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Preserve at Marks Creek<br>Traffic Impact Analysis<br>Knightdale, North Carolina

## TRAFFIC IMPACT ANALYSIS

FOR

## PRESERVE AT MARKS CREEK

## LOCATED

I N

KNI GHTDALE, NC

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December 2021

# TRAFFIC IMPACT ANALYSIS PRESERVE AT MARKS CREEK KNI GHTDALE, NORTH CAROLI NA 

## EXECUTI VE SUMMARY

## 1. Development Overview

A Traffic Impact Analysis (TIA) was conducted for the proposed Preserve at Marks Creek development in accordance with the Knightdale (Town) Unified Development Ordinance (UDO) and North Carolina Department of Transportation (NCDOT) capacity analysis guidelines. The proposed development is to be located west of Marks Creek Road and north of US 64 Business in Knightdale, N orth Carolina. Access to the development is proposed via three (3) driveways along Marks Creek Road. Based on coordination with the Town, the southernmost site driveway should be restricted due to the proximity of the driveway to US 64 Business. A left-over (right$\mathrm{in} /$ right-out with left-in) will be assumed for this driveway in the analysis; however, additional restriction (right-in/ right-out only) may be considered if there are concerns based on the capacity and queuing analysis results. The middle and northernmost site driveways are proposed to be full movement.

Per the Town UDO, future analysis should include the build year +1 year, as well as a future (build year +10 years) scenario. The study analyzes traffic conditions during the weekday AM and PM peak hours for the following scenarios:

- 2021 Existing Traffic Conditions
- 2028+1 No-Build Traffic Conditions
- 2028+1 Build Traffic Conditions
- 2028+1 Build Traffic Conditions with Improvements
- 2028+10 Future - Per Town UDO


## 2. Existing Traffic Conditions

The study area for the TIA was determined through coordination with the Town and NCDOT and consists of the following existing intersections:

- Marks Creek Road and H orton Road
$\qquad$
- Marks Creek Road and US 64 Business
- US 64 Business and Western U-Turn Bulb

Existing peak hour traffic volumes were determined based on traffic counts conducted at the study intersections listed above, in October of 2021 by RKA during a typical weekday AM (7:00 AM - 9:00 AM ) and PM (4:00 PM - 6:00 PM) peak periods, while schools were in session. Because schools were in session and in-person during data collection, and based on recent studies within the vicinity of the site indicating traffic volumes are more consistent with what would be expected, no traffic adjustments were made to account for the COVID-19 pandemic. It should be noted that minimal pedestrians were counted within the study area during data collection and there were minimal eastbound u-turning trips at the intersection of US 64 Business and Western U-Turn Bulb.

## 3. Site Trip Generation

The proposed development is assumed to consist of a maximum of 150 singlefamily homes. Average weekday daily, AM peak hour, and PM peak hour trips for the proposed development were estimated using methodology contained within the ITE Trip Generation Manual, 10 ${ }^{\text {th }}$ Edition. Table E-1 provides a summary of the trip generation potential for the site.

Table E-1: Site Trip Generation

| Land Use (ITE Code) | I ntensity | Daily Traffic (vpd) | Weekday AM Peak Hour Trips (vph) |  | Weekday PM Peak Hour Trips (vph) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Enter | Exit | Enter | Exit |
| Single-Family Detached Housing (210) | 246 units | 2,380 | 45 | 134 | 152 | 89 |
| Multifamily Low-Rise Housing (220) | 121 units | 880 | 13 | 44 | 44 | 26 |
| Total Trips |  | 3,260 | 58 | 178 | 196 | 115 |

## 4. Future Traffic Conditions

Through coordination with the Town and NCDOT, it was determined that an annual growth rate of 3\% would be used to generate 2029 projected weekday AM and PM peak hour traffic volumes.

After 2029, an annually compounded growth rate of $1 \%$ was used to project 2029 volumes to 2038. The following adjacent devel opments were considered under future conditions:

- Old Milburnie Road Residential
- East Wake Middle School Expansion
- Buffaloe Shoals
- Forestville Road Townhomes
- BlueRun LaneTownhomes
- Knightdale Soccer Park
- Buffaloe A ssemblage (previously known as Saluda Tract)
- ForestvilleVillage
- Haywood Glen (Phase4)


## 5. Capacity Analysis Summary

The analysis considered weekday AM and PM peak hour traffic for 2021 existing, 2029 no-build, 2029 build, and 2038 build conditions. Refer to Section 7 of the TIA for the capacity analysis summary performed at each study intersection.

## 6. Recommendations

Based on the findings of this study, specific geometric and traffic control improvements have been identified at study intersections. The improvements are summarized below and are illustrated in Figure E-1.

## Recommended Improvements by Developer

## Marks Creek Road and US 64 Business

- Monitor the northern portion of this intersection (westbound through/ right-turn, southbound right-turn, and eastbound left-turn movements) for signalization, and install traffic signal if warranted and approved by NCDOT.


## Marks Creek Road and Site Drive 1

- Construct the western leg of the intersection with one ingress and one egress lane. Restrict the egress lane to right-out only.
- Provide an exclusive northbound left-turn lane with at least 100 feet of storage and appropriate deceleration and taper length.
- Provide stop-control for the eastbound approach.


## Marks Creek Road and Site Drive 2

- Construct the western leg of the intersection with one ingress and one egress lane.
- Provide an exclusive northbound left-turn lane with at least 100 feet of storage and appropriate deceleration and taper length.
- Provide stop-control for the eastbound approach.


## Marks Creek Road and Site Drive 3

- Construct the western leg of the intersection with one ingress and one egress lane.
- Provide an exclusive northbound left-turn lane with at least 100 feet of storage and appropriate deceleration and taper length.
- Provide stop-control for the eastbound approach.
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| Moving forward. <br> RAMEY KEMP ASSOCIATES | Preserve at Marks Creek Knightdale, NC | Recommended Lane Configurations |  |
| :---: | :---: | :---: | :---: |
|  |  | Scale: Not to Scale | Figure E-1 |

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# TRAFFIC IMPACT ANALYSIS <br> PRESERVE AT MARKS CREEK KNI GHTDALE, NORTH CAROLI NA 

## 1. I NTRODUCTI ON

The contents of this report present the findings of the Traffic Impact Analysis (TIA) conducted for the proposed Preserve at Marks Creek development to be located west of Marks Creek Road and north of US 64 Business in Knightdale, North Carolina. The purpose of this study is to determine the potential impacts to the surrounding transportation system created by traffic generated by the proposed development, as well as recommend improvements to mitigate the impacts.

The proposed development, anticipated to be completed in 2028, is assumed to consist of the following uses:

- 101 townhomes
- 246 single-family homes

Access to the development is proposed via three (3) driveways along Marks Creek Road. Based on coordination with the Town, the southernmost site driveway should be restricted due to the proximity of the driveway to US 64 Business. A left-over (right-in/ right-out with left-in) will be assumed for this driveway in the analysis; however, additional restriction (right-in/ right-out only) may be considered if there are concerns based on the capacity and queuing analysis results. The middle and northernmost site driveways are proposed to be full movement. This methodology was approved during scoping by the Town of Knightdale (Town) and the North Carolina Department of Transportation (NCDOT). Refer to Appendix A for a copy of the approved Memorandum of Understanding (MOU).

