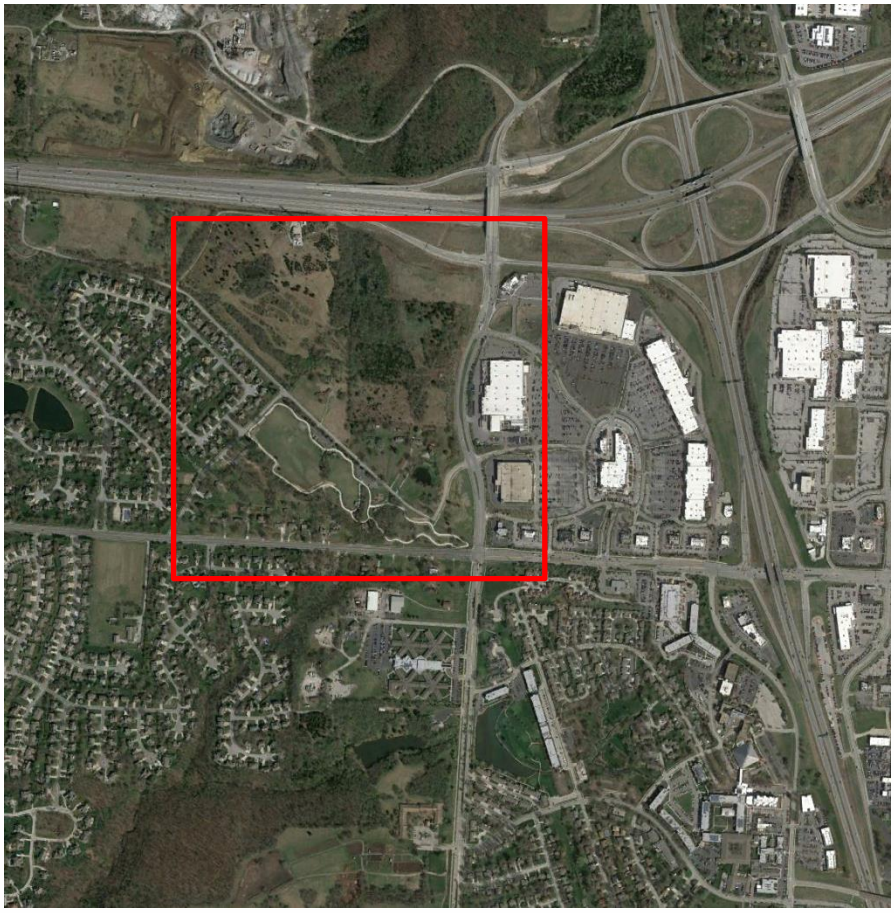
West Pryor Village
Traffic Impact Study



General Location of Study Area

TRAFFIC IMPACT STUDY

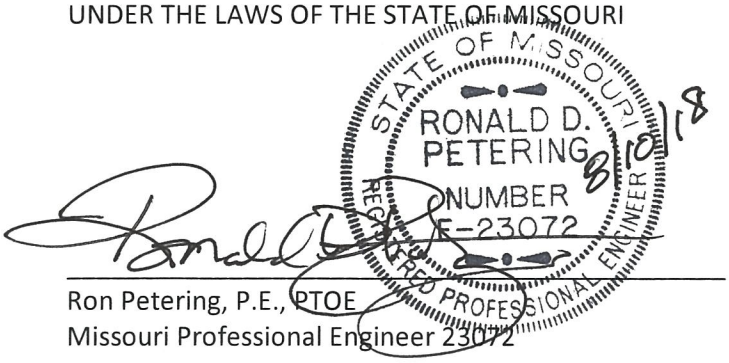
August 2018

West Pryor Village

Traffic Impact Study

August 2018

I HEREBY CERTIFY THAT THIS REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION, AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER EXISTING UNDER THE LAWS OF THE STATE OF MISSOURI



Ron Petering, P.E., PTOE
Missouri Professional Engineer 23072

TABLE OF CONTENTS

Table of Figures

Table of Tables

Exhibits

Appendix

Section 1: Introduction

1.1 Purpose and Objectives

The purpose of this study is to assess the impacts of the phased multi-use development proposed on approximately 80 acres of land that is bordered by Lowenstein Drive to the south, Pryor Road to the east, and I-470 to the north, which is outlined in Figure 1 below. The specific impact of traffic generated and distributed from this proposed area will be examined in the highlighted intersections, also found in Figure 1. The development will occur in five phases, outlined in Figure 2, with phase one occurring along Lowenstein Drive and in the south corner of Lowenstein Drive and Pryor Road, including a grocery store and restaurants. The second phase will be on the northeast corner of the property along Pryor Road and I-470, with additional restaurants and two hotels. The third phase of development will be between phase one and two and includes apartments and restaurants. Phase four includes senior luxury apartments and ball courts. Phase five will be single family homes to be built to the west of Black Twig Lane.

