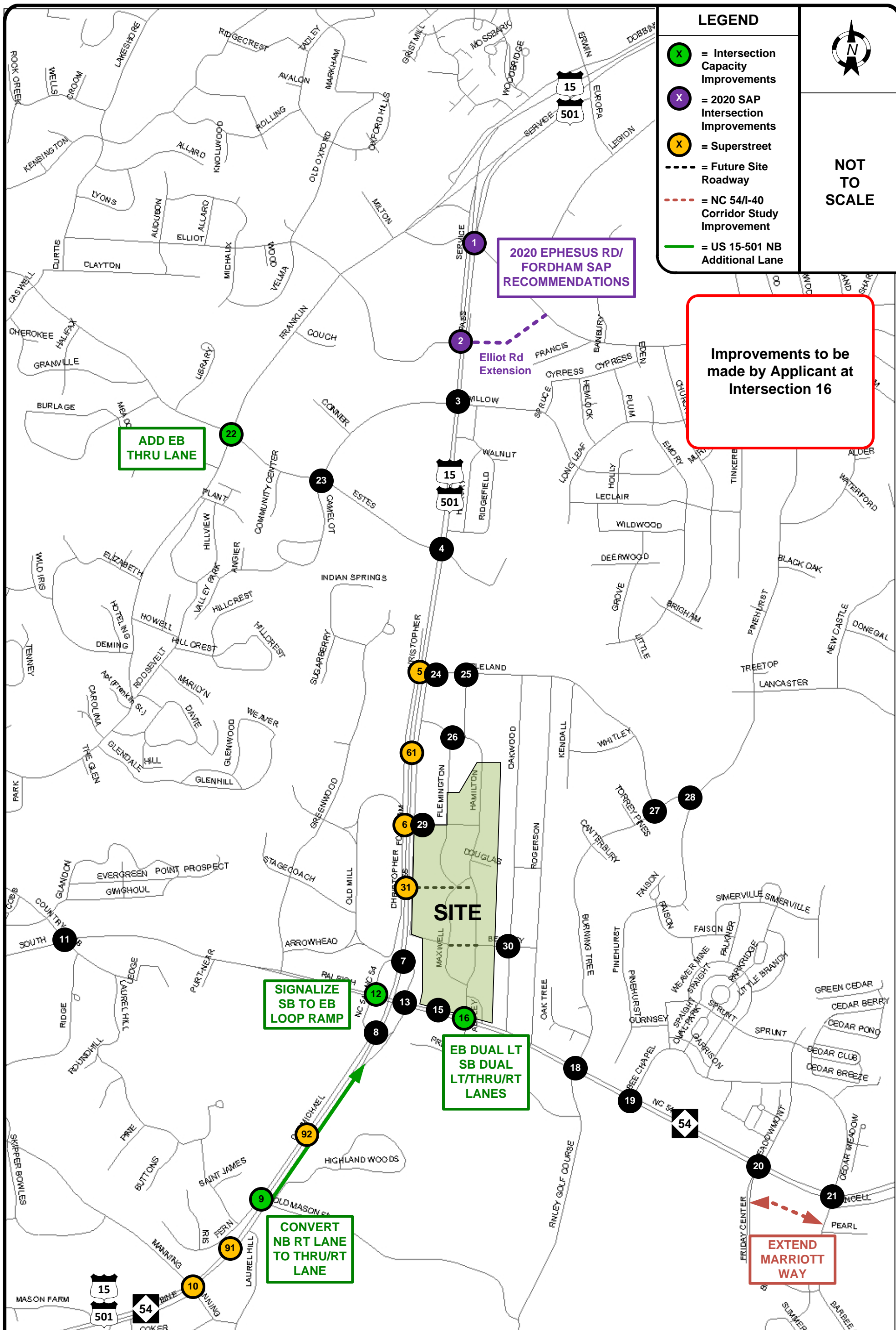
**Glen Lennox Redevelopment
Traffic Impact Study**

DATE: October 2013



2018 RECOMMENDED IMPROVEMENTS

FIGURE ES-3



LEGEND

- X = Intersection Capacity Improvements
- X = 2020 SAP Intersection Improvements
- X = Superstreet
- = Future Site Roadway
- = NC 54/I-40 Corridor Study Improvement
- = US 15-501 NB Additional Lane

