

Technical Memorandum

To: Tiffany Faro, CZO
City of Belmont

From: Brady Finklea, PE
Kimley-Horn

Re: *Oaks Commerce Center*
Transportation Technical Memorandum
Hickory Grove Road, Belmont, North Carolina

Date: August 23, 2022



The purpose of this Transportation Technical Memorandum (TTM) is to evaluate the incremental impacts on the surrounding transportation infrastructure as a result of the proposed Oaks Commerce Center located east of Hickory Grove Road and north of I-85 and the Piedmont & Northern Railroad in Belmont, North Carolina (<https://goo.gl/maps/DuJxYhhcxtgVQP1Z8>). The primary objectives of the study are:

- To estimate trip generation and distribution for the proposed development.
- To perform intersection capacity analyses for each of the identified study intersections.
- To determine the potential transportation impacts of the proposed development.
- To identify potential improvements to mitigate the proposed development’s transportation impacts.
- To evaluate intersection sight distance for the proposed site driveway.

Kimley-Horn was retained to determine the potential transportation impacts of this development (in accordance with the traffic study guidelines in the [NCDOT Policy on Street and Driveway Access to North Carolina Highways](#) and set forth by the [City of Belmont Land Development Code – Section 16.14 Transportation Impact Analysis](#)) and to identify transportation improvements that may be required to mitigate these impacts. This technical memorandum presents trip generation, distribution, capacity analyses, crash analyses, sight distance evaluation and identified transportation improvements required to mitigate anticipated transportation demands produced by the subject development.

Executive Summary

Based on the capacity analyses performed at each of the identified study intersections, along with review of the auxiliary turn-lane warrants and crash analyses contained herein, **the proposed Oaks Commerce Center is not expected to have a significant adverse impact on operations at the off-site study area intersections; therefore, no additional mitigation improvements beyond the necessary laneage and appropriate sight distance required for site access (as discussed on the following page) is identified for the proposed Oaks Commerce Center.** Given the planned transportation improvement identified as mitigation for the approved RiverWest development in combination with the relatively low trip generation potential of the proposed site (less than 100 site trips in each peak hour), the proposed development is not expected to have a significant adverse impact on operations at offsite study area intersections. Note that as the end user of the development becomes identified, the applicant should coordinate with City of Belmont and North Carolina Department of Transportation (NCDOT) staff to determine if turn lanes are warranted to accommodate projected truck traffic and/or if an updated traffic study is required depending on the type of industrial user that ultimately occupies this building.

Driveway access improvements identified herein include:

Int #4. Hickory Grove Road and Access 1

- Construction of Access 1 as a full movement, stop-controlled driveway with a single egress lane and single ingress lane
- Provide a 100-foot internal protected stem (IPS) along Access 1

Sight Distance Easements (Hickory Grove Road and Access 1)

- Based on a horizontal and vertical sight distance analysis, no immediate vertical conflicts were found; however, any obstructions located above ground level within the limits of the sight distance triangles (as shown on the sight distance profile included in the **Attachments**) will need to be cleared. Four (4) parcels, two (2) of which appear to be developer-owned, will require sight distance easements. No landscaping, vegetation, fencing, structures, parking areas, or other obstructions shall encroach within the sight distance easements.

The mitigation improvements identified within the study area are subject to approval by NCDOT and the City of Belmont. All additions and attachments to the State and City roadway system shall be properly permitted, designed, and constructed in conformance to standards maintained by the agencies.

Project Overview

The proposed Oaks Commerce Center is located east of Hickory Grove Road and north of I-85 and the Piedmont & Northern Railroad in Belmont, North Carolina (<https://goo.gl/maps/DujxYhhcxtgVQP1Z8>). The 44-acre site is currently undeveloped and zoned as BC-D (Business Campus Development). Based on the site plan provided by the applicant and shown in **Figure 1** (attached), the proposed development is currently envisioned to include a single industrial building with approximately 470,000 square feet of warehousing space.

For the purposes of this TTM, the development is assumed to be built-out in 2023 and accessed via one (1) access point along Hickory Grove Road:

- **Access 1** – full-movement connection to Hickory Grove Road approximately 125’ south of Linn Street

Note that discussion occurred at the TTM Scoping Meeting to endeavor to align proposed Access 1 with Linn Street; however, the applicant has indicated that right-of-way is unable to be acquired to align Access 1 with Linn Street.

A TTM Scoping Meeting was held with the City of Belmont, NCDOT, Gaston-Cleveland-Lincoln Metropolitan Planning Organization (GCLMPO) and representatives of the applicant on April 19, 2022, to establish the scope and parameters to be included in this TTM. The City’s Memorandum of Understanding (MOU) was developed based on discussions from this meeting and was reviewed and agreed upon by the City, NCDOT and applicant. The approved MOU is included in the **Attachments**.

The following AM and PM peak-hour scenarios were analyzed to determine the proposed development’s transportation impacts on the surrounding network:

- 2023 Background Conditions
- 2023 Build-out Conditions

Based on the expected site trip generation and discussions of projected travel patterns for the proposed site trips in context with the surrounding area, this TTM evaluated operations under each of the AM and PM peak-hour scenarios above for the following study area intersections as agreed upon at the TTM Scoping Meeting (and shown in the MOU and **Figure 2** (attached):

1. Hickory Grove Road and Woodlawn Street

2. Hickory Grove Road and Linn Street
3. Hickory Grove Road and Riverside Drive (NC 7)
4. Hickory Grove Road and Access 1 (*build-out conditions*)

Note that the signalized intersection of Hickory Grove Road and Perfection Avenue was also included in the Synchro model analysis to properly reflect the operational impact of this signal along the Hickory Grove corridor, specifically at the adjacent Woodlawn Street intersection; however, as determined at the TTM Scoping Meeting, no mitigation analysis was performed for this intersection.

For the purposes of this TTM, Hickory Grove Road is considered to run north/south with the intersecting streets assumed to be east/west.

Traffic Volume Development

2023 Background Traffic Volumes

Existing AM (6:30-8:30) and PM (4:30-7:00) peak-period intersection turning-movement, heavy-vehicle, pedestrian and bicycle counts were collected by Quality Counts, LLC on Tuesday, April 26, 2022 (when Gaston County Schools were in session) at the study intersections listed above.

The projected 2023 background AM and PM peak-hour traffic volumes include both non-specific general growth based on usage increases in local traffic volumes along with and/or change in traffic volumes caused by approved off-site developments within the vicinity of the study area that were not yet fully constructed at the time of the counts. As shown in the approved MOU, an annual growth rate of one-half percent (0.5%) was applied to the 2022 existing peak-hour traffic volumes to calculate base 2023 background traffic volumes. This growth rate was determined based on review of historical NCDOT annual average daily traffic (AADT) maps specifically along Hickory Grove Road between 2008 and 2019, in coordination with NCDOT and City of Belmont, along with consideration of the additional specific traffic being added by the approved off-site development discussed below.

Based on input from City and NCDOT staff, one (1) nearby approved development expected to impact traffic volumes within the study area was included in the background traffic volumes for this TTM and is summarized in **Table 1** below.

Table 1: Approved Developments

Development	Land Use/Intensity	% Build-out	TIA Included?	Required Improvements
RiverWest (Woodlawn Industrial Park)	620,000 SF Industrial	0%	Yes	<u>Woodlawn St/Hickory Grove Rd</u> - WBL w/ 125'

The RiverWest development is located north of Woodlawn Street in the vicinity of Cason Street (<https://goo.gl/maps/pNb52HgBdLVpAfUQ9>). Site traffic volume figures from the TIA for this site are included in the **Attachments**.

The existing laneage for the study area intersections is shown in **Figure 3** (attached) and the 2023 background AM and PM peak-hour traffic volumes are shown in **Figures 4 and 5**, respectively (attached).

2023 Build-out Traffic Volumes

The traffic generation potential of the proposed development was determined using the trip generation equations published in *Trip Generation* (Institute of Transportation Engineers (ITE), Eleventh Edition, 2021).

Table 2 summarizes the projected trip generation for the proposed development, showing the projected vehicle split between passenger cars and trucks as provided by truck trip generation data plots for land-use code 150 in ITE's *Trip Generation Supplement*. During a typical weekday, the proposed development has the potential to generate 80 and 83 net new external trips during the AM and PM peak hours, respectively, with 11-17% truck traffic during the peak hours.

ITE LUC	Land Use	Intensity	Daily	AM Peak Hour			PM Peak Hour			Peak Hour Type/ Data Source
				Total	In	Out	Total	In	Out	
150	Warehousing	470,000 SF	781	80	62	18	83	23	60	Adj Street/ITE Eqn
	Passenger Cars		499	71	57	14	69	16	53	
	Trucks*		282	9	5	4	14	7	7	Adj Street/ITE Rate
Subtotal			781	80	62	18	83	23	60	
Total - Passenger Cars			499	71	57	14	69	16	53	
Total - Trucks			282	9	5	4	14	7	7	

*Vehicle type split determined using Truck Trip Generation Data Plots (average rate) provided in ITE's *Trip Generation Supplement, 10th Edition*

The proposed development's trips were assigned to the surrounding network based on the distribution approved as part of the MOU by the City of Belmont, NCDOT and applicant and is shown in **Figures 6 and 7** (attached). Given expected differences in travel characteristics, separate trip distributions were developed for the passenger cars and truck traffic.