Per the Town Unified Development Ordinance (UDO), future analysis should include the build year +1 year, as well as a future (build year +10 years) scenario. The study analyzes traffic conditions during the weekday AM and PM peak hours for the following scenarios:

- 2021 Existing Traffic Conditions
- 2028+1 No-Build Traffic Conditions
- 2028+1 Build Traffic Conditions
- 2028+1 Build Traffic Conditions with Improvements
- 2028+10 Future - Per Town UDO


### 1.1. Site Location and Study Area

The development is proposed to be located west of Marks Creek Road and north of US 64 Business in Knightdale, N orth Carolina. Refer to Figure 1 for the site location map.

The study area for the TIA was determined through coordination with the NCDOT and the Town and consists of the following existing intersections:

- M arks Creek Road and H orton Road
- Marks Creek Road and US 64 Business
- US 64 Business and Western U-Turn Bulb

Refer to A ppendix A for the approved scoping documentation.

### 1.2. Proposed Land Use and Site Access

The site is located west of Marks Creek Road and north of US 64 Business. The proposed development, anticipated to be completed in 2028, is assumed to consist of the following uses:

- 101 townhomes
- 246 single-family homes

Access to the development is proposed via three (3) driveways along Marks Creek Road. Based on coordination with the Town, the southernmost site driveway should be restricted due to the proximity of the driveway to US 64 Business. A left-over (right-in/ right-out with left-in) will be assumed for this driveway in the analysis; however, additional restriction (right-in/ right-out only) may be considered if there are concerns based on the capacity and queuing analysis results. The middle and northernmost site driveways are proposed to be full movement. Refer to Figure 2 for a copy of the preliminary site plan.

### 1.3. Adjacent Land Uses

The proposed development is located in an area consisting primarily of residential development. Farm land and undeveloped land are located to the north of the site.

### 1.4. Existing Roadways

Existing lane configurations (number of traffic lanes on each intersection approach), speed limits, storage capacities, and other intersection and roadway information within the study area are shown in Figure 3. Table 1 provides a summary of this information, as well.

Table 1: Existing Roadway Inventory

| Road Name | Route <br> Number | Typical <br> Cross <br> Section | Speed Limit | Maintained <br> By | 2019 AADT <br> (vpd) |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Knightdale <br> Boulevard | US 64 <br> Business | 4-lane <br> divided | 45 mph | NCDOT | 19,500 |
| MarksCreek <br> Road | SR 2234 | 2-lane <br> undivided | 45 mph | NCDOT | $1,600^{*}$ |
| Horton Road | SR 2231 | 2-lane <br> undivided | 35 mph | NCDOT | 2,300 |

*AADT from 2015


-     - ı Proposed Site Location

Oxisting Study Intersection

- -ı Study Area

Preserve at Marks Creek Knightdale, NC

Site Location Map


*Pavement width exists to allow an exclusive right-turn lane with approximately $25^{\prime}$ of storage; however, this turn lane is not striped, so will not be assumed for Synchro analysis to provide conservative results.


| Moving forward. <br> RAMEY KEMP ASSOCIATES | Preserve at Marks Creek Knightdale, NC | 2021 Existing <br> Lane Configurations |  |
| :---: | :---: | :---: | :---: |
|  |  | Scale: Not to Scale | Figure 3 |

## 2. 2021 EXISTING PEAK HOUR CONDITIONS

### 2.1. 2021 Existing Peak Hour Traffic Volumes

Existing peak hour traffic volumes were determined based on traffic counts conducted at the study intersections listed below, in October of 2021 during typical weekday AM (7:00 AM 9:00 AM ) and PM (4:00 PM - 6:00 PM ) peak periods:

- Marks Creek Road and Horton Road
- Marks Creek Road and US 64 Business
- US 64 Business and Western U-Turn Bulb

Because schools were in session and in-person during data collection, and based on recent studies within the vicinity of the site indicating traffic volumes are more consistent with what would be expected, no traffic adjustments were made to account for the COVID-19 pandemic. It should be noted that minimal pedestrians were counted within the study area during data collection and there were minimal eastbound u-turning trips at the intersection of US 64 Business and Western U-Turn Bulb. Refer to Figure 4 for 2021 existing weekday AM and PM peak hour traffic volumes. A copy of the count data is located in A ppendix B of this report.

### 2.2. Analysis of 2021 Existing Peak Hour Traffic Conditions

The 2021 existing weekday AM and PM peak hour traffic volumes were analyzed to determine the current levels of service at the study intersections under existing roadway conditions. The results of the analysis are presented in Section 7 of this report.

| $\mathrm{X} / \mathrm{Y} \rightarrow$ | LEGEND <br> Unsignalized Intersection <br> Weekday AM / PM Peak <br> Hour Traffic |
| :--- | :--- |



| Moving forward. <br> RAMEY KEMP ASSOCIATES | Preserve at Marks Creek Knightdale, NC | 2021 Existing Peak Hour Traffic |  |
| :---: | :---: | :---: | :---: |
|  |  | Scale: Not to Scale | Figure 4 |

## 3. 2029/ 2038 NO-BUI LD PEAK HOUR CONDITIONS

In order to account for growth of traffic and subsequent traffic conditions at a future year, nobuild traffic projections are needed. No-build traffic is the component of traffic due to the growth of the community and surrounding area that is anticipated to occur regardless of whether the proposed development is constructed. No-build traffic is comprised of existing traffic growth within the study area and additional traffic created as a result of adjacent approved developments.

### 3.1. Ambient Traffic Growth

Through coordination with the Town and NCDOT, it was determined that an annually compounded growth rate of $3 \%$ would be used to generate 2029 projected weekday AM and PM peak hour traffic volumes. After 2029, an annually compounded growth rate of $1 \%$ will be utilized to project 2029 volumes to 2038. Refer to Figure 5a and Figure 5b for 2029 projected peak hour traffic volumes and 2038 projected peak hour traffic volumes, respectively.

### 3.2. Adjacent Development Traffic

Through coordination with the Town and NCDOT, the following adjacent developments were identified to be included as an approved adjacent development in this study:

- Old Milburnie Road Residential
- East Wake Middle School Expansion
- Buffaloe Shoals
- Forestville Road Townhomes
- BlueRun LaneTownhomes
- Knightdale Soccer Park
- Buffaloe Assemblage (previously known as Saluda Tract)
- ForestvilleVillage
- Haywood Glen (Phase4)

Table 2, on thefollowing page, provides a summary of the adjacent developments.

Table 2: Adjacent Development I nformation

| Development Name | Location | BuildOut Year | Land Use / I ntensity | TIA <br> Performed |
| :---: | :---: | :---: | :---: | :---: |
| Old Milburnie Road Residential | North of Buffaloe Road and west of Old Milburnie Road | 2022 | 177 singlefamily homes and 93 townhomes | $\begin{gathered} \text { March } 2021 \\ \text { by RKA } \end{gathered}$ |
| East Wake Middle School Expansion | 2700 Old Milburnie Road | 2020 | 287 students added to the existing 1,163 student enrollment | September 2016 by AMT |
| Buffaloe Shoals | Southwest quadrant at the intersection of Buffaloe Road and Forestville Road | 2023 | 414 apartment units | January of 2021 by RKA |
| Forestville Road Townhomes | N orthwestern quadrant of the intersection of Forestville Road and Needham Road | 2024 | 284 Townhomes | August of 2020 by Timmons Group |
| Blue Run Lane | West of Blue Run Lane | 2026 | 207 Townhomes | January of 2020 by RKA |
| Knightdale Soccer Park | N orth of Forestville Road and west of Horton Road | N/ A* | 10 Soccer Fields | N/A (trip generation) |
| Buffaloe Assemblage | South of Buffaloe Road and east of Old Crews Road | 2027 | 799 single-family homes and 514 townhomes | $\begin{gathered} \text { May of } 2021 \\ \text { by RKA } \end{gathered}$ |
| Forestville Village | West of Old Knight Road and north of Forestville Road | 2025 | 90 single-family homes, 190 townhomes, and 40,000 sq. ft. retail | January of 2021 by RKA |
| Haywood Glen (Phase 4) | Along Old Knight Road | N/ A* | 129 single-family homes | N/A <br> (trip generation) |

*Assumed prior to the build-out of the proposed Preserve at M arks Creek development.