Figure 1 - Location of Study

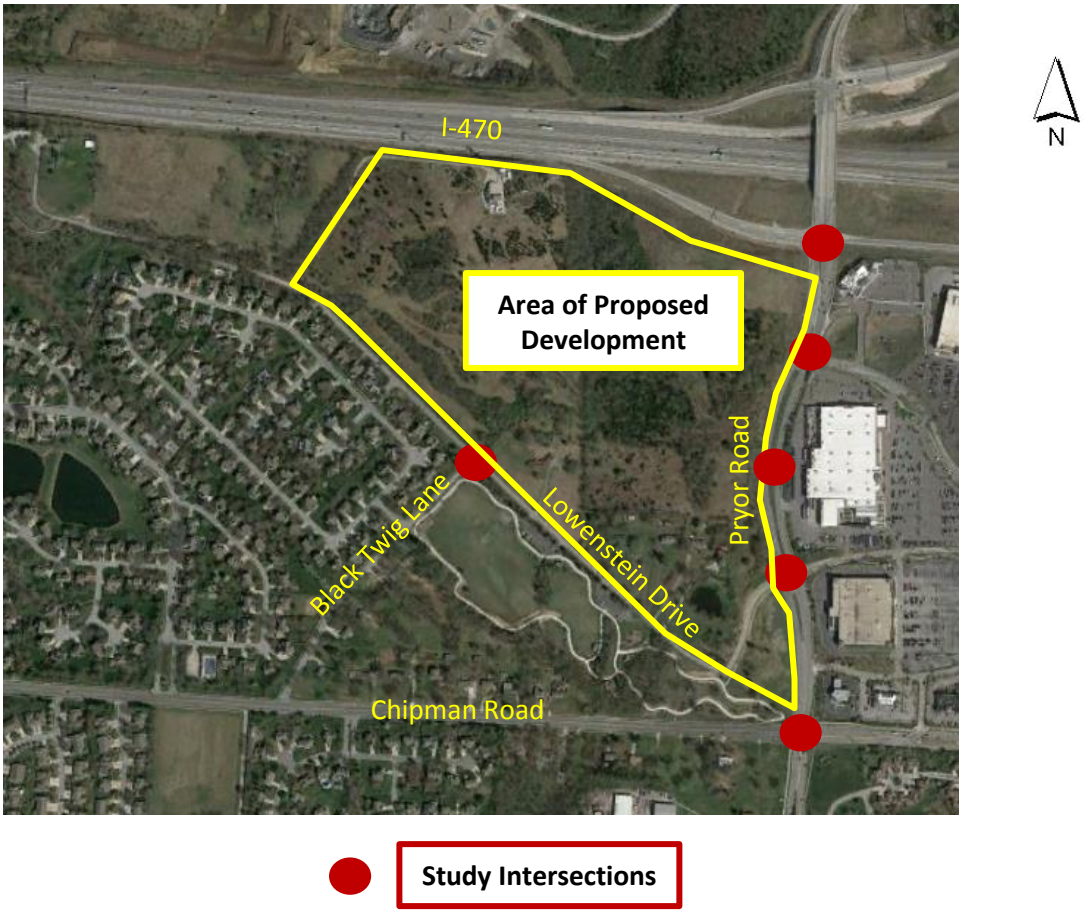