The 2023 build-out traffic volumes include the assignment of the projected site traffic generation added to the 2023 background traffic volumes. The projected 2023 build-out traffic volumes for the AM and PM peak hours are shown in **Figures 8 and 9**, respectively (attached). Intersection volume development worksheets for all intersections are included in the **Attachments**.

Capacity Analysis

Synchro Version 11 software along with SimTraffic microsimulation analysis were used to evaluate the AM and PM peak-hour operating characteristics of the study intersections. The capacity of an intersection quantifies its ability to accommodate traffic volumes and is expressed in terms of level-of-service (LOS), measured in average delay per vehicle and describes motorists' perceptions within a traffic stream. The Transportation Research Board's Highway Capacity Manual (HCM) defines six (6) levels of service, LOS A through LOS F, with LOS A as the highest (best traffic flow and least delay), LOS E as saturated or at-capacity conditions, and LOS F as the lowest (oversaturated conditions).

The LOS grades shown below quantify and categorize the driver's discomfort, frustration, fuel consumption, and travel times experienced as a result of intersection control and the resulting traffic queuing. A detailed description of each LOS rating for unsignalized and signalized intersections can be found in **Table 3**.

LOS	Avg Control Delay [sec/veh]			Description
	Unsignalized	Signalized		
A		≤ 10	≤ 10	Minimal control delay; traffic operates at primarily free-flow conditions; unimpeded movement within traffic stream.
B	Short Delays	> 10 – 15	> 10 – 20	Minor control delay at signalized intersections; traffic operates at a fairly unimpeded level with slightly restricted movement within traffic stream.
C		> 15 – 25	> 20 – 35	Moderate control delay; movement within traffic stream more restricted than at LOS B; formation of queues contributes to lower avg travel speeds.
D	Moderate Delays	> 25 – 35	> 35 – 55	Considerable control delay that may be substantially increased by small increases in flow; average travel speeds continue to decrease.
E		> 35 – 50	> 55 – 80	High control delay; average travel speed no more than 33 percent of free flow speed.
F	Long Delays	> 50	> 80	Extremely high control delay; extensive queuing and high volumes create exceedingly restricted traffic flow.

LOS for a two-way stop-controlled (TWSC) intersection is determined by the control delay and is reported for the side-street approaches, typically during the highest volume periods of the day, the AM and PM peak periods. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. With respect to field measurements, control delay is defined as the total elapsed time from the time a vehicle stops at the end of the queue to the time the vehicle departs from the stop line. It is typical for stop sign-controlled side streets and driveways intersecting major streets to experience long delays during peak hours, particularly for left-turn movements. The majority of the traffic moving through the intersection on the major street experiences little or no delay.

LOS for signalized intersections is reported for the intersection as a whole and typically during the highest volume periods of the day, the AM and PM peak periods. One or more movements at an intersection may experience a low level-of-service, while the intersection as a whole may operate acceptably.

Based on the requirements set forth by the [City of Belmont Land Development Code – Section 16.14 Transportation Impact Analysis](#) and in accordance with the traffic study guidelines in the [NCDOT Policy on Street and Driveway Access to North Carolina Highways](#), capacity analyses were performed at the study area intersections for each of the following AM and PM peak-hour scenarios:

- 2023 Background Conditions
- 2023 Build-out Conditions

NCDOT provided the signal geometric plans for each of the following signalized intersections (each of which are isolated), which were used in the development of the background conditions Synchro network:

- Hickory Grove Road and Woodlawn Street
- Hickory Grove Road and Riverside Drive (NC 7)
- Hickory Grove Road and Perfection Avenue

Based on the provided signal plans, all signalized study intersections operate as isolated signals; therefore, cycle lengths and splits were optimized individually given the timing inputs and in accordance with [NCDOT Congestion Management Capacity Analysis Guidelines](#). Cycle lengths and splits were maintained throughout the build-out scenarios. Signal geometric plans are included in the **Attachments**.

The following modifications from the background data collected were applied to the capacity analyses to meet [NCDOT Congestion Management Capacity Analysis Guidelines](#):

- Right-turn-on-red (RTOR) operations were not allowed.
- Lost time adjust was added to the yellow and all-red times provided in the existing signal plans to maintain a total lost time of five (5) seconds for each movement.
- Protected-only left-turn phasing was used for analysis for future operations where protected/permitted left-turn phasing exists or is planned (which includes the southbound left-turn movement at both signalized study intersections).

A 0.9 peak-hour factor was used in all conditions in accordance with [NCDOT Congestion Management Capacity Analysis Guidelines](#). Heavy-vehicle percentages collected with the counts were used in the background conditions analysis, subject to a two-percent (2%) minimum. A weighted heavy-vehicle percentage was calculated under build conditions to account for the added truck traffic by utilizing field-observed heavy-vehicle percentages for the background traffic combined with the passenger car/truck split for each intersection movement within the study area.

Mitigation for transportation impacts caused by the proposed development were identified based on City of Belmont mitigation requirements. When determining the proposed development's transportation impact to the study area intersections, the 2023 background and 2023 build-out conditions were compared. Based on the [City of Belmont Land Development Code – Section 16.14 Transportation Impact](#)

Analysis, “the applicant shall be required to identify mitigation improvements to the roadway network if at least one of the following conditions exists when comparing future year background conditions to future year build-out conditions:

- the total average delay at an intersection or individual approach increases by 25% or greater, while maintaining the same LOS,
- the LOS degrades by at least one level,
- or the LOS is “D” or worse in background conditions and the proposed project shows a negative impact on the intersection or approach”.

Capacity analysis reports generated by Synchro Version 11 software are included in the **Attachments** along with queuing and blocking reports generated by the SimTraffic microsimulation model.

Int #1. Hickory Grove Road and Woodlawn Street

As shown in the existing signal included in the **Attachments**, this cluster intersection operates under a single signal controller with the adjacent Perfection Avenue intersection with timed overlaps that are intended to flush out the traffic from one intersection to the other. However, note that the results provided below reflects the anticipated operations specifically for the Woodlawn Street study area intersection. As discussed at the TTM Scoping Meeting, the Perfection Avenue intersection was not evaluated for mitigation analysis but was included in the Synchro model given its proximity and impact to the adjacent Woodlawn Street intersection).

Table 4 - Hickory Grove Road and Woodlawn Street								
Condition	Measure	WB		NB		SB		Intersection
		WBL	WBR	NBT	NBR	SBL	SBT	LOS (Delay)
AM Peak Hour								
2023 Background	LOS (Delay)	C (27.8)		D (44.5)		B (18.5)		C (27.6)
	Synchro 95th Q	67'	99'	#440'	-	#390'	9'	
2023 Build-out	LOS (Delay)	C (29.1)		D (48.5)		B (19.8)		C (29.7)
	Synchro 95th Q	89'	99'	#464'	-	#391	9'	
2023 Build-out IMP NBR	LOS (Delay)	C (25.9)		D (39.7)		B (16.6)		C (24.9)
	Synchro 95th Q	89'	93'	344'	87'	344'	9'	
PM Peak Hour								
2023 Background	LOS (Delay)	E (61.8)		D (50.3)		B (12.8)		D (39.9)
	Synchro 95th Q	#147'	#349'	#560'	-	m136'	m7'	
2023 Build-out	LOS (Delay)	E (65.1)		D (53.8)		B (13.5)		D (42.5)
	Synchro 95th Q	#162'	#349'	#606'	-	m135'	m7'	
2023 Build-out IMP NBR	LOS (Delay)	E (56.6)		D (46.5)		B (12.0)		D (36.9)
	Synchro 95th Q	#151'	#329'	#503'	52'	m138'	7'	
Background Storage		125'						
# 95th percentile volume exceeds capacity, queue may be longer								
m Volume for 95th percentile queue is metered by upstream signal								

As previously shown in **Table 1**, the following mitigation improvement is required to be installed at this intersection as part of the approved RiverWest industrial development and was assumed to be in place under future-year conditions:

- Westbound left-turn lane along Woodlawn Street with 125 feet of storage

With this improvement in place, **Table 4** shows that the signalized intersection is expected to operate at LOS C during the AM peak hour and LOS D during the PM peak hour under 2023 background conditions.

When the proposed site traffic is added to the 2023 background traffic volumes, the overall intersection is expected to continue to operate at LOS C during the AM peak hour and LOS D during the PM peak hour with similar operations and minor increases in delay as compared to 2023 background conditions. However,

given the increased delay on multiple approaches already operating at LOS D or worse, potential mitigation was considered.

With turn lanes already provided along the southbound and westbound approaches (with the westbound left-turn lane required as mitigation for the approved RiverWest development), a potential northbound right-turn lane was considered. As shown in **Table 4**, the operational impact to this intersection caused by the proposed site is projected to be fully mitigated with the approach and intersection delays improved beyond background conditions during both peak hours; however, the improvement is not expected to provide significant capacity improvements to this intersection, decreasing the overall intersection delay by less than six (6) seconds per vehicle during both peak hours while also maintaining the same LOS as the projected operations without the turn lane.

As shown below in the aerial image adjacent to a field photo collected on June 1, 2022, widening the northbound approach to provide a northbound right-turn lane would likely require relocation of the existing signal pole, ditch and associated stormwater infrastructure, as well as potential removal of the large mature tree currently located adjacent to the northbound travel lane along Hickory Grove Road.