For developments in which a TIA was not performed, a site trip generation and assignment was performed based on other development in the area. The adjacent developments were
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approved, during scoping, by the Town and NCDOT. None of the adjacent developments have committed roadway improvements within the study area. Adjacent development trips are shown in Figure 6. A djacent development information can be found in A ppendix D.

### 3.3. Future Roadway I mprovements

Based on coordination with the NCDOT and the Town, it was determined there are no future roadway improvements to consider with this study.

### 3.4. 2029/ 2038 No-Build Peak Hour Traffic Volumes

The 2029 no-build traffic volumes were determined by projecting the 2021 existing peak hour traffic to the year 2029 and adding the adjacent development trips. Similarly, 2038 no-build traffic volumes were determined by projecting 2029 projected peak hour traffic to the year 2038 and adding the adjacent development trips. Refer to Figure 7a and Figure 7b for 2029 nobuild peak hour traffic volumes and 2038 no-build peak hour traffic volumes, respectively.

### 3.5. Analysis of 2029 No-Build Peak Hour Traffic Conditions

The 2029 no-build AM and PM peak hour traffic volumes at the study intersections were analyzed with future geometric roadway conditions and traffic control. Based on the Town's UDO, 2038 conditions were only analyzed with the site fully built-out. Refer to Section 5 of this report for more information. The analysis results of 2029 no-build traffic conditions are presented in Section 7 of this report.



| Moving forward. |
| :--- | :--- | :--- |
| RAMEY KEMP ASSOCIIATES |$\quad$| Preserve at Marks Creek |
| :---: |
| Knightdale, NC |$\quad$| 2029 Projected <br> Peak Hour Traffic |  |
| :---: | :---: |
|  |  |




| Moving forward. |
| :--- | :--- | :--- |
| RAMEY KEMP ASSOCIIATES |$\quad$| Preserve at Marks Creek |
| :---: |
| Knightdale, NC |$\quad$| 2038 Projected <br> Peak Hour Traffic |  |
| :---: | :---: |
|  |  |

```
LEGEND
    \bigcirc \text { Onsignalized Intersection}
    X/Y }->\mathrm{ Weekday AM / PM Peak Hour
    Adjacent Development Trips
```




Peak Hour Adjacent Development Trips

$$
\begin{array}{|r|l|}
\hline \quad \begin{array}{l}
\text { LEGEND } \\
\text { Unsignalized Intersection } \\
\text { X / Y } \rightarrow \text { Weekday AM / PM Peak } \\
\text { Hour Traffic }
\end{array}
\end{array}
$$




| Moving forward. |
| :--- | :--- | :--- | :--- |
| RAMEY KEMP ASSOCIATES |$\quad$| Preserve at Marks Creek |
| :---: |
| Knightdale, NC |$\quad$| 2029 No-Build <br> Peak Hour Traffic |  |
| :---: | :---: |
|  |  |


| $\mathrm{X} / \mathrm{Y} \rightarrow$ | LEGEND |
| :--- | :--- |
| Unsignalized Intersection |  |
| Weekday AM / PM Peak |  |
| Hour Traffic |  |



| Moving forward. <br> RAMEY KEMP ASSOCIATES | Preserve at Marks Creek Knightdale, NC | 2038 No-Build Peak Hour Traffic |  |
| :---: | :---: | :---: | :---: |
|  |  | Scale: Not to Scale | Figure 7b |

## 4. SITE TRIP GENERATI ON AND DISTRIBUTI ON

### 4.1. Trip Generation

The proposed development is assumed to consist of 246 singlefamily homes and 121 low-rise multifamily units. Average weekday daily, AM peak hour, and PM peak hour trips for the proposed development were estimated using methodology contained within the ITE Trip Generation M anual, $10^{\text {th }}$ Edition. Table 3 provides a summary of the trip generation potential for the site.

Table 3: Trip Generation Summary

| Land Use (ITE Code) | I ntensity | Daily Traffic (vpd) | Weekday AM Peak Hour Trips (vph) |  | Weekday PM Peak Hour Trips (vph) |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Enter | Exit | Enter | Exit |
| Single-Family Detached Housing (210) | 246 units | 2,380 | 45 | 134 | 152 | 89 |
| Multifamily Low-Rise Housing (220) | 121 units | 880 | 13 | 44 | 44 | 26 |
| Total Trips |  | 3,260 | 58 | 178 | 196 | 115 |

It is estimated that the proposed development will generate approximately 3,260 total site trips on the roadway network during a typical 24 -hour weekday period. Of the daily traffic volume, it is anticipated that 236 trips ( 58 entering and 178 exiting) will occur during the weekday AM peak hour and 311 (196 entering and 115 exiting) will occur during the weekday PM peak hour.

### 4.2. Site Trip Distribution and Assignment

Trip distribution percentages used in assigning site traffic for this development were estimated based on a combination of existing traffic patterns, population centers adjacent to the study area, and engineering judgment.

It is estimated that the sitetrips will be regionally distributed as follows:

- $5 \%$ to/ from the north via M arks Creek Road
- $15 \%$ to/ from the west via Horton Road
- $65 \%$ to/ from the west via US 64 Business
- $15 \%$ to/ from the east via US 64 Business

The site trip distribution is shown in Figure 8. Refer to Figure 9 for the site trip assignment.


| Moving forward. | Preserve at Marks Creek <br> Knightdale, NC | Site Trip Distribution |  |
| :--- | :--- | :--- | :--- |
|  |  | Scale: Not to Scale | Figure 8 |



## 5. 2029/2038 BUI LD TRAFFIC CONDI TI ONS

### 5.1. 2029/ 2038 Build Peak Hour Traffic Volumes

To estimate traffic conditions with the site fully built-out, the total site trips were added to the 2029 no-build traffic volumes to determine the 2029 build traffic volumes. Similarly, site trips were added to the 2038 no-build traffic volumes to determine the 2038 build traffic volumes. Refer to Figure 10a and Figure 10b for an illustration of the 2029 build peak hour traffic volumes and 2028 build peak hour traffic volumes, respectively, with the proposed site fully developed.

### 5.2. Analysis of 2029/ 2038 Build Peak Hour Traffic Conditions

Study intersections were analyzed with the 2029/ 2038 build traffic volumes using the same methodology previously discussed for existing and no-build traffic conditions. Intersections were analyzed with improvements necessary to accommodate future traffic volumes. The results of the capacity analysis for each intersection are presented in Section 7 of this report.

## LEGEND

$$
\mathrm{x} / \mathrm{Y} \rightarrow \begin{aligned}
& \text { Weekday AM / PM Peak } \\
& \text { Hour Traffic }
\end{aligned}
$$

| Moving forward. |
| :--- | :--- | :--- |
| RAMEY KEMP ASSOCIIATES |$\quad$| Preserve at Marks Creek |
| :---: |
| Knightdale, NC |$\quad$| 2029 Build <br> Peak Hour Traffic |  |
| :---: | :---: |
|  |  |



## 6. TRAFFIC ANALYSIS PROCEDURE

Study intersections were analyzed using the methodology outlined in the Highway Capacity $M$ anual (HCM), $6^{\text {th }}$ Edition published by the Transportation Research Board. Capacity and level of service are the design criteria for this traffic study. A computer software package, Synchro (Version 10.3), was used to complete the analyses for the study area intersections. Please note that the unsignalized capacity analysis does not provide an overall level of service for an intersection; only delay for an approach with a conflicting movement.