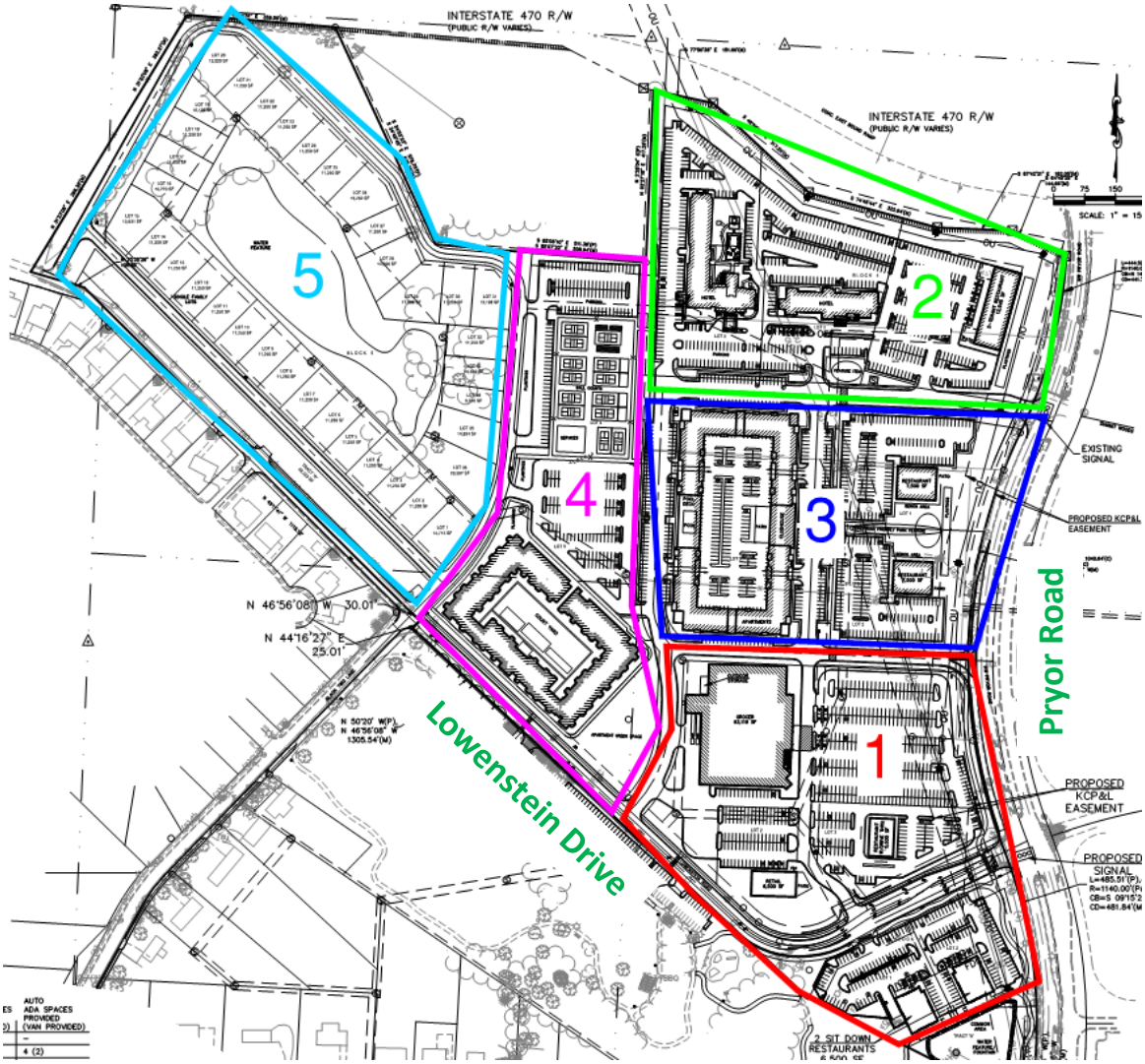