Based on the relatively minor delay increases caused by the proposed site while maintaining the same LOS for all approaches and overall intersection during both peak hours, along with consideration for the constraints and projected operational benefit discussed above for a potential northbound right-turn lane, **no mitigation improvements are recommended for the proposed Oaks Commerce Center.**

Also note that Woodlawn Street and Riverside Drive (NC 7) both provide alternative routing options for the proposed Oaks Commerce Center site traffic to access I-85. If drivers experience undue delay at this intersection, some drivers will likely reroute and utilize Riverside Drive (NC 7), which is shown in **Table 6** to operate at LOS B during both peak hours with the southbound approach projected to operate at LOS A.

Int #2. Hickory Grove Road and Linn Street

Table 5 shows that the stop-controlled eastbound approach of Linn Street is expected to operate with short delays during both peak hours under 2023 background conditions.

When the proposed site traffic is added to the 2023 background traffic volumes, the stop-controlled eastbound approach is expected to continue to operate with similar operations as compared to 2023 background conditions with minimal increases in approach delay. Note that the LOS degradation shown for the eastbound

approach during the AM peak hour is a result of the background delay hovering just below the LOS B/C demarcation at 15 seconds, in which the site traffic pushes the delay less than 0.1 second beyond this demarcation. **Since the proposed development is not expected to have a significant adverse impact on operations at this intersection, no mitigation improvements are recommended for the proposed Oaks Commerce Center.**

Note that discussion occurred at the TTM Scoping Meeting to endeavor to align proposed Access 1 with Linn Street; however, the applicant has indicated that right-of-way is unable to be acquired to align Access 1 with Linn Street. As shown in the aerial image to the right, Access 1 is proposed to be constructed approximately 125 feet south of Linn Street. Based on discussions at the TTM Scoping Meeting, it was determined that the proximity and offset of Access 1 to the adjacent intersection at Linn Street may create a safety concern if queues extended from each intersection and created left-turn conflicts. Based on review of SimTraffic simulation, the maximum northbound left-turn queue from Linn Street and the maximum southbound left-turn queue from Access 1 are not projected to conflict. Additionally, as further described in the auxiliary turn-lane warrant section of this TTM, a southbound left-turn lane is not warranted at Access 1, which could have also potentially created a left-turn conflict along Hickory Grove Road between the two (2) intersections.

Table 5 - Hickory Grove Road and Linn Street					
Condition	Measure	EB	NB		SB
		EBLR	NBL*	NBT	SBTR
AM Peak Hour					
2023 Background	LOS (Delay)	B (14.6)	A (8.5)	A (0.0)	A (0.0)
	Synchro 95th Q	10'	0'	0'	0'
2023 Build-out	LOS (Delay)	C (15.0)	A (8.6)	A (0.0)	A (0.0)
	Synchro 95th Q	13'	0'	0'	0'
PM Peak Hour					
2023 Background	LOS (Delay)	B (14.1)	A (8.5)	A (0.0)	A (0.0)
	Synchro 95th Q	5'	3'	0'	0'
2023 Build-out	LOS (Delay)	B (14.4)	A (8.5)	A (0.0)	A (0.0)
	Synchro 95th Q	5'	3'	0'	0'

*Conflicting left-turn movements are broken out per NCDOT guidelines



Int #3. Hickory Grove Road and Riverside Drive (NC 7)

Table 6 shows that the signalized intersection of Hickory Grove Road and Riverside Drive (NC 7) is expected to operate at LOS B during both peak hours under 2023 background conditions.

When the proposed site traffic is added to the 2023 background volumes, the overall intersection is expected to continue to operate at LOS B during both

peak hours with similar operations and minimal increases in delay as compared to 2023 background conditions. **Since the proposed development is not expected to have a significant adverse impact on operations at this intersection, no mitigation improvements are recommended for the proposed Oaks Commerce Center.**

Table 6 - Hickory Grove Road and Riverside Drive (NC 7)							
Condition	Measure	WB		NB	SB		Intersection LOS (Delay)
		WBL	WBR	NBTR	SBL	SBT	
AM Peak Hour							
2023 Background	LOS (Delay)	C (22.1)		B (15.0)	A (8.8)		B (12.8)
	Synchro 95th Q	58'	37'	305'	112'	71'	
2023 Build-out	LOS (Delay)	C (21.7)		B (15.3)	A (9.1)		B (13.1)
	Synchro 95th Q	60'	53'	324'	120'	71'	
PM Peak Hour							
2023 Background	LOS (Delay)	B (18.8)		B (13.7)	A (6.2)		B (11.3)
	Synchro 95th Q	69'	50'	256'	57'	92'	
2023 Build-out	LOS (Delay)	B (19.2)		B (14.0)	A (7.2)		B (11.8)
	Synchro 95th Q	70'	56'	269'	73'	97'	
Background Storage		100'		275'			

Int #4. Hickory Grove Road and Access 1

Based on the site plan and input from the applicant, Access 1 is proposed to serve as a full-movement connection to Hickory Grove Road located approximately 125 feet south of Linn Street. The westbound egress was assumed to operate unsignalized with single-lane approaches.

Table 7 shows that the stop-controlled westbound approach of Access 1 is expected

to operate with short delays during both peak hours under 2023 build-out conditions. **Therefore, no additional improvements beyond construction of Access 1 with a single egress and single ingress lane with a minimum internal protected stem (IPS) of 100 feet are recommended at this intersection for capacity purposes.**

Table 7 - Hickory Grove Road and Access 1					
Condition	Measure	WB	NB	SB	
		WBLR	NBTR	SBL*	SBT
AM Peak Hour					
2023 Build-out	LOS (Delay)	C (18.6)	A (0.0)	A (8.4)	A (0.0)
	Synchro 95th Q	5'	0'	3'	0'
PM Peak Hour					
2023 Build-out	LOS (Delay)	C (21.6)	A (0.0)	A (9.1)	A (0.0)
	Synchro 95th Q	23'	0'	0'	0'

*Conflicting left-turn movements are broken out per NCDOT guidelines

Note that the recommended IPS length is based on review of the SimTraffic maximum queue lengths and NCDOT minimum requirements. The IPS is defined as the length required to be protected along the driveway stem from Hickory Grove Road before any crossing or left-turn conflicts are allowed. Based on the attached site plan, it appears a 100-foot IPS is provided.

Review of auxiliary turn-lane warrants at this intersection is described on the following page.

Auxiliary Turn Lane Warrants

Warrants for additional turn-lane improvements for unsignalized driveways beyond those necessary for capacity were determined based on a review of the figure titled ‘Warrant for Left and Right-Turn Lanes’ found on page 80 in the [NCDOT Policy on Street and Driveway Access to North Carolina Highways](#).

The results of the warrants for left- and right-turn lanes under 2023 build-out conditions indicate that turn lanes are not warranted along Hickory Grove Road at the proposed Access 1. Turn-lane warrant figures are included in the **Attachments**.

Note that as the end user of the development becomes identified, the applicant should coordinate with the City of Belmont and NCDOT staff to determine if turn lanes are warranted to accommodate projected truck traffic and/or if an updated traffic study is required depending on the type of industrial user that ultimately occupies this building.

Crash Data Analysis

Crash data was obtained at the study intersections for crashes that occurred between May 1, 2019, and April 30, 2022. Over this three (3)-year period, 19 total crashes were reported at the existing study intersections. The breakdown of the crashes at these study intersections by severity, frequency, and crash type are shown in the tables below.

Crash Type	Number of Crashes
Fatal Crashes	0
Class A	0
Class B	0
Class C	6
Property Damage Only	13
Total	19

Table 8.1 above shows the total number of crashes by severity type from most to least severe. As shown, 68% of the crashes over the past three (3) years at the study intersections had no injury reported. The crash types are defined as follows:

- Class A - crashes where serious injury is suspected and can include significant loss of blood or broken bones.
- Class B - crashes where minor injury is suspected, such as bruises or minor cuts.
- Class C - crashes wherein possible injuries occur, which are injuries reported by the person or indicated by his/her behavior, but no wounds or injuries are physically present, such as limping or complaint of neck pain.
- Property Damage Only (PDO) – crashes where no injury is reported.

Location	Crashes/100 MEV
1. Hickory Grove Rd and Woodlawn St	69.73
2. Hickory Grove Rd and Linn St	15.74
3. Hickory Grove Rd and Riverside Dr (NC 7)	39.00
Average	44.45

Table 8.2 shows the crash rates at the study area intersections resulted in a weighted average crash rate of 44.45 crashes per 100 million entering vehicles (MEV), with the highest rate occurring at the cluster

signalized intersection of Hickory Grove Road and Woodlawn Street. There have been 12 total crashes reported over this three (3)-year period at this intersection.

Table 8.3 – Crash Type Summary			
Crash Type	1. Hickory Grove Rd and Woodlawn St	2. Hickory Grove Rd and Linn St	3. Hickory Grove Rd and Riverside Dr (NC 7)
Angle	0	0	2
Fixed Object	0	1	0
Head On	0	0	0
Left-Turn, Different Roadways	0	0	1
Left-Turn, Same Roadway	1	0	0
Overturn/Rollover	0	1	0
Parked Motor Vehicle	1	0	0
Ran off Road - Right	0	0	1
Rear End, Slow or Stop	6	0	1
Right-Turn, Different Roadways	1	0	0
Right-Turn, Same Roadway	1	0	0
Sideswipe, Same Direction	2	0	0
Unknown	0	0	0
Total	12	2	5

The most common crash type within the study area was rear-end collisions caused by slowing or stopping vehicles, contributing to 7 of the 19 total crashes. As shown in **Table 8.3**, rear-end collisions were most prevalent at the signalized intersection of Hickory Grove Road and Woodlawn Street.