The HCM defines capacity as "the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions." Level of service (LOS) is a term used to represent different driving conditions and is defined as a "qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/ or passengers." Level of service varies from Level "A" representing free flow, to Level "F" where breakdown conditions are evident. Refer to Table 4 for HCM levels of service and related average control delay per vehicle for both signalized and unsignalized intersections. Control delay as defined by the HCM includes "initial deceleration delay, queue moveup time, stopped delay, and final acceleration delay". An average control delay of 50 seconds at a signalized intersection results in LOS "D" operation at the intersection.

Table 4: Highway Capacity Manual - Levels-of-Service and Delay

| UNSI GNALI ZED I NTERSECTI ON |  | SI GNALI ZED INTERSECTI ON |  |
| :---: | :---: | :---: | :---: |
| LEVEL | AVERAGE CONTROL <br> OF <br> SERVI CE | DELYY PER <br> VEHI CLE <br> (SECONDS) | LEVEL OF <br> SERVI CE |
| A | $0-10$ | AVERAGE CONTROL <br> DELAY PER <br> VEHI CLE <br> (SECONDS) |  |
| B | $10-15$ | A | 0.10 |
| C | $15-25$ | B | $10-20$ |
| D | $25-35$ | C | $20-35$ |
| E | $35-50$ | D | $35-55$ |
| F | $>50$ | E | $55-80$ |

### 6.1. Adjustments to Analysis Guidelines

Capacity analysis at all study intersections was completed according to the NCDOT Congestions Management Guidelines and the Town's Unified Development Ordinance (UDO).

## 7. CAPACI TY ANALYSIS

### 7.1. Marks Creek Road and Horton Road

The existing unsignalized intersection of Marks Creek Road and Horton Road was analyzed under 2021 existing, 2029 no-build, 2029 build, and 2038 build traffic conditions with the lane configurations and traffic control shown in Table 5. Refer to Table 5 for a summary of the analysis results. Refer to Appendix $D$ for the Synchro capacity analysis reports. Refer to A ppendixJ for a copy of the SimTraffic queuing reports and queuing summary.

Table 5: Analysis Summary of Marks Creek Road and Horton Road

| ANALYSIS SCENARIO | $\begin{aligned} & \hline \mathbf{A} \\ & \mathbf{P} \\ & \mathbf{P} \\ & \mathbf{R} \\ & \mathbf{O} \\ & \mathbf{A} \\ & \mathbf{C} \\ & \mathbf{H} \\ & \hline \end{aligned}$ | LANE <br> CONFIGURATI ONS | WEEKDAY AM PEAK HOUR LEVEL OF SERVICE |  | WEEKDAY PM PEAK HOUR LEVEL OF SERVICE |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Approach | Overall (seconds) | Approach | Overall (seconds) |
| 2021 Existing | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{aligned} & 1 \text { LT-RT } \\ & 1 \text { LT-TH } \\ & 1 \text { TH-RT } \end{aligned}$ | $\begin{aligned} & \mathrm{B}^{2} \\ & \mathrm{~A}^{1} \end{aligned}$ | N/ A | $\begin{aligned} & \mathrm{C}^{2} \\ & \mathrm{~A}^{1} \end{aligned}$ | N/ A |
| 2029 N o-Build | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{aligned} & \text { 1 LT-RT } \\ & 1 \text { LT-TH } \\ & \text { 1TH-RT } \end{aligned}$ | $\begin{aligned} & \mathrm{C}^{2} \\ & \mathrm{~A}^{1} \\ & -- \\ & \hline \end{aligned}$ | N/ A | $\begin{aligned} & \mathrm{E}^{2} \\ & \mathrm{~A}^{1} \end{aligned}$ | N/ A |
| 2029 Build | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { 1 LT-RT } \\ & 1 \text { LT-TH } \\ & \text { 1 TH-RT } \end{aligned}$ | $\begin{gathered} \mathrm{C}^{2} \\ \mathrm{~A}^{1} \\ -- \end{gathered}$ | N/ A | $\begin{aligned} & \mathrm{F}^{2} \\ & \mathrm{~A}^{1} \end{aligned}$ | N/ A |
| 2038 Build | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{aligned} & \text { 1 LT-RT } \\ & 1 \text { LT-TH } \\ & 1 \text { TH-RT } \end{aligned}$ | $\begin{gathered} \mathrm{C}^{2} \\ \mathrm{~A}^{1} \\ -- \end{gathered}$ | N/ A | $\begin{aligned} & \hline \mathrm{F}^{2} \\ & \mathrm{~A}^{1} \end{aligned}$ | N/ A |
| 2029 Build Improvements | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} 1 \mathrm{LT}-\mathrm{RT} \\ 1 \mathrm{LT}-\mathrm{TH} \\ 1 \mathrm{TH}, 1 \mathrm{RT} \end{gathered}$ | $\begin{aligned} & \mathrm{B}^{2} \\ & \mathrm{~A}^{1} \end{aligned}$ | N/ A | $\begin{aligned} & D^{2} \\ & A^{1} \end{aligned}$ | N/ A |

1. Level of service for major-street left-turn movement.
2. Level of servicefor minor-street approach.

Improvements needed to meet Town UDO shown underlined.

Capacity analysis of 2021 existing, 2029 no-build, 2029 build, and 2038 build traffic conditions indicates the major-street left-turn movement at the intersection of Marks Creek Road and Horton Road is expected to operate at LOS A during both weekday AM and PM peak hours. The minor-street approach currently operates at LOS C or better during the weekday AM and PM peak hours. Under 2029 no-build, 2029 build, and 2038 build conditions, the minor-street approach is expected to operate at LOS C during the weekday AM peak hour and is expected
to operate at a failing level-of-service during the weekday PM peak hour. These levels-ofservice are not uncommon for unsignalized minor-street approaches with heavy minor-street left-turning volumes, as the left-turn movement opposes both directions on mainline traffic. It should be noted that the proposed development does not add any traffic to the minor-street left-turn movement.

A traffic signal was considered at this intersection, and 2029 build traffic volumes were analyzed utilizing the criteria contained in the $M$ anual on Uniform Traffic Control Devices (MUTCD). Based on the weekday AM and PM peak hour volumes, a traffic signal is not expected to be warranted during either peak period due to relatively low mainline volumes along Marks Creek Road. Additionally, based on the land use of the proposed development and the current development located within the vicinity of this intersection (predominately residential, which generates traffic during two distinct peak periods), 4-and 8-hour warrants are not expected to be met.

Based on the Town's UDO, improvements were considered to improve the minor-street approach to an acceptable level-of-service during the weekday PM peak hour. Turn lanes were considered on the northbound and eastbound approaches; however, were not anticipated to provide significant improvement to capacity at the intersection. A southbound right-turn lane would be needed for the minor-street approach to operate at an acceptable level-of-service. It should be noted that the proposed development is not expected to add any trips to the southbound right-turn movement, nor the eastbound left-turn movement, which is expected to be the main cause of the failing level-of-service. Additionally, the proposed development is anticipated to account for less than $6 \%$ of the overall 2029 build traffic volumes at this intersection.

Overall, the proposed development is anticipated to have minimal impact on this study intersection (less than 6\% of overall traffic volumes); therefore, no improvements are recommended by the developer at this intersection.