Figure 2 - Current Development Phasing



Section 2: Existing Conditions

2.1 Roadway Geometrics

Lowenstein Drive, west of Pryor Drive, currently has three 12-foot wide lanes at the intersection – a lane for eastbound and westbound traffic as well as a dedicated left turn lane for eastbound vehicles wanting to go north on Pryor Road. West of the intersection with Pryor Road, Lowenstein Drive goes south, south-west for 500 feet, and then makes a sharp turn to the northwest and narrows to a width of 20 feet. Lowenstein Drive currently has a speed limit of 25 miles per hour. This roadway has proposed improvements for both the sharp turn and narrow roadway to be constructed with the subject development.

The intersection of Lowenstein Drive and Pryor Road, seen in Figure 3, is currently unsignalized, with minor road stop control. The vehicles using the east leg come from the Summit Woods Crossing development. Those currently using the west leg come from Lowenstein Park or the single family homes with access to Lowenstein. Pryor Road itself is an arterial roadway, providing access to I-470 for motorists in the surrounding area. Pryor Road currently has a speed limit of 35 miles per hour.

Figure 3 - Existing Intersection of Lowenstein Drive and Pryor Road

The I-470 south ramp terminal at NW Pryor Road is currently signalized and has five 12-foot wide lanes at the intersection – two lanes for eastbound traffic that will continue onto Blue Parkway before acting as an on-ramp for I-470 eastbound, two dedicated right turn lanes for eastbound vehicles wanting to go south on Pryor Road, and a dedicated left turn lane for vehicles wanting to go north on Pryor Road.

Summit Woods Crossing is the first intersection south of the I-470 ramp terminal on Pryor Road. This intersection is signalized and currently has four 12-foot wide lanes at the east leg of the intersection – two dedicated left turn lanes for vehicles headed south, a dedicated right turn lane for vehicles wanting to go north on Pryor Road, and a lane for traffic entering the development, turning right or left off of Pryor Road. Currently, there is a dedicated left turn lane for southbound traffic and a dedicated right turn lane for northbound traffic wanting to enter the Summit Woods Crossing development.

The Chipman Road and Pryor Road intersection is the southernmost intersection in this study area along the Pryor Road corridor and is currently signalized. Westbound traffic on Chipman Road currently has four 12-foot wide lanes– two dedicated through lanes, a dedicated right turn lane for vehicles wanting to go north on Pryor Road, and dedicated left turn lane for vehicles wanting to go south on Pryor Road. The remaining three legs of the intersection each have three lanes – one lane for dedicated left turns and two through lanes that also accommodate any vehicles turning right. Chipman Road intersection currently has a speed limit of 35 miles per hour.

The next intersection included in this study is Black Twig Lane and Lowenstein Drive. This minor road stop-controlled intersection has two 12-foot wide lanes at each of the three legs of the intersection. All approaches have a speed limit of 25 miles per hour. This area is primarily residential with the proposed

development land to the north of Lowenstein Drive, a neighborhood to the west and Lowenstein Park to the South.

Figure 4 - Intersection of Black Twig Lane and Lowenstein Drive

The last intersection included in this study is Black Twig Lane and Chipman Road. This is a three-leg minor road stop-controlled intersection. Chipman Road has three 12-foot wide lanes, one each for eastbound and westbound as well as a two-way left-turn lane. There are also two six foot wide bike lanes. Black Twig Lane is approximately 26 feet wide where it meets Chipman Road. The west side of the street has full curb and gutter and storm sewer while the east side of the roadway has no curb and gutter and storm drainage is handled by an open ditch.

2.2 Current Developments in the Area

The area immediately surrounding the proposed development is well developed. There are several businesses to the east of Pryor Road in the Summit Woods Crossing development, an 87-acre site. This development contains several large businesses such as Lowe's, Dick's Sporting Goods, Target, Kohl's and more. There are also several restaurants such as Chipotle, Chili's, On the Border, Jack Stack and others.

Lowenstein Park is an 18 acre park south of Lowenstein Drive on the west side of Pryor Road. This park has three picnic shelters with picnic tables, one basketball goal, open space area, a playground area, a one mile concrete trail, and parking.

The land to the west of Lowenstein Park is residential with single family homes. The remaining developments to the south of the Chipman Road and Pryor Road intersection are residential uses and the John Knox Village retirement community.

Section 3: Description of Development and Proposed Access Points

3.1 Proposed Development

The proposed development encompasses 80 acres with a proposed mixture of uses including single family homes, senior apartments, restaurants, medical/retail, a grocery store, and two hotels. A general concept plan is provided in the Appendix.

There are five phases proposed for this development. This first phase contains a grocery store, medical/retail building, and three restaurants. The first phase of development is contained in the southern and western areas of the development property. The second phase is the northeastern part of the property and will include an extended stay hotel, hotel, and two restaurants. The third phase will be between the first two phases, filling out the eastern area of the property. This phase will include two restaurants and an apartment complex with clubhouse. The fourth phase is to the west of the first three phases and will include a senior luxury apartment complex and ball courts. The fifth and final phase uses the most western area of the development property and will be a small neighborhood of single family homes surrounding a water feature.

3.2 Proposed Development Access Points

The main access to Pryor Road for phase one of the development will be the existing intersection with Lowenstein, which is currently unsignalized. Lowenstein will have several access points to the restaurants, grocery, apartments and single family housing. These driveways have been reviewed and were found to meet Lee's Summit's Access Management Code's regulation of a minimum 300 foot separation between driveways on a collector road.