Rear-end collisions are often associated with higher levels of congestion at signalized intersections and lack of available turn-lane storage at signalized or unsignalized intersections. As noted in **Section 1** under the **Capacity Analysis**, a westbound left-turn lane is required to be installed at this intersection as part of the approved RiverWest industrial development.

Additionally, as discussed through the **Capacity Analysis**, the proposed Oaks Commerce Center is not expected to significantly increase congestion at these intersections, and therefore is not expected to have a significant impact on safety at these intersections upon build-out of the proposed site.

Crash data provided by NCDOT is included in the **Attachments**.

Sight Distance Review

A horizontal and vertical sight distance analysis was performed for proposed Access 1 along Hickory Grove Road at the request of NCDOT and was based on survey provided by the applicant. Based on the existing 35 mph speed limit on Hickory Grove Road (SR-2000), a design speed of 40 mph was used for this analysis in accordance with NCDOT guidelines. The analysis found no immediate vertical conflicts; however, any obstructions located above ground level within the limits of the sight distance triangles (as shown on the sight distance profile included in the **Attachments**) will need to be cleared. Four (4) parcels, two (2) of which appear to be developer-owned, will require sight distance easements. No landscaping, vegetation, fencing, structures, parking areas, or other obstructions shall encroach within the sight distance easements.

A combination of field photos collected on June 1, 2022, is shown on the following page and reflects the current view from the approximate location of proposed Access 1. The photo on the left is a view looking left toward the south along Hickory Grove Road, while the photo on the right is a view looking right toward the north along Hickory Grove Road.



Conclusions

Based on the capacity analyses performed at each of the identified study intersections, along with review of the auxiliary turn-lane warrants and crash analyses contained herein, **the proposed Oaks Commerce Center is not expected to have a significant adverse impact on operations at the off-site study area intersections; therefore, no additional mitigation improvements beyond the necessary laneage and appropriate sight distance required for site access (as discussed below) is identified for the proposed Oaks Commerce Center.** Given the planned transportation improvement identified as mitigation for the approved RiverWest development in combination with the relatively low trip generation potential of the proposed site (less than 100 site trips in each peak hour), the proposed development is not expected to have a significant adverse impact on operations at offsite study area intersections. Note that as the end user of the development becomes identified, the applicant should coordinate with City of Belmont and North Carolina Department of Transportation (NCDOT) staff to determine if turn lanes are warranted to accommodate projected truck traffic and/or if an updated traffic study is required depending on the type of industrial user that ultimately occupies this building. Driveway access improvements identified herein include:

Int #4. Hickory Grove Road and Access 1

- Construction of Access 1 as a full movement, stop-controlled driveway with a single egress lane and single ingress lane
- Provide a 100-foot internal protected stem (IPS) along Access 1

Sight Distance Easements (Hickory Grove Road and Access 1)

- Based on a horizontal and vertical sight distance analysis, no immediate vertical conflicts were found; however, any obstructions located above ground level within the limits of the sight distance triangles (as shown on the sight distance profile included in the **Attachments**) will need to be cleared. Four (4) parcels, two (2) of which appear to be developer-owned, will require sight distance easements. No landscaping, vegetation, fencing, structures, parking areas, or other obstructions shall encroach within the sight distance easements.

The mitigation improvements identified within the study area are subject to approval by NCDOT and the City of Belmont. All additions and attachments to the State and City roadway system shall be properly permitted, designed, and constructed in conformance to standards maintained by the agencies.

Attachments

1. Figures 1-9 (under same cover)
2. Access 1 Sight Distance Profile (under same cover)
3. Memorandum of Understanding
4. Intersection Volume Development Worksheets
5. Signal Geometric Plans
6. Synchro Capacity Analysis Reports
7. Queueing and Blocking Reports
8. Auxiliary Turn Lane Warrants

Cc:	Shelley DeHart, AICP	City of Belmont
	Blake Guffey	NCDOT
	Chris Urquhart	CHI Acquisitions, LLC
	Matt Cochrane	Crow Holdings
	Elizabeth Richard	Kimley-Horn



SKETCH PLAN
FOR
THE OAKS COMMERCE
BELMONT, NORTH CAROLINA

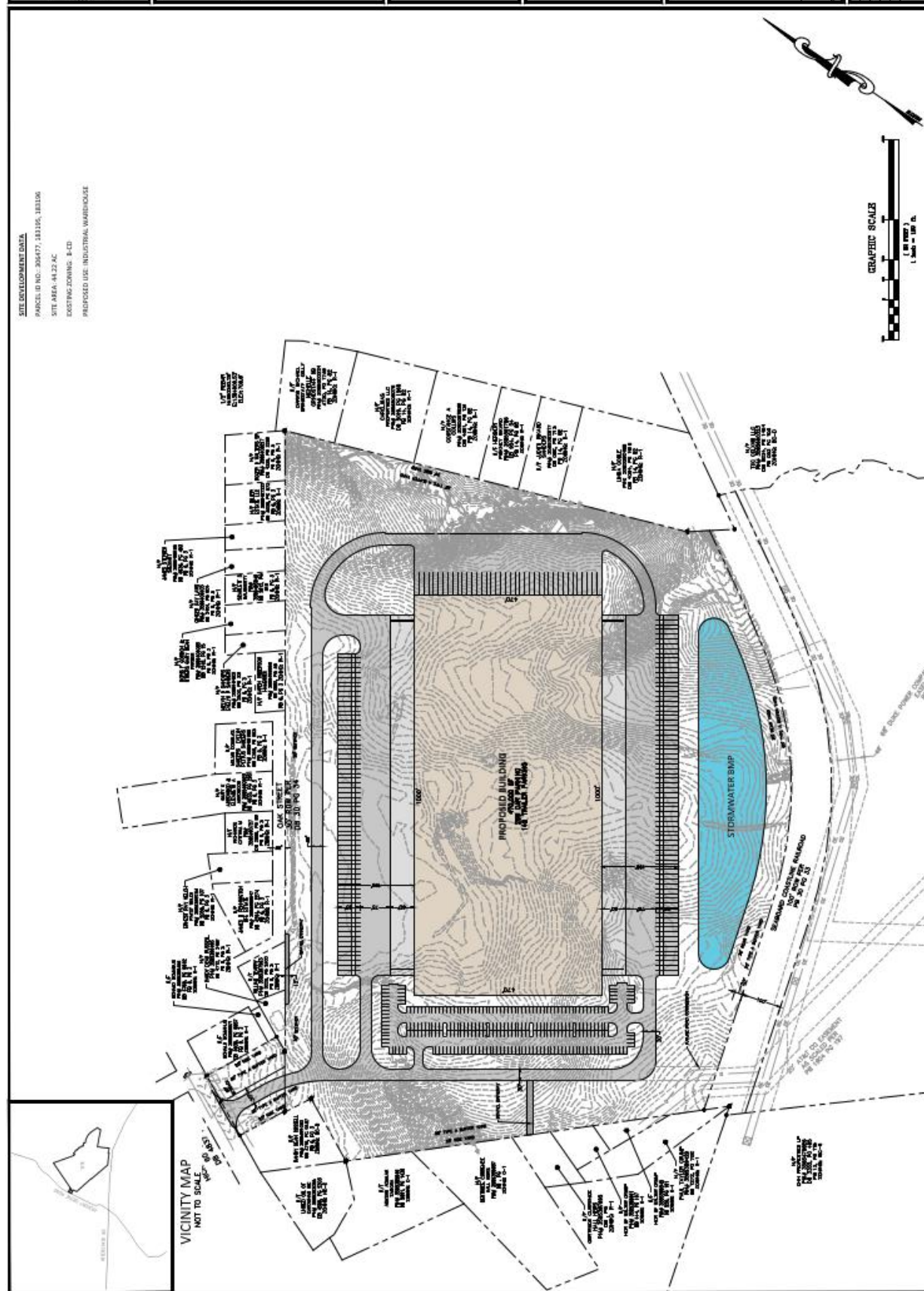
CROW HOLDINGS, DBA
CH/ACQUISITIONS, L.P.
CHARLOTTE, NC 28211
4004 COLONY ROAD, SUITE 405



DATE:	12/15/22
SCALE:	AS SHOWN
PROJECT:	Oaks Commerce Center
DRAWN BY:	KLH
CHECKED BY:	KLH
APPROVED BY:	KLH

S-1

SITE DEVELOPMENT DATA
PARCEL ID NO: 306477, 383195, 383198
SITE AREA: 64.22 AC
EXISTING ZONING: I-CD
PROPOSED USE: INDUSTRIAL WAREHOUSE