### 7.2. Marks Creek Road and US 64 Business

The existing unsignalized intersection of M arks Creek Road and US 64 Business was analyzed under 2021 existing, 2029 no-build, 2029 build, and 2038 build traffic conditions with the lane configurations and traffic control shown in Table 6 on the following page. It should be noted that this intersection exists as a reduced conflict intersection with restricted minor-street approaches (right-turn only). The intersection was modelled based on NCDOT Congestion Management Superstreet Coding Guidelines. Refer to Table 6 on the following page for a summary of the analysis results. Refer to Appendix E for the Synchro capacity analysis reports. Refer to Appendix J for a copy of the SimTraffic queuing reports and queuing summary.

Table 6: Analysis Summary of Marks Creek Road and US 64 Business

| ANALYSIS SCENARIO | $\begin{aligned} & \hline \mathbf{A} \\ & \mathbf{P} \\ & \mathbf{P} \\ & \mathbf{R} \\ & \mathbf{0} \\ & \mathbf{A} \\ & \mathbf{C} \\ & \mathbf{H} \end{aligned}$ | LANE <br> CONFIGURATI ONS | WEEKDAY AM PEAK HOUR LEVEL OF SERVICE |  | WEEKDAY PM PEAK HOUR LEVEL OF SERVICE |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Approach | Overall (seconds) | Approach | Overall (seconds) |
| 2021 Existing | $\begin{aligned} & \text { WB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} 1 \mathrm{TH}, 1 \mathrm{TH}-\mathrm{RT} \\ 1 \mathrm{TH} * \\ 1 \mathrm{RT} \\ \hline \end{gathered}$ | $\begin{aligned} & -- \\ & \mathrm{C}^{1} \\ & \mathrm{~B}^{2} \end{aligned}$ | N/ A | $\begin{aligned} & --1 \\ & \mathrm{C}^{1} \\ & \mathrm{~B}^{2} \end{aligned}$ | N/ A |
|  | $\begin{gathered} \hline \text { EB } \\ \text { NB } \\ \text { SB** } \end{gathered}$ | $\begin{gathered} 2 \mathrm{TH}, 1 \mathrm{RT} \\ 1 \mathrm{RT} \\ 1 \mathrm{TH} * * \end{gathered}$ | B2 $\mathrm{B}^{1}$ | N/ A | $\begin{aligned} & \mathrm{B}^{2} \\ & \mathrm{D}^{1} \end{aligned}$ | N/ A |
| 2029 No-Build | $\begin{gathered} \text { WB } \\ \text { NB } \\ \text { SB } \end{gathered}$ | $\begin{gathered} 1 \mathrm{TH}, 1 \mathrm{TH}-\mathrm{RT} \\ 1 \mathrm{TH} * \\ 1 \mathrm{RT} \\ \hline \end{gathered}$ | $\begin{aligned} & --{ }^{E^{1}} \\ & \mathrm{C}^{2} \end{aligned}$ | N/ A | $\begin{aligned} & -- \\ & \mathrm{E}^{1} \\ & \mathrm{~B}^{2} \end{aligned}$ | N/ A |
|  | $\begin{gathered} \hline \text { EB } \\ \text { NB } \\ \text { SB** } \end{gathered}$ | $\begin{gathered} \hline 2 \mathrm{TH}, 1 \mathrm{RT} \\ 1 \mathrm{RT} \\ 1 \mathrm{TH} * * \\ \hline \end{gathered}$ | $\begin{aligned} & \mathrm{B}^{2} \\ & \mathrm{C}^{1} \\ & \hline \end{aligned}$ | N/ A | $\begin{aligned} & -- \\ & \mathrm{C}^{2} \\ & \mathrm{~F}_{1} \end{aligned}$ | N/ A |
| 2029 Build | $\begin{aligned} & \text { WB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} 1 \mathrm{TH}, 1 \mathrm{TH}-\mathrm{RT} \\ 1 \mathrm{TH} \\ 1 \mathrm{RT} \end{gathered}$ | $\begin{aligned} & -- \\ & \mathrm{F}^{1} \\ & \mathrm{D}^{2} \end{aligned}$ | N/ A | $\begin{aligned} & -- \\ & \mathrm{F}^{1} \\ & \mathrm{C}^{2} \end{aligned}$ | N/ A |
|  | $\begin{gathered} \text { EB } \\ \text { NB } \\ \text { SB** } \end{gathered}$ | $\begin{gathered} 2 \mathrm{TH}, 1 \mathrm{RT} \\ 1 \mathrm{RT} \\ 1 \mathrm{TH} * \\ \hline \end{gathered}$ | $\begin{aligned} & -- \\ & \mathrm{B}^{2} \\ & \mathrm{C}^{1} \\ & \hline \end{aligned}$ | N/ A | $\begin{aligned} & -- \\ & \mathrm{C}^{2} \\ & \mathrm{~F} 1 \end{aligned}$ | N/ A |
| 2038 Build | $\begin{aligned} & \hline \text { WB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} \hline 1 \mathrm{TH}, 1 \mathrm{TH}-\mathrm{RT} \\ 1 \mathrm{TH} \\ 1 \mathrm{RT} \end{gathered}$ | $\begin{aligned} & -- \\ & \mathrm{F}^{1} \\ & \mathrm{E}^{2} \end{aligned}$ | N/ A | $\begin{aligned} & \mathrm{F}^{1} \\ & \mathrm{C}^{2} \end{aligned}$ | N/ A |
|  | $\begin{gathered} \hline \text { EB } \\ \text { NB } \\ \text { SB**}^{* *} \end{gathered}$ | $\begin{gathered} \hline 2 \mathrm{TH}, 1 \mathrm{RT} \\ 1 \mathrm{RT} \\ 1 \mathrm{TH} * * \end{gathered}$ | $\begin{aligned} & --B^{2} \\ & \mathrm{C}^{1} \\ & \hline \end{aligned}$ | N/ A | $\begin{aligned} & -- \\ & \mathrm{C}^{2} \\ & \mathrm{~F}^{1} \end{aligned}$ | N/A |
| 2029 Build Signalized | $\begin{gathered} \text { WB } \\ \mathrm{NB}^{*} \\ \text { SB } \end{gathered}$ | $\begin{gathered} 1 \mathrm{TH}, 1 \mathrm{TH}-\mathrm{RT} \\ 1 \mathrm{TH} * \\ 1 \mathrm{RT} \\ \hline \end{gathered}$ | $\begin{aligned} & \mathrm{B} \\ & \mathrm{~B} \\ & \mathrm{C} \end{aligned}$ | $\begin{gathered} \text { B } \\ (16) \end{gathered}$ | $\begin{aligned} & \hline B \\ & B \\ & B \end{aligned}$ | $\begin{gathered} B \\ (14) \end{gathered}$ |
|  | $\begin{gathered} \text { EB } \\ \text { NB } \\ \text { SB** } \end{gathered}$ | $\begin{gathered} 2 \mathrm{TH}, 1 \mathrm{RT} \\ 1 \mathrm{RT} \\ 1 \mathrm{TH} * * \\ \hline \end{gathered}$ | $\begin{aligned} & \text { A } \\ & \text { A } \\ & \text { A } \end{aligned}$ | A <br> (2) | $\begin{aligned} & \text { A } \\ & \text { C } \\ & \text { C } \end{aligned}$ | $\begin{aligned} & \text { A } \\ & (4) \end{aligned}$ |

1. Level of service for major-street left-turn movement.
2. Level of service for minor-street approach.
*The eastbound left-turn movement was modeled in Synchro as a northbound through movement based on N CDOT Congestion M anagement Superstreet Coding Guidelines.
**The westbound left-turn movement was modeled in Synchro as a southbound through movement based on N CDOT Congestion M anagement Superstreet Coding Guidelines.
The northern portion of the intersection is shown in red.
The southern portion of the intersection is shown in yellow.
Improvements are show $n$ in bold.