A right-in right-out access point is also proposed between the Summit Woods Crossing intersection and the Lowenstein Drive intersection, at approximately 450 ft to the north of the Lowenstein Drive and Pryor Road intersection. Lowenstein Drive is expected to service all patrons and residents from phase one of this development that desire to access I-470 to the north as well as giving access to most of those going to the restaurants or grocery store. The proposed right-in right-out intersection will be used by those accessing the retail and grocery store in the northern area of phase one as well as giving access to those in the apartments built in Phase 3 that need to head south on Pryor Road.

There will also be some new traffic introduced to Black Twig Lane. This would mainly be from those approaching the development from the west, are familiar with the local street network, and want to avoid the intersection at Pryor Road and Chipman Road. A sight distance analysis, summarized in Exhibit 1, was also performed for this intersection as it is stop-controlled.

An additional access point is proposed for phase two. This access would be opposite the existing signalized access at Summit Woods Crossing. This access is expected to primarily serve the proposed hotel and proposed restaurants developed during phase two. It is also anticipated to carry some of the traffic from the remaining phases.

Section 4: Existing and Projected Traffic Generation and Distribution

4.1 Existing Traffic Data

Traffic counts were collected at the six subject intersections on Wednesday, September 28th, 2016, Thursday, September 29th, 2016, and Tuesday, January 10th, 2017, as shown in Exhibit 2. Peak hour traffic counts were collected for all intersections, and 12 hours of traffic were recorded at the intersection of Lowenstein Drive and Pryor Road to allow for a traffic signal warrant analysis to be performed. The raw count data can be found in the Appendix. A summary of morning and evening peak hour is provided in Exhibit 3.

The City of Lee's Summit provided 24 hour counts, captured by their camera equipment along Pryor Road, from a random weekday and Saturday to determine if a Saturday peak hour count would be necessary. In analyzing the data, it was determined that the weekday peak hour counts were higher by 100 to 200 vehicles at a minimum in both the mornings and evenings. Saturdays do see a higher consistency in hourly volumes throughout the day, but as the peak hour impacts are the main concern, the weekday counts were judged to be sufficient for the purpose of this study. The counts provided by the City can be found in the Appendix.

4.2 Vehicular Trip Projection

To estimate these turning movements in and out of the subject access driveways, data compiled by the Institute of Transportation Engineers (ITE) in their report Trip Generation Manual, 9th Edition was initially utilized to estimate the number of trips generated by the development. Since the first iteration of this study completed in late 2016, ITE has since released the Trip Generation Manual, 10th Edition, which contains updated trip generation data.

The Trip Generation report documents historical vehicular trips counted at a variety of land uses. The trips are then plotted against independent variables, such as "number of employees" or "gross leasable square footage of buildings", to develop correlations between these independent variables and the vehicular trips generated by the various land uses. These correlations can then be used to estimate trips generated by future development of similar land uses.

Estimates of daily, AM peak hour, and PM peak hour vehicular trips were developed with both the 9th and 10th editions using the development plan contained in the Appendix. Trips were estimated using the most current plans the developer had available at the time of this report. A 10% buffer for all housing developments was added to allow for possible adjustments in final design. This included the apartments and single family housing. In comparing the difference in trips generated during the peak hours between the two ITE editions, it was found that the 9th edition yielded trips that are slightly higher than those estimated with the 10th edition. Due to this, it was determined to continue using the 9th edition to allow for additional buffer.

While a large number of trips will be generated by the proposed development, not all trips will impact the external road network a common trait of multi-use developments, such as this one, is to have some internal trips by people who stop to shop at the grocery store as well as a restaurant or then return home

or to a hotel. These internal trips were accounted for by using a conservative assumption that 15% of trips would be internal for phases one, two and three.

Pass by trips were not assessed during the trip generation analysis. Pass by trips are made by those passing adjacent to the development while on their way to a final destination, for example it may be between one driver's work and home. The exclusion of these gives a worst case scenario for the roadway. Table 1 shows how many trips each phase is estimated to generate using both the 9th and 10th editions during the evening peak hour as well as the estimate of internal trips based on the 9th edition.