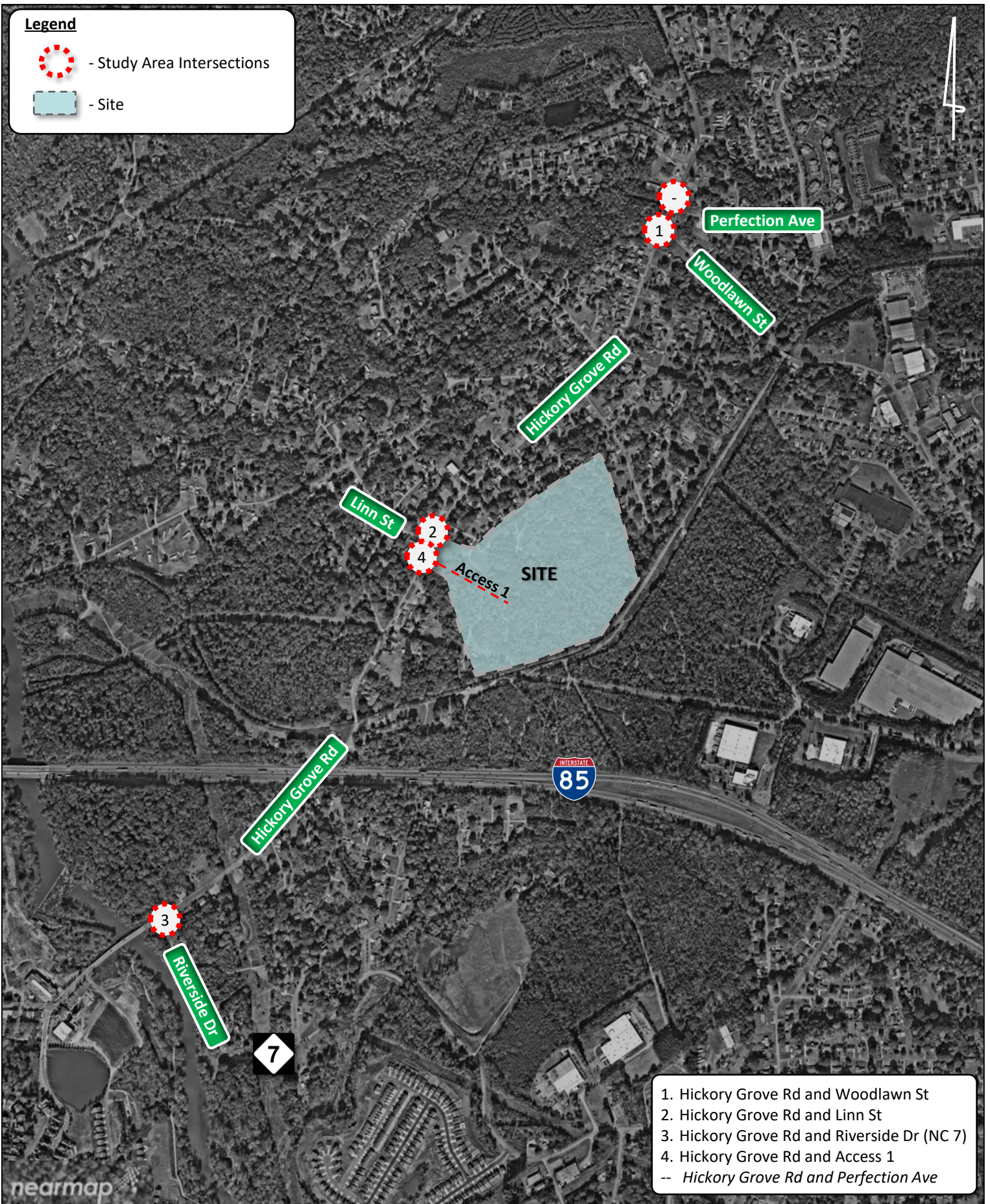
Legend



- Study Area Intersections



- Site

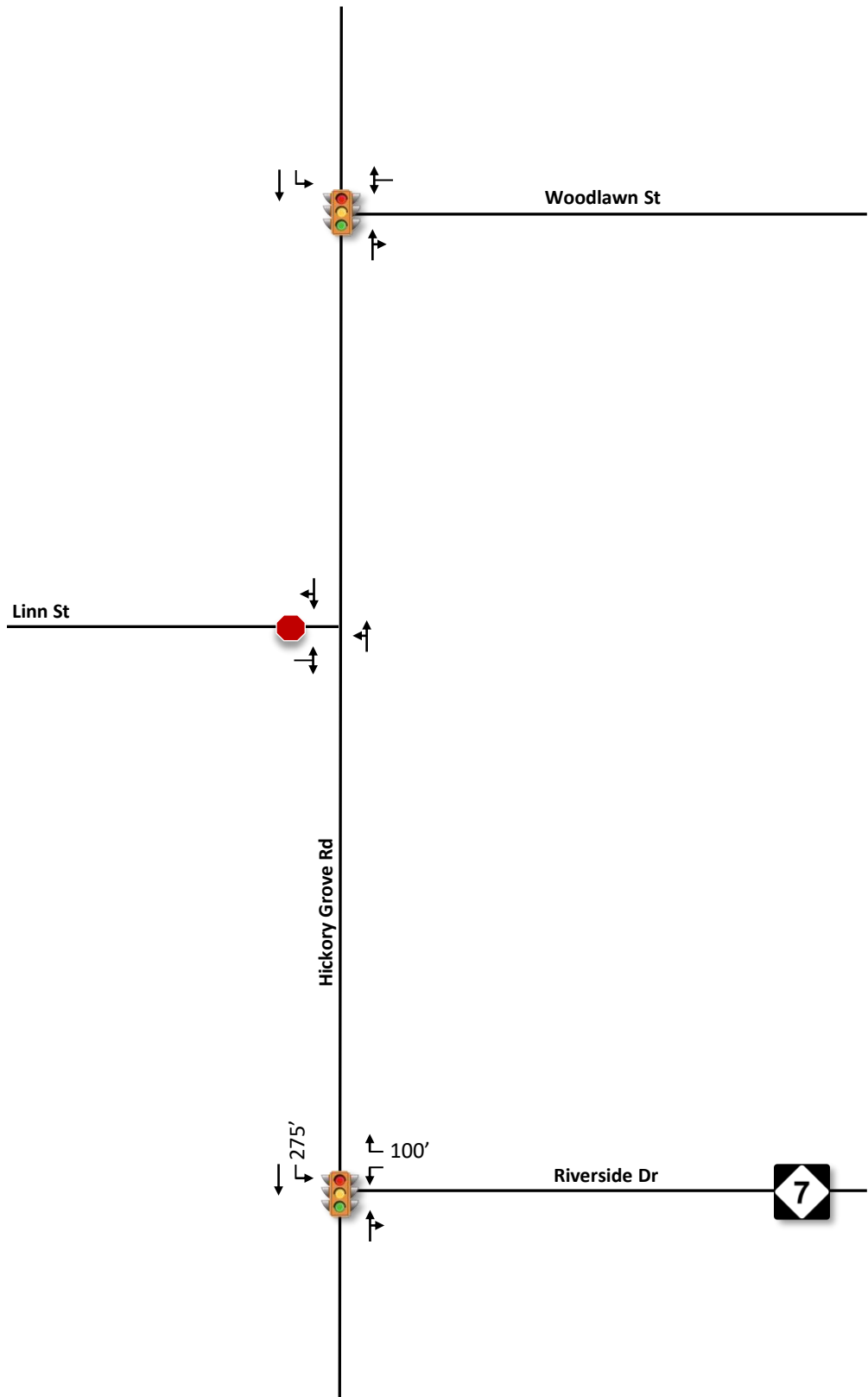


- 1. Hickory Grove Rd and Woodlawn St
- 2. Hickory Grove Rd and Linn St
- 3. Hickory Grove Rd and Riverside Dr (NC 7)
- 4. Hickory Grove Rd and Access 1
- Hickory Grove Rd and Perfection Ave