Capacity analysis of 2021 existing traffic conditions indicates the major-street left-turn movements and minor-street approaches at the intersection of Marks Creek Road and US 64 Business currently operate at acceptable levels-of-service during both weekday AM and PM peak hours. The minor-street approaches are also expected to operate at acceptable levels-ofservice during the weekday AM and PM peak hours under 2029 no-build and 2029 build conditions.

During the weekday AM and PM peak hours, the eastbound left-turn movement is expected to operate at LOS E under 2029 no-build conditions and LOS F under 2029 build conditions. The westbound left-turn movement is expected to operate at LOS C during the weekday AM peak hour and LOS F during the weekday PM peak hour under both 2029 no-build and 2029 build conditions. It should be noted that the proposed development is not expected to add any trips to the westbound left-turn movement. Based on SimTraffic simulations, the queues along the eastbound left-turn lane are anticipated to exceed the existing storage length during the weekday PM peak hour by approximately five (5) left-turning movement vehicles at its peak. All other storages are expected to sufficiently contain turning movement queues. It should be noted that the signalized intersection of US 64 Business and I-87 Southbound OffRamp may help provide gaps in mainline volumes for eastbound left-turning and southbound right-turning vehicles. Similarly, the signalized intersection of US 64 Business and Morning Flyer Way may provide gaps in mainline volumes for westbound left-turning and northbound right-turning vehicles; therefore, queues may be less than is shown in the analysis for this study area.

Based on the queuing on the eastbound left-turn movement and the poor major-street leftturn movement levels-of-service, a half signal was considered on the northern portion of the intersection (westbound through/ right-turn, southbound right-turn, and eastbound left-turn movements). Based on 2029 build traffic volumes, the weekday AM peak hour is expected to meet signal warrants, as contained within the MUTCD; however, the weekday PM peak hour is not expected to meet warrants for signalization. With signalization, the northern portion of this intersection (westbound through/ right-turn, southbound right-turn, and eastbound leftturn movements) is expected to operate at an overall LOS B during the weekday AM and PM
peak hours. If a half signal is not provided at this portion of the intersection, the eastbound left-turn movement should be extended to a minimum of 350 feet of storage plus appropriate deceleration and taper length to accommodate the expected queues.

Similarly, signalization was considered on the southern portion of the intersection (eastbound through/ right-turn, northbound right-turn, and westbound left-turn movements) in order to meet the Town UDO. Based on 2029 build traffic volumes, peak hour warrants are not expected to be met during either the weekday AM or PM peak hours. Turn lanes currently exist on all turning movements at this portion of the intersection. Additional through lanes or signalization would be expected to be needed for this portion of the intersection to operate acceptably. With signalization, this portion of the intersection (eastbound through/ right-turn, northbound right-turn, and westbound left-turn movements) is expected to operate at an overall LOS A during the weekday AM and PM peak hours. This improvement is not recommended by the developer, because the proposed development is not anticipated to add any trips to the turning movement volumes at this portion of the intersection and based on SimTraffic queuing reports, the existing storages are expected to sufficiently contain queues.

Overall, it is recommended that the northern portion of this intersection (westbound through/ right-turn, southbound right-turn, and eastbound left-turn movements) is monitored for signalization. No improvements are recommended to be provided by the developer for the southern portion of this intersection (eastbound through/ right-turn, northbound right-turn, and westbound left-turn movements) due to the proposed development's minimal impact for these movements.


### 7.3. US 64 Business and Western U-Turn Bulb

The existing unsignalized intersection of US 64 Business and Western U-Turn Bulb was analyzed under 2021 existing, 2029 no-build, 2029 build, and 2038 build traffic conditions with the lane configurations and traffic control shown in Table 7. Refer to Table 7 for a summary of the analysis results. Refer to Appendix F for the Synchro capacity analysis reports. Refer to AppendixJ for a copy of the SimTraffic queuing reports.

Table 7: Analysis Summary of US 64 Business and Western U-Turn Bulb

| ANALYSIS SCENARIO | $\begin{aligned} & \hline \mathbf{A} \\ & \mathbf{P} \\ & \mathbf{P} \\ & \mathbf{R} \\ & \mathbf{O} \\ & \mathbf{A} \\ & \mathbf{C} \\ & \mathbf{H} \end{aligned}$ | LANE CONFIGURATI ONS | WEEKDAY AM PEAK HOUR LEVEL OF SERVICE |  | WEEKDAY PM PEAK HOUR LEVEL OF SERVI CE |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Approach | Overall (seconds) | Approach | Overall (seconds) |
| 2021 Existing | $\begin{aligned} & \text { EB } \\ & \text { SB }^{*} \end{aligned}$ | $\begin{aligned} & 2 \mathrm{TH} \\ & 1 \mathrm{LT} * \\ & \hline \end{aligned}$ | $B^{1}$ | N/ A | $\begin{aligned} & -- \\ & \mathrm{C}^{1} \end{aligned}$ | N/ A |
| 2029 No-Build | $\begin{gathered} \text { EB } \\ \mathrm{SB}^{*} \end{gathered}$ | $\begin{aligned} & 2 \mathrm{TH} \\ & 1 \mathrm{LT} \end{aligned}$ | $\mathrm{B}^{1}$ | N/ A | $\begin{aligned} & -- \\ & \mathrm{C}^{1} \end{aligned}$ | N/ A |
| 2029 Build | $\begin{aligned} & \hline \text { EB } \\ & \text { SB }^{*} \end{aligned}$ | $\begin{aligned} & 2 \mathrm{TH} \\ & 1 \mathrm{LT} \end{aligned}$ | $\mathrm{B}^{1}$ | N/ A | $\overline{C^{1}}$ | N/ A |
| 2038 Build | $\begin{aligned} & \text { EB } \\ & \text { SB }^{*} \end{aligned}$ | $\begin{aligned} & 2 \mathrm{TH} \\ & 1 \mathrm{LT} \end{aligned}$ | $B^{1}$ | N/ A | $\overline{D^{1}}$ | N/ A |

1. Level of service for U-turn movement.
*The westbound U-turn movement was modeled in Synchro as a southbound left-turn movement based on N CDOT Congestion Management Superstreet Coding Guidelines.

Capacity analysis of 2021 existing, 2029 no-build, and 2029 build conditions indicates that the westbound U-turn movement at the intersection of US 64 Business and Western U-Turn Bulb is expected to operate at LOS B during the weekday AM peak hour and LOS C during the weekday PM peak hour. Under 2038 build conditions, the U-turn movement is expected to continue to operate at LOS B during the weekday AM peak hour and degrade to LOS D during the weekday PM peak hour due to the annually compounded growth along US 64 Business. Based on SimTraffic simulations, the westbound U-turn movement queues are expected to be contained within the existing storage.

### 7.4. Marks Creek Road and Site Drive 1

The proposed intersection of Marks Creek Road and Site Drive 1 was analyzed under 2029 build and 2038 build traffic conditions with the lane configurations and traffic control shown in Table 8. Refer to Table 8 for a summary of the analysis results. Refer to Appendix G for the Synchro capacity analysis reports. Refer to Appendix J for a copy of the SimTraffic queuing reports and queuing summary.