N

NOT TO SCALE

ADD EB THRU LANE

2020 EPHEsus RD/
FORDHAM SAP
RECOMMENDATIONS

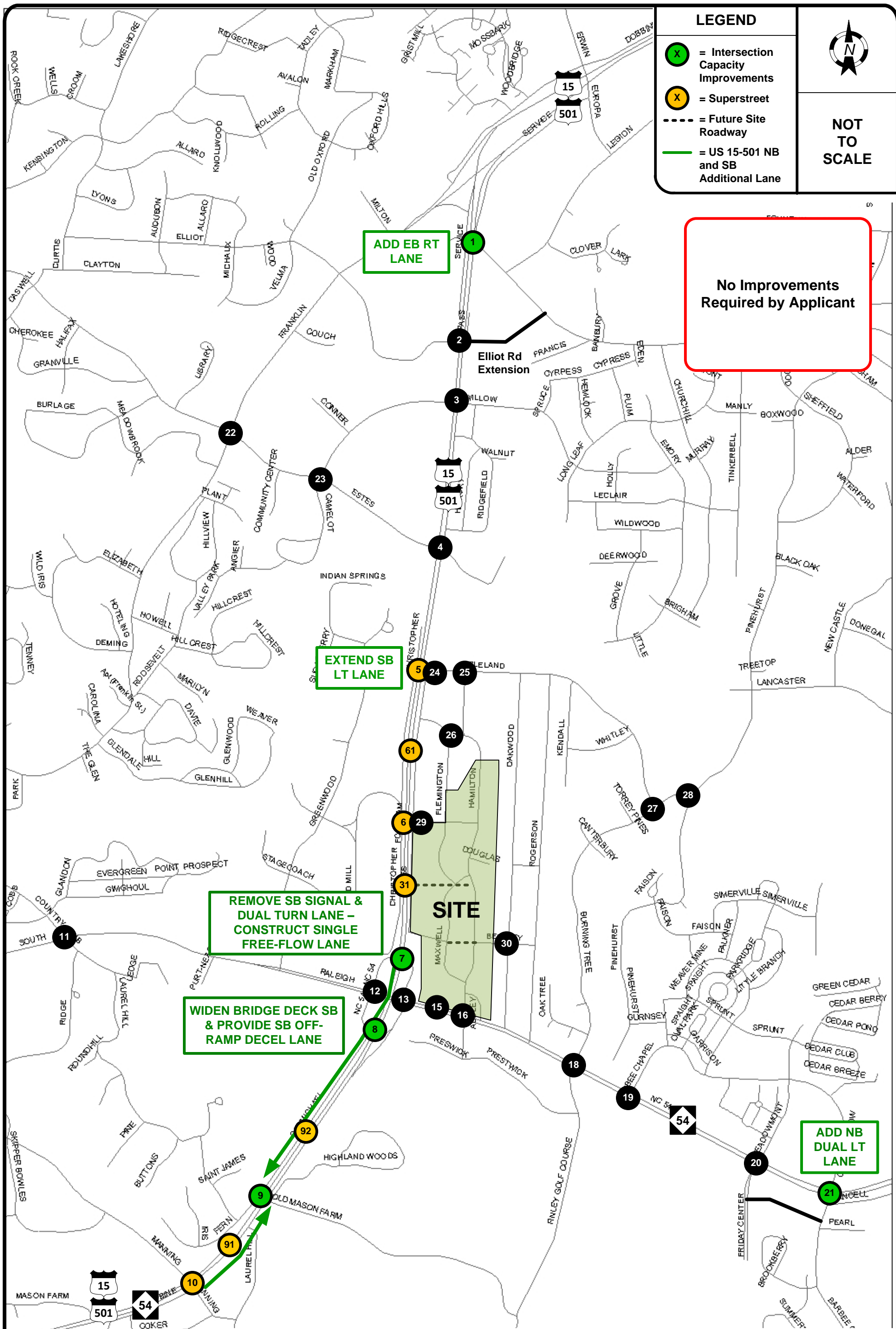
Improvements to be
made by Applicant at
Intersection 16

SIGNALIZE
SB TO EB
LOOP RAMP

EB DUAL LT
SB DUAL
LT/THRU/RT
LANES

CONVERT
NB RT LANE
TO THRU/RT
LANE

EXTEND
MARRIOTT
WAY



LEGEND

- X = Intersection Capacity Improvements
- X = Superstreet
- = Future Site Roadway
- = US 15-501 NB and SB Additional Lane

N

NOT TO SCALE

No Improvements Required by Applicant

REMOVE SB SIGNAL & DUAL TURN LANE - CONSTRUCT SINGLE FREE-FLOW LANE

WIDEN BRIDGE DECK SB & PROVIDE SB OFF-RAMP DECEL LANE

ADD EB RT LANE

EXTEND SB LT LANE

ADD NB DUAL LT LANE

**Glen Lennox Redevelopment
Traffic Impact Study**

2028 RECOMMENDED IMPROVEMENTS

DATE: October 2013

FIGURE ES-5