nearmap



NOT TO SCALE

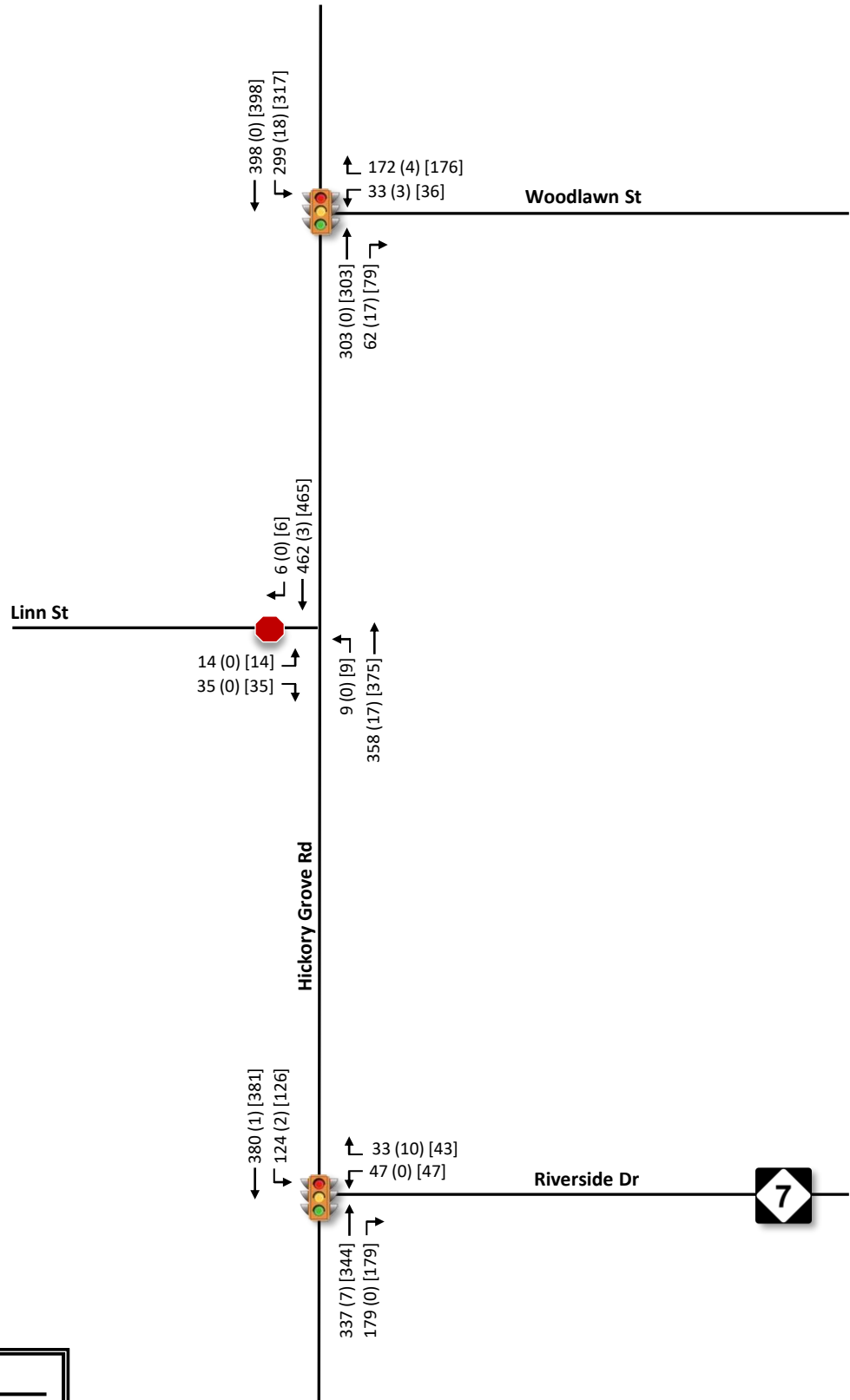


LEGEND

- Existing Lane
- X' Storage Length
- Traffic Signal
- Stop Control



NOT TO SCALE

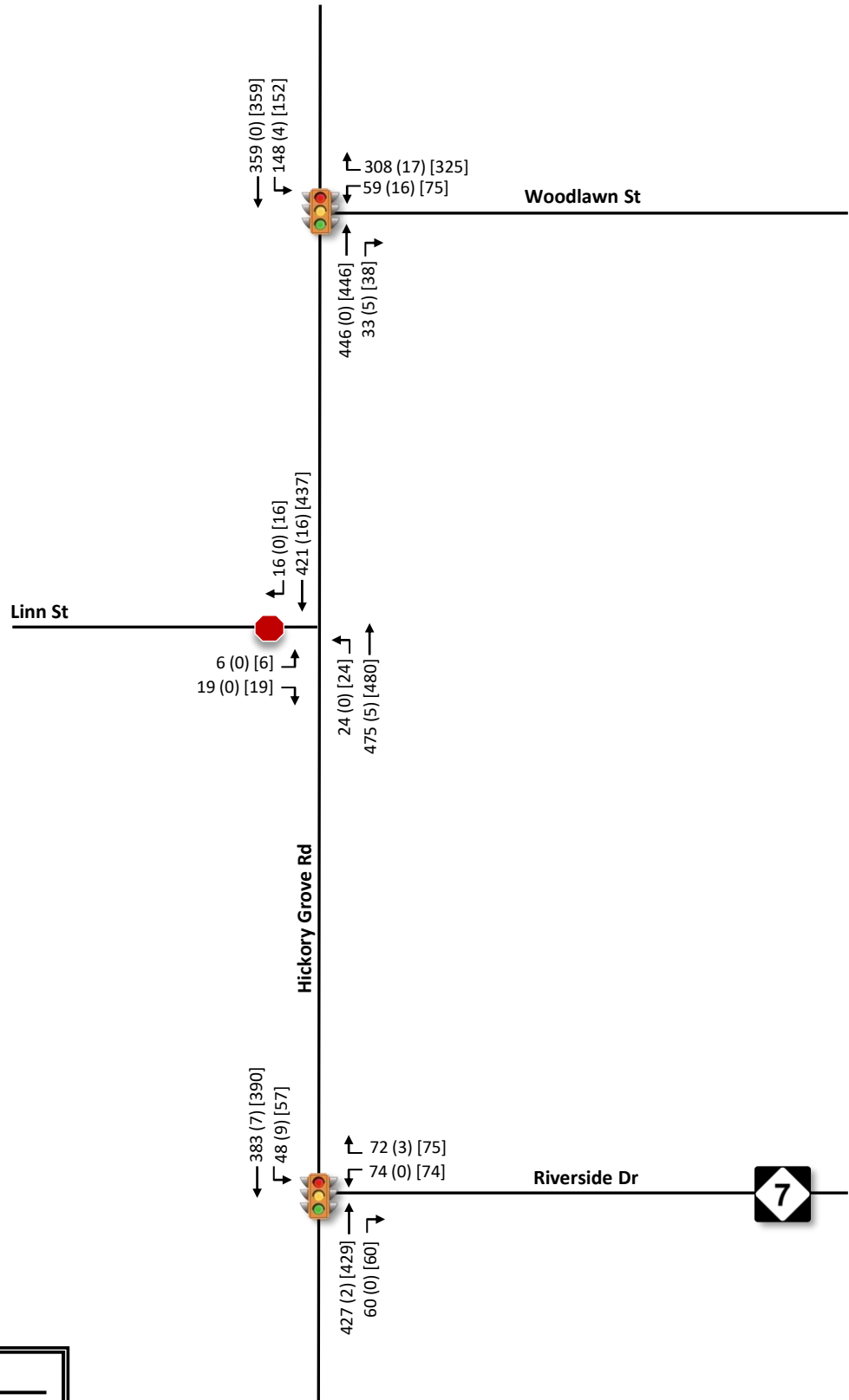


LEGEND

- XX Historic Growth Traffic
- ((XX)) Approved Development Trips
- [XX] Background Traffic Volumes



NOT TO SCALE

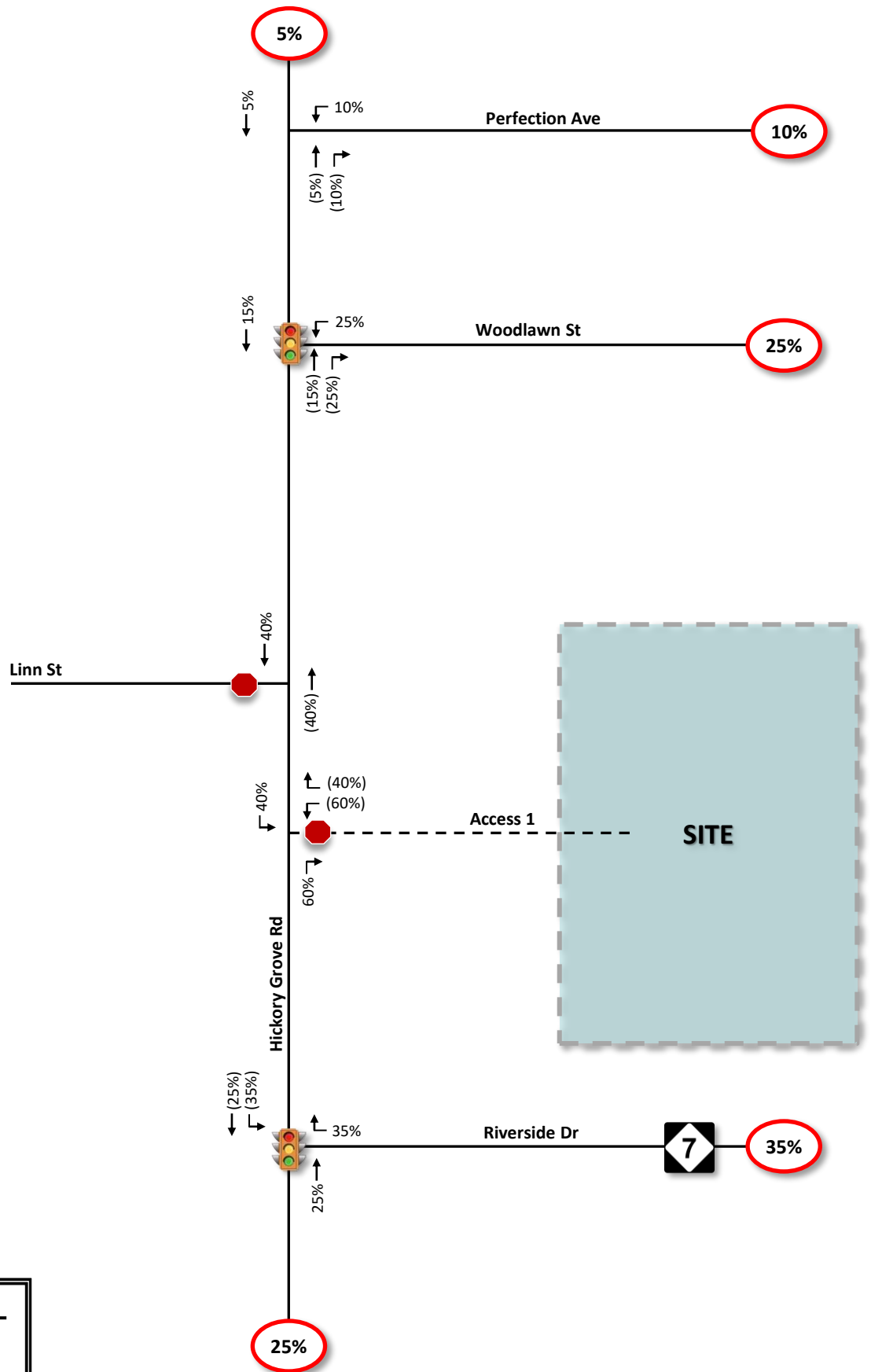


LEGEND

- XX Historic Growth Traffic
- (XX) Approved Development Trips
- [XX] Background Traffic Volumes