Table 8: Analysis Summary of Marks Creek Road and Site Drive 1

| ANALYSIS SCENARIO | $\begin{aligned} & \mathbf{A} \\ & \mathbf{P} \\ & \mathbf{P} \\ & \mathbf{R} \\ & \mathbf{O} \\ & \mathbf{A} \\ & \mathbf{C} \\ & \mathbf{H} \end{aligned}$ | LANE CONFIGURATI ONS | WEEKDAY AM PEAK HOUR LEVEL OF SERVICE |  | WEEKDAY PM PEAK HOUR LEVEL OF SERVI CE |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Approach | Overall (seconds) | Approach | Overall (seconds) |
| 2029 Build | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} \text { 1RT } \\ \text { 1LT, } 1 \mathrm{TH} \\ \text { 1TH-RT } \end{gathered}$ | $\begin{gathered} A^{2} \\ A^{1} \\ -- \end{gathered}$ | N/ A | $\begin{gathered} A^{2} \\ A^{1} \\ -- \end{gathered}$ | N/ A |
| 2038 Build | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} 1 \mathrm{RT} \\ \text { 1LT, 1TH } \\ \text { 1TH-RT } \end{gathered}$ | $B^{2}$ $A^{1}$ -- | N/ A | $A^{2}$ $A^{1}$ -- | N/ A |

Improvements to lane configurations are show $n$ in bold.

1. Level of service for major-street left-turn movement.
2. Level of service for minor-street approach.

Capacity analysis of 2029 build and 2038 build traffic conditions indicates the minor-street approach and major-street left-turn movement at the proposed intersection of Marks Creek Road and Site Drive 1 are expected to operate at LOS B or better during the weekday AM and PM peak hours.

Left- and right-turn lanes were considered based on the NCDOT Policy on Street and D riveway Access to North Carolina Highways and an exclusive northbound left-turn lane is recommended. An exclusive southbound right-turn lane is not recommended due to the low southbound right-turning volumes (a maximum of 10 vph ).

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### 7.5. Marks Creek Road and Site Drive 2

The proposed unsignalized intersection of Marks Creek Road and Site Drive 2 was analyzed under 2029 build and 2038 build traffic conditions with lane configurations and traffic control shown in Table 9. Refer to Table 9 for a summary of the analysis results. Refer to Appendix H for the Synchro capacity analysis reports. Refer to Appendix J for a copy of the SimTraffic queuing reports and queuing summary.

Table 9: Analysis Summary of Marks Creek Road and Site Drive 2

| ANALYSIS SCENARIO | $\begin{aligned} & \mathbf{A} \\ & \mathbf{P} \\ & \mathbf{P} \\ & \mathbf{R} \\ & \mathbf{O} \\ & \mathbf{A} \\ & \mathbf{C} \\ & \mathbf{H} \end{aligned}$ | LANE CONFIGURATI ONS | WEEKDAY AM PEAK HOUR <br> LEVEL OF SERVI CE |  | WEEKDAY PM PEAK HOUR <br> LEVEL OF SERVICE |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Approach | Overall (seconds) | Approach | Overall (seconds) |
| 2029 Build | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} 1 \mathrm{LT}-\mathrm{RT} \\ \text { 1LT, } 1 \mathrm{TH} \\ \text { 1TH-RT } \end{gathered}$ | $\begin{gathered} \mathrm{B}^{2} \\ \mathrm{~A}^{1} \\ -- \end{gathered}$ | N/ A | $\begin{aligned} & \mathrm{B}^{2} \\ & \mathrm{~A}^{1} \end{aligned}$ | N/ A |
| 2038 Build | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} 1 \mathrm{LT}-\mathrm{RT} \\ \text { 1LT, } 1 \mathrm{TH} \\ \text { 1TH-RT } \end{gathered}$ | $\begin{gathered} \mathrm{B}^{2} \\ \mathrm{~A}^{1} \\ -- \end{gathered}$ | N/ A | $\begin{gathered} \mathrm{B}^{2} \\ \mathrm{~A}^{1} \\ -- \end{gathered}$ | N/ A |

Improvements to lane configurations are show $n$ in bold.

1. Level of service for major-street left-turn movement.
2. Level of service for minor-street approach.

Capacity analysis of 2029 build and 2038 build traffic conditions indicates the minor-street approach and major-street left-turn movement at the proposed intersection of Marks Creek Road and Site Drive 1 are expected to operate at LOS B or better during the weekday AM and PM peak hours.

Left- and right-turn lanes were considered based on the NCDOT Policy on Street and D riveway Access to North Carolina Highways and an exclusive northbound left-turn lane is recommended. An exclusive southbound right-turn lane is not recommended due to the low southbound right-turning volumes (a maximum of 10 vph ).

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### 7.6. Marks Creek Road and Site Drive 3

The unsignalized intersection of M arks Creek Road and Site Drive 3 was analyzed under 2029 build and 2038 build traffic conditions with lane configurations and traffic control shown in Table 10. Refer to Table 10 for a summary of the analysis results. Refer to A ppendix I for the Synchro capacity analysis reports. Refer to Appendix J for a copy of the SimTraffic queuing reports and queuing summary.

Table 10: Analysis Summary of Marks Creek Road and Site Drive 3

| ANALYSIS SCENARIO | $\begin{aligned} & \mathbf{A} \\ & \mathbf{P} \\ & \mathbf{P} \\ & \mathbf{R} \\ & \mathbf{O} \\ & \mathbf{A} \\ & \mathbf{C} \\ & \mathbf{H} \end{aligned}$ | LANE <br> CONFIGURATIONS | WEEKDAY AM PEAK HOUR LEVEL OF SERVI CE |  | WEEKDAY PM PEAK HOUR LEVEL OF SERVICE |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Approach | Overall (seconds) | Approach | Overall (seconds) |
| 2029 Build | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} 1 \mathrm{LT}-\mathrm{RT} \\ \text { 1LT, } 1 \mathrm{TH} \\ \text { 1TH-RT } \end{gathered}$ | $\begin{gathered} A^{2} \\ A^{1} \\ -- \end{gathered}$ | N/ A | $\begin{aligned} & A^{2} \\ & A^{1} \end{aligned}$ | N/ A |
| 2038 Build | $\begin{aligned} & \text { EB } \\ & \text { NB } \\ & \text { SB } \end{aligned}$ | $\begin{gathered} 1 \mathrm{LT}-\mathrm{RT} \\ \text { 1LT, } 1 \mathrm{TH} \\ \text { 1TH-RT } \end{gathered}$ | $\begin{gathered} \text { A }^{2} \\ \text { A }^{1} \\ -- \end{gathered}$ | N/ A | $A^{2}$ A -- | N/ A |

Improvements to lane configurations are show $n$ in bold.

1. Level of service for major-street left-turn movement.
2. Level of service for minor-street approach.

Capacity analysis of 2029 build and 2038 build traffic conditions indicates the minor-street approach and major-street left-turn movement at the proposed intersection of Marks Creek Road and Site Drive 1 are expected to operate at LOS A during the weekday AM and PM peak hours.

Left- and right-turn lanes were considered based on the NCDOT Policy on Street and D riveway Access to North Carolina Highways and an exclusive northbound left-turn lane is recommended. An exclusive southbound right-turn lane is not recommended due to the low southbound right-turning volumes (a maximum of 20 vph ).

## 8. CONCLUSI ONS

This Traffic Impact Analysis was conducted to determine the potential traffic impacts of the proposed residential development, west of Marks Creek Road and north of US 64 Business in Knightdale, North Carolina. The proposed development is expected to be a residential development and be built out in 2029. Access to the development is proposed via three (3) driveways along Marks Creek Road. Based on coordination with the Town, the southernmost site driveway should be restricted dueto the proximity of the driveway to US 64 Business.