Table 1 - Projected Trips Created By Phase – Evening Peak Hour

	Phase One	Phase Two	Phase Three	Phase Four	Phase Five
Total Trips – 9th Edition	958	256	317	165	46
Internal Trips – 9th Edition	136	38	47	0	0
Total Trips – 10th Edition	933	236	292	155	42

4.3 Trip Assignment

Existing traffic counts and observations of traffic patterns of motorists accessing and exiting the nearby Summit Woods Crossing development were used to estimate the distribution of new trips to/from the proposed development. Exhibit 4 shows the current distribution of trips for motorists going to the Summit Woods Crossing development. The current distributions were used to estimate the use of the access points for the proposed developments as well as taking into account the vision of the development. Also included in Exhibit 4 are the estimated trip distributions for phases one, two, three and four and five combined.

Distribution at the Black Twig Lane and Chipman Road assumed that all incoming vehicles to the development would be turning left from Chipman Road north onto Black Twig Road and all vehicles exiting the development would be turning right from Black Twig Lane west onto Chipman Road.

Distributions at both the Chipman Road and I-470 ramps used the existing distributions to assign the new development generated trips. At I-470, these trips were relatively evenly distributed, with a 45%/55% split NB/EB for vehicles leaving the area and vehicles entering the area SB/EB. At Chipman Road, the majority of trips come to and from the south, with roughly 30% coming from the east and west legs.

Section 5: Analysis

5.1 Operational Level of Service (LOS)

The existing and projected morning and evening peak hour traffic volumes were analyzed using methodology contained in the publication Highway Capacity Manual (HCM). The manual provides a methodology of calculating the expected average delay of vehicles subjected to stop and yield conditions. The expected average delay is further equated to a level of service (LOS) which is a letter designation

between A and F. A level of service designation "A" describes the best of operating conditions, a movement where delays are very short and there is significant remaining capacity to accommodate additional vehicle movements before traffic operations begin to degrade significantly. A level of service designation "F" describes a movement where more traffic demand is present that what can be adequately accommodated. Therefore, average delays that are long, over 50 seconds per vehicle at an unsignalized intersection, will cause a rapid decline in traffic operations. Table 2 demonstrates the delay with corresponding LOS for both signalized and unsignalized intersections.

Table 2 - Levels of Service Corresponding Delay Lengths

LOS	Delay (Signalized Intersection)	Delay (Unsignalized Intersection)
A	≤ 10 seconds	≤ 10 seconds
B	10 – 20 seconds	10 – 15 seconds
C	20 – 35 seconds	15 – 25 seconds
D	35 – 55 seconds	25 – 35 seconds
E	55 – 80 seconds	35 – 50 seconds
F	> 80 seconds	> 50 seconds

The Highway Capacity Software (HCS) is software that compliments the HCM, and it was used to calculate the existing and expected LOS for stop-controlled intersections. When calculating the LOS for stop-controlled intersections, the LOS is calculated for each leg, and the LOS for the stop-controlled legs are noted as they experience delay. The traffic simulation tools Synchro and SimTraffic were utilized to calculate expected delays and determine expected LOS designations for signalized and proposed signalized intersections. In each calculation, signalization was optimized with weighting provided in minimizing delay for the movements along Pryor Road. This will be most noticeably seen in the LOS movement exhibits, where Pryor Road has movement LOS of As and Bs while the intersecting roadways experience LOS of Cs, Ds, and Es. Overall, the intersection LOS will reflect a weighted average of these. All HCS, Synchro and SimTraffic reports mentioned in this section of the report can be found in the Appendix.

In determining if an intersection's LOS is appropriate, the City of Lee's Summit's "Level of Service Policy" will be followed. This policy states that a "LOS C is the desired goal; however LOS D may be deemed acceptable where extraordinary circumstances, as determined by the City Council, exist or are projected" for a signalized intersection. For a stop-controlled intersection, the policy states that a "Level of Service C is the desired goal for traffic movements that must yield to other movements. LOS D and E may be allowed if deemed acceptable by the City Engineer (or designee) taking into account such factors as traffic volumes of subject movements, alternative travel routes available, and duration of activity resulting in such LOS."

The traffic simulation modeling utilized the following geometric and traffic control assumptions for the following intersections surrounding the proposed development:

- **I-470 Eastbound Ramps** – Existing lane configurations and optimized traffic signal operation were used for all scenarios.
- **Summit Woods Crossing** – Existing lane configurations were used for phase one. For phase two, the west leg was added for the northern access point to the development.

- **Developer's Road** – This is a proposed right-in, right-out access point along Pryor Road that would be built with phase one.
- **Lowenstein Drive** – Existing lane configuration with minor road stop control was part of the existing LOS assessment. A signal was added for phase one and two development scenarios.
- **Chipman Road & Pryor Road**– Existing lane configuration was evaluated in all models.
- **Black Twig Lane & Chipman Road** – Existing lane configuration was evaluated in all models.