NOT TO SCALE

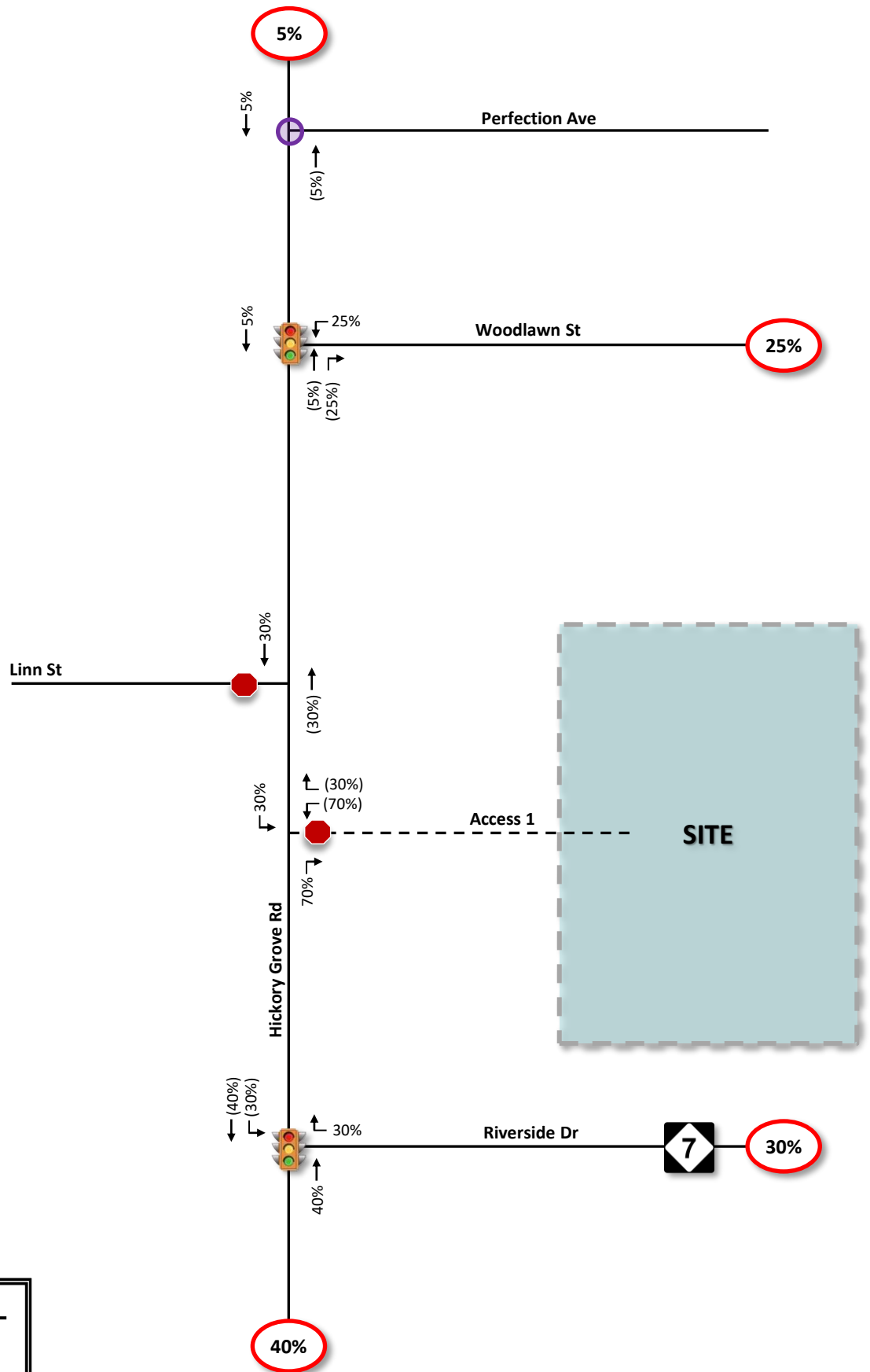


LEGEND

- XX%** Site Traffic Distribution
- XX% Inbound Assignment
- (XX%) Outbound Assignment



NOT TO SCALE

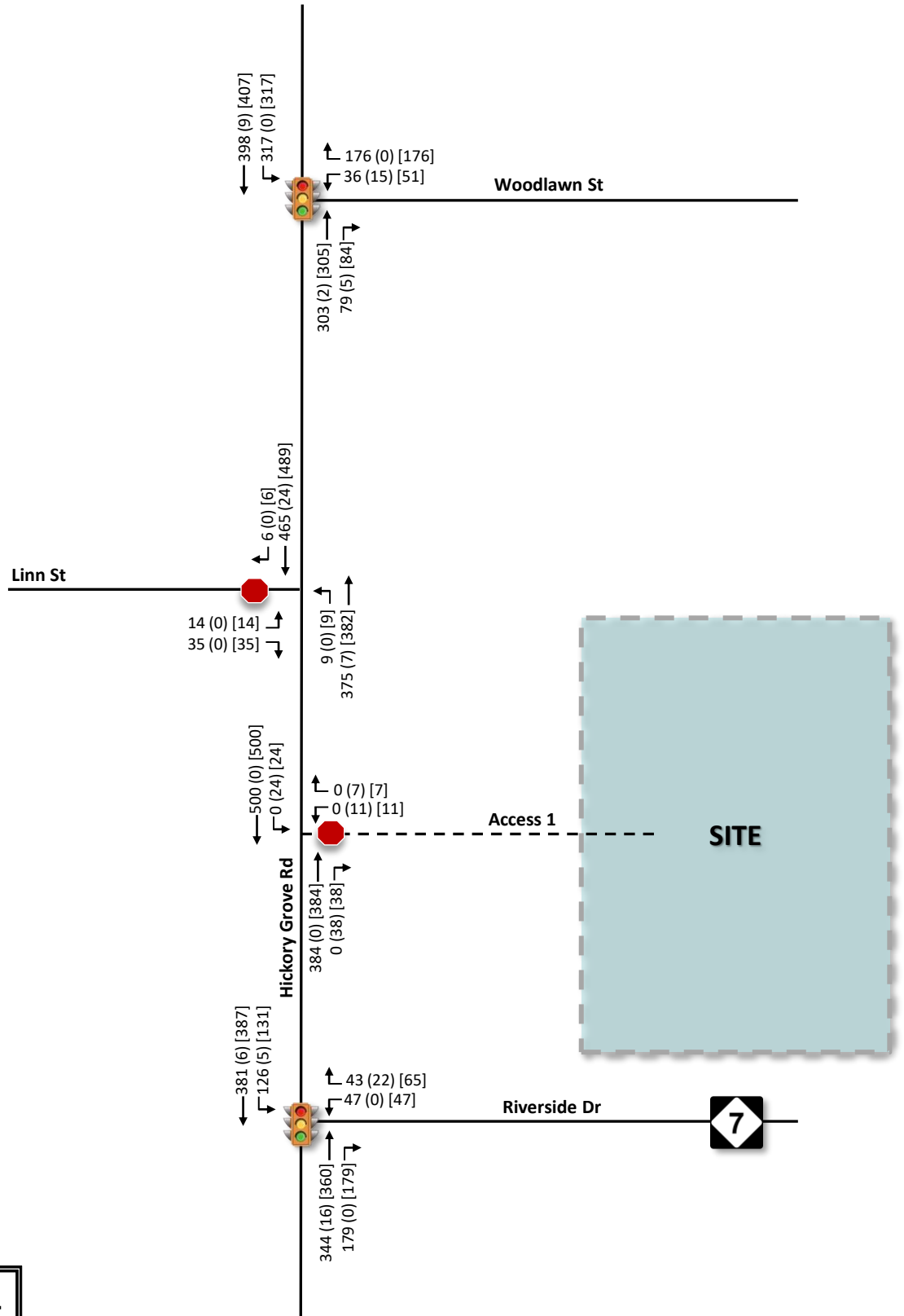


LEGEND

- XX% Site Traffic Distribution
- XX% Inbound Assignment
- (XX%) Outbound Assignment