The study analyzes traffic conditions during the weekday AM and PM peak hours for the following scenarios:

- 2021 Existing Traffic Conditions
- 2029 No-Build Traffic Conditions
- 2029 Build Traffic Conditions
- 2029 Build Traffic Conditions with Improvements
- 2038 Future Traffic Conditions - Per Town UDO


## Trip Generation

It is estimated that the proposed development will generate approximately 3,260 total site trips on the roadway network during a typical 24 -hour weekday period. Of the daily traffic volume, it is anticipated that 236 trips ( 58 entering and 178 exiting) will occur during the weekday AM peak hour and 311 (196 entering and 115 exiting) will occur during the weekday PM peak hour.

## Adjustments to Analysis Guidelines

Capacity analysis at all study intersections was completed according to NCDOT Congestion Management Guidelines. Refer to section 6.1 of this report for a detailed description of any adjustments to these guidelines made throughout the analysis.

## Intersection Capacity Analysis Summary

All the study area intersections (including the proposed site driveways) are expected to operate at acceptable levels-of-service under existing and future year conditions with the
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exception of the intersections listed below. A summary of the study area intersections that would be expected to need improvements based on NCDOT and Town guidelines are as follows:

## Marks Creek Road and Horton Road

Under 2029 no-build, 2029 build, and 2038 build conditions, the minor-street approach is expected to operate at a failing level-of-service during the weekday PM peak hour. This is not uncommon for unsignalized minor-street approaches with heavy minor-street left-turning volumes, as the left-turn movement opposes both directions on mainline traffic. It should be noted that the proposed development does not add any traffic to the minor-street left-turn movement. A traffic signal was considered at this intersection, and 2029 build traffic volumes were analyzed utilizing the criteria contained in the $M$ anual on U niform Traffic Control Devices (MUTCD). Based on the weekday AM and PM peak hour volumes, a traffic signal is not expected to be warranted during either peak period due to relatively low mainline volumes along Marks Creek Road. Additionally, based on the land use of the proposed development and the current development located within the vicinity of this intersection (predominately residential, which generates traffic during two distinct peak periods), 4- and 8-hour warrants are not expected to be met. Based on the Town's UDO, improvements were considered to improve the minor-street approach to an acceptable level-of-service during the weekday PM peak hour. Turn lanes were considered on the northbound and eastbound approaches; however, were not anticipated to provide significant improvement to capacity at the intersection. A southbound right-turn lane would be needed for the minor-street approach to operate at an acceptable level-of-service. It should be noted that the proposed development is not expected to add any trips to the southbound right-turn movement, nor the eastbound leftturn movement, which is expected to be the main cause of the failing level-of-service. Additionally, the proposed development is anticipated to account for less than $6 \%$ of the overall 2029 build traffic volumes at this intersection.

Overall, the proposed development is anticipated to have minimal impact on this study intersection (less than 6\% of overall traffic volumes); therefore, no improvements are recommended by the developer at this intersection.
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## Marks Creek Road and US 64 Business

During the weekday AM and PM peak hours, the eastbound left-turn movement is expected to operate at LOS E under 2029 no-build conditions and LOS F under 2029 build conditions. The westbound left-turn movement is expected to operate at LOS F during the weekday PM peak hour under both 2029 no-build and 2029 build conditions. It should be noted that the proposed development is not expected to add any trips to the westbound left-turn movement. Based on SimTraffic simulations, the queues along the eastbound left-turn lane are anticipated to exceed the existing storage length during the weekday PM peak hour by approximately five (5) left-turning movement vehicles at its peak. All other storages are expected to sufficiently contain turning movement queues. It should be noted that the signalized intersection of US 64 Business and I-87 Southbound Off-Ramp may help provide gaps in mainline volumes for eastbound left-turning and southbound right-turning vehicles. Similarly, the signalized intersection of US 64 Business and Morning Flyer Way may provide gaps in mainline volumes for westbound left-turning and northbound right-turning vehicles; therefore, queues may be less than is shown in the analysis for this study area.

Based on the queuing on the eastbound left-turn movement and the poor major-street leftturn movement levels-of-service, a half signal was considered on the northern portion of the intersection (westbound through/ right-turn, southbound right-turn, and eastbound left-turn movements). Based on 2029 build traffic volumes, the weekday AM peak hour is expected to meet signal warrants, as contained within the MUTCD; however, the weekday PM peak hour is not expected to meet warrants for signalization. With signalization, the northern portion of this intersection (westbound through/ right-turn, southbound right-turn, and eastbound leftturn movements) is expected to operate at an overall LOS B during the weekday AM and PM peak hours. If a half signal is not provided at this portion of the intersection, the eastbound left-turn movement should be extended to a minimum of 350 feet of storage plus appropriate deceleration and taper length to accommodate the expected queues. Similarly, signalization was considered on the southern portion of the intersection (eastbound through/ right-turn, northbound right-turn, and westbound left-turn movements) in order to meet the Town UDO. Based on 2029 build traffic volumes, peak hour warrants are not expected to be met during either the weekday AM or PM peak hours. Turn lanes currently exist on all turning
movements at this portion of the intersection. Additional through lanes or signalization would be expected to be needed for this portion of the intersection to operate acceptably. With signalization, this portion of the intersection (eastbound through/ right-turn, northbound right-turn, and westbound left-turn movements) is expected to operate at an overall LOS A during the weekday AM and PM peak hours. This improvement is not recommended by the developer, because the proposed development is not anticipated to add any trips to the turning movement volumes at this portion of the intersection and based on SimTraffic queuing reports, the existing storages are expected to sufficiently contain queues.

Overall, it is recommended that the northern portion of this intersection (westbound through/ right-turn, southbound right-turn, and eastbound left-turn movements) is monitored for signalization. No improvements are recommended to be provided by the developer for the southern portion of this intersection (eastbound through/ right-turn, northbound right-turn, and westbound left-turn movements) due to the proposed development's minimal impact for these movements.

## 9. RECOMMENDATI ONS

Based on the findings of this study, specific geometric improvements have been identified and are recommended to accommodate future traffic conditions. See a more detailed description of the recommended improvements below. Refer to Figure 11 for an illustration of the recommended lane configuration for the proposed development.

## Recommended Improvements by Developer

## Marks Creek Road and US 64 Business

- Monitor the northern portion of this intersection (westbound through/ right-turn, southbound right-turn, and eastbound left-turn movements) for signalization, and install traffic signal if warranted and approved by NCDOT.


## Marks Creek Road and Site Drive 1

- Construct the western leg of the intersection with one ingress and one egress lane. Restrict the egress lane to right-out only.
- Provide an exclusive northbound left-turn lane with at least 100 feet of storage and appropriate deceleration and taper length.
- Provide stop-control for the eastbound approach.


## Marks Creek Road and Site Drive 2

- Construct the western leg of the intersection with one ingress and one egress lane.
- Provide an exclusive northbound left-turn lane with at least 100 feet of storage and appropriate deceleration and taper length.
- Provide stop-control for the eastbound approach.


## Marks Creek Road and Site Drive 3

- Construct the western leg of the intersection with one ingress and one egress lane.
- Provide an exclusive northbound left-turn lane with at least 100 feet of storage and appropriate deceleration and taper length.
- Provide stop-control for the eastbound approach.


| Moving forward. <br> RAMEY KEMP ASSOCIATES | Preserve at Marks Creek Knightdale, NC | Recommended Lane Configurations |  |
| :---: | :---: | :---: | :---: |
|  |  | Scale: Not to Scale | Figure 11 |