Each phase analysis includes all trips generated by previous phases. For example, phase three analysis includes existing vehicles counts as well as trips generated by phases one and two.

5.1.1 Existing Operations and LOS

Using the traffic counts collected, the existing LOS were calculated to get a baseline of the intersection operations for existing traffic conditions. Overall, traffic moves well throughout both the morning and evening peak hours, as Table 3 shows. Lowenstein Drive has the worst LOS due to the delay for left and right turning movements on the west leg of the intersection and left turning movements on the east leg of the intersection. Signal timings used in Synchro to help aid in evaluating the LOS were optimized using the most efficient cycle length between 100-140 seconds allowing the software to choose the cycle length and splits is intended to align with the adaptive signal system that that is in place along Pryor Road.

A signal warrant analysis was also completed using existing volumes for the Lowenstein Drive and Pryor Road and Chipman Road and Black Twig Lane intersections. There are three volume based warrants, or sets of conditions, where installation of traffic signals may be considered. The meeting of one of the warrants does not require the installation of a signal, however at least one warrant should be satisfied or projected to be satisfied before signalization is implemented. While the legs at Lowenstein Drive do have some delay, a traffic signal is not warranted for existing traffic patterns. A copy of the HCS Warrants report can be found in the Appendix. The Black Twig Lane intersection has little delay as it currently operates and no signal is warranted when looking at peak hours. None of the peak hours meet any of the hourly requirements necessary for a signal warrant.

Table 3 - Existing AM and PM Levels of Service

Intersection	Existing AM LOS	Existing PM LOS
I-470 South Terminal	B	B
Summit Woods Crossing	A	B
Right-In, Right-Out	N/A	N/A
Lowenstein Drive	B/C*	D/E*
Chipman Road & Pryor Road	C	C
Black Twig Lane & Lowenstein Drive	A*	A*
Black Twig Lane & Chipman Road	B*	C*

* Denotes stop-controlled leg LOS

5.1.2 Phase One Operations and LOS

The operations of the same six intersections and the new right-in, right-out intersection were next analyzed using the projected volumes for existing plus phase one conditions, which can be seen in Exhibit 3. Overall, little impact is seen to the LOS at all studied intersections.

Table 4 compares the existing LOS to the expected LOS after phase one of the development is completed. Despite the additional vehicles using Lowenstein Drive, the LOS improves due to the addition of a traffic signal. Overall, little impact is seen to the LOS at all studied intersections.

Table 4 - Expected Phase One Levels of Service

Intersection	Existing AM LOS	Existing PM LOS	Phase One AM LOS	Phase One PM LOS
I-470 South Terminal	B	B	B	B
Summit Woods Crossing	A	B	A	B
Right-In, Right-Out	N/A	N/A	A*	B*
Lowenstein Drive	B/C*	D/E*	B	C
Chipman Road & Pryor Road	C	C	C	C
Black Twig Lane & Lowenstein Drive	A*	A*	A*	A*
Black Twig Lane & Chipman Road	B*	C*	B*	C*

* Denotes stop-controlled leg LOS

A signal warrant analysis was completed for the Lowenstein Drive and Pryor Road intersection taking into account the additional traffic generated by phase one of the development. Warrants 1 (8 hour) and 2 (4 hour) were both evaluated by taking the peak hour projections for traffic exiting Lowenstein Drive and adjusting that projection by the same percentage difference as documented in the exiting traffic patterns for the 4th and 8th highest hours exiting the Summit Woods Crossing development. This was judged to be a reasonable means of approximating the 4th and 8th highest hours since many of the development types contained within Summit Woods Crossing and the newly proposed development along Lowenstein are similar in nature. A copy of the warrant evaluation is contained in the Appendix for reference. It was found that the intersection meets the following warrants: 1 – 8-Hour Vehicular Volume, 2 – 4-Hour Vehicular Volume and 3 – Peak Hour.

A signal warrant analysis was also completed for Black Twig Lane and Chipman Road with phase one volumes although it is projected to continue operating at a LOS B during the morning peak hour and LOS C during the evening peak hour. None of the peak hours with the additional traffic met any of the warrants, and therefore no signal is warranted for the traffic generated by phase one.