NOT TO SCALE

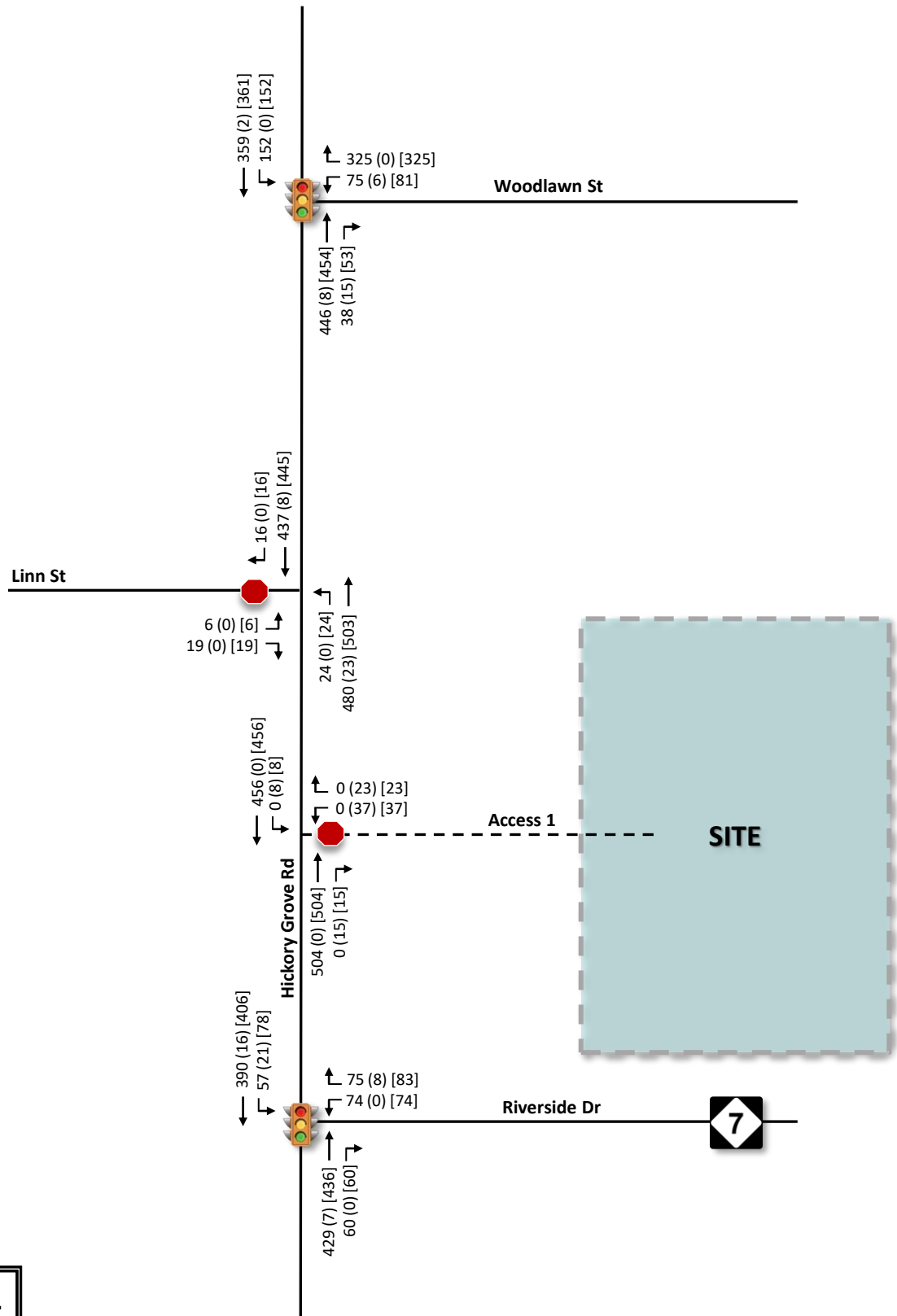


LEGEND

XX Background Traffic
 (XX) Site Trips
 [XX] Build-out Traffic

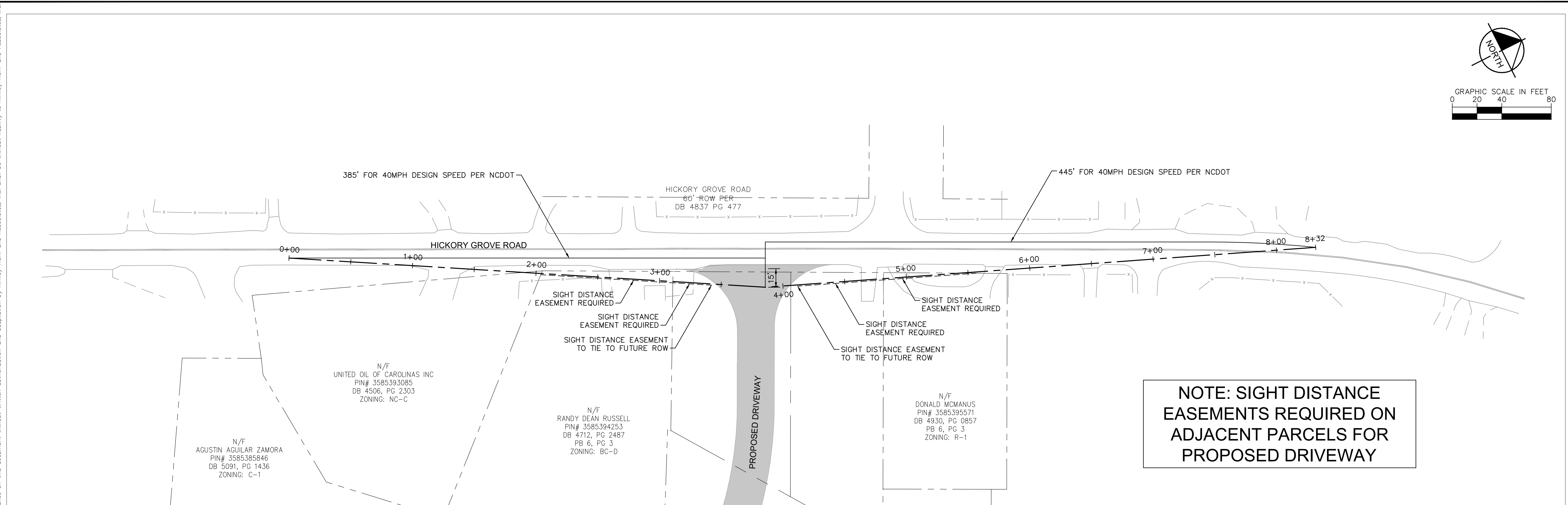


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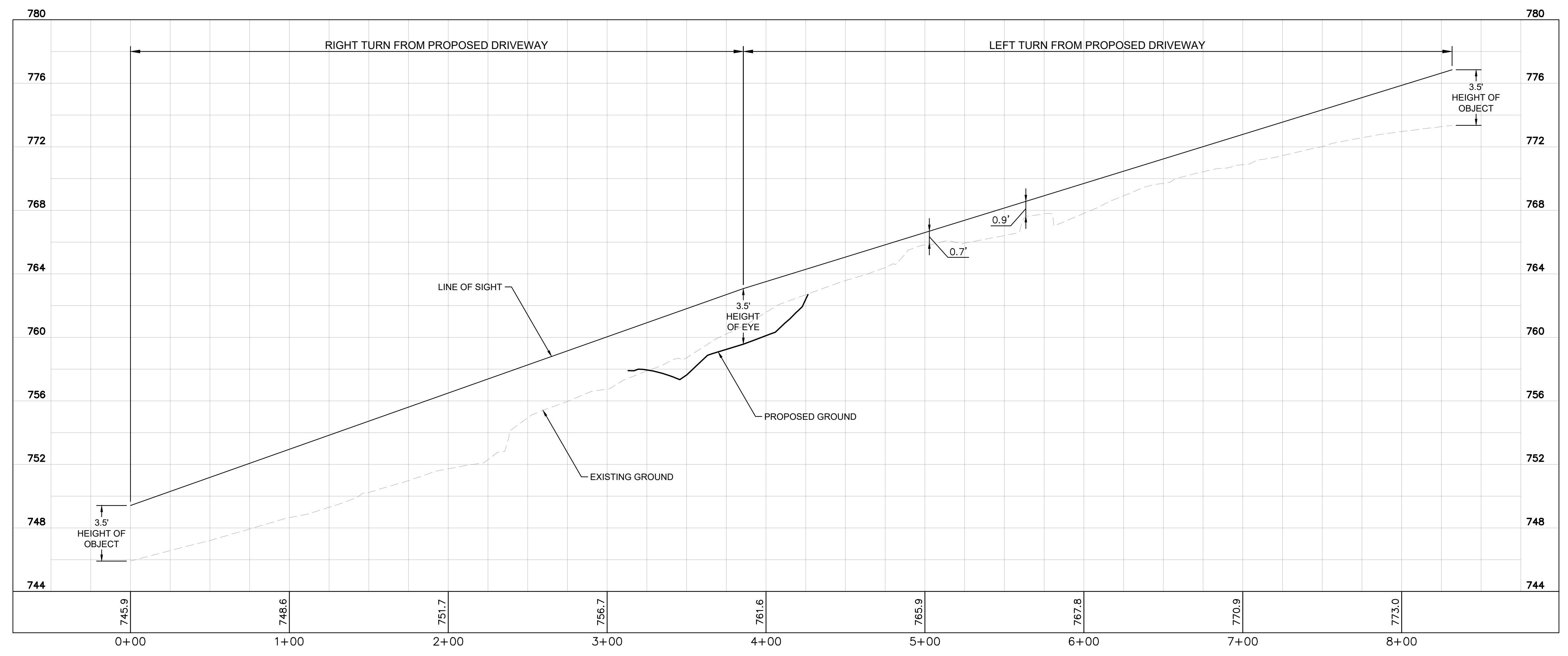


LEGEND	
XX	Background Traffic
(XX)	Site Trips
[XX]	Build-out Traffic

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SIGHT DISTANCE PROFILES



No.	REVISIONS	DATE	BY

Kimley-Horn
 © 2022 KIMLEY-HORN AND ASSOCIATES, INC.
 200 SOUTH TRYON ST., SUITE 200, CHARLOTTE, NC 28202
 WWW.KIMLEY-HORN.COM
 NC LICENSE #F-0102

NOT FOR CONSTRUCTION

KHA PROJECT	015020023
DATE	JUNE 2022
SCALE	AS SHOWN
DESIGNED BY	SHA
DRAWN BY	SHA
CHECKED BY	JMR

SIGHT DISTANCE PROFILES

OAKS COMMERCE CENTER
 PREPARED FOR
 CROW HOLDINGS
 GASTONIA NC



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