5.1.3 Phase Two Operations and LOS

The impact of the additional phase two of the development was next analyzed. Table 5 shows the changes in LOS with the additional vehicle trips added in. Summit Woods Crossing intersection on Pryor Road experiences a decline in LOS. Although a decline is experienced, the lowest LOS is B, which is still a very acceptable operational level during the peak morning hour.

Table 5 - Expected Phase Two Levels of Service

Intersection	Existing AM LOS	Existing PM LOS	Phase One AM LOS	Phase One PM LOS	Phase Two AM LOS	Phase Two PM LOS
I-470 South Terminal	B	B	B	B	B	C
Summit Woods Crossing	A	B	A	B	A	B
Right-In, Right-Out	N/A	N/A	A*	B*	A*	B*
Lowenstein Drive	B/C*	D/E*	B	C	B	B
Chipman Road & Pryor Road	C	C	C	C	C	C
Black Twig Lane & Lowenstein Drive	A*	A*	A*	A*	A*	A*
Black Twig Lane & Chipman Road	B*	C*	B*	C*	B*	C*

* Denotes stop-controlled leg LOS

5.1.4 Phase Three Operations and LOS

The impact of additional traffic generated by phase three of the development was then analyzed. Table 6 shows the changes in LOS with due to the increase in vehicle trips in comparison to the previous phases. The Summit Woods Crossing intersection on Pryor Road experiences another slight decline in LOS during the peak evening hour. The lowest intersection LOS experienced throughout the project is C at the unsignalized intersection of Black Twig Lane and Chipman Road, and at the Summit Woods Crossing, I-470 ramp, and Chipman Road intersections with Pryor Road.

Table 6 - Expected Phase Three Levels of Service

Intersection	Phase One AM LOS	Phase One PM LOS	Phase Two AM LOS	Phase Two PM LOS	Phase Three AM LOS	Phase Three PM LOS
I-470 South Terminal	B	B	B	C	B	C
Summit Woods Crossing	A	B	A	B	B	C
Right-In, Right-Out	A*	B*	A*	B*	B*	B*
Lowenstein Drive	B	C	B	B	B	B
Chipman Road & Pryor Road	C	C	C	C	C	C
Black Twig Lane & Lowenstein Drive	A*	A*	A*	A*	A*	A*
Black Twig Lane & Chipman Road	B*	C*	B*	C*	B*	C*

* Denotes stop-controlled leg LOS

5.1.5 Phases Four and Five Operations and LOS

The impact of the additional traffic generated by phases four and five of the development were the last to be analyzed. These phases were combined as the final phase (five) of the project is made up of single family homes, which do not create much traffic relative to the rest of the development. Table 7 shows

the changes in LOS due to the increase in vehicle trips in comparison to the other phases while Exhibit 5 compares existing and impact of all phases of development by LOS and queue length at each intersection. The lowest LOS experienced throughout the project is D at the unsignalized intersection of Black Twig Lane and Chipman Road. All other intersections meet the City's Level of Service Policy for adequate operations, by having intersection LOS of C or better. The 95% queue lengths for the left-turn movement during the morning peak hour get long with only one lane available, requiring a turn lane length of 300 ft. As an alternate, a second left lane can be added, decreasing the turn lane length to 150 ft. With one, long left-turn lane, the individual lane LOS is E, which is improved to LOS D if a second lane is added. A printout of the Synchro analysis of the alternative intersection is included in the Appendix.

Table 7 – Expected Phases 4 & 5 Levels of Service

Intersection	Phase Two AM LOS	Phase Two PM LOS	Phase Three AM LOS	Phase Three PM LOS	Phase Four&Five AM LOS	Phase Four&Five PM LOS
I-470 South Terminal	B	C	B	C	B	C
Summit Woods Crossing	A	B	B	C	B	C
Right-In, Right-Out	A*	B*	B*	B*	B*	B*
Lowenstein Drive	B	B	B	B	B	B
Chipman Road & Pryor Road	C	C	C	C	B	C
Black Twig Lane & Lowenstein Drive	A*	A*	A*	A*	A/B*	A/B*
Black Twig Lane & Chipman Road	B*	C*	B*	C*	B*	D*

* Denotes stop-controlled leg LOS

Also reviewed, as requested by the City of Lee's Summit, was the northbound right turn movement at the Chipman Road and Pryor Road intersection. In reviewing the LOS for this movement, it stayed consistently at an acceptable LOS of C during the evening peak hour and LOS of B during the morning peak hour. Therefore, it is not anticipated to be necessary to add a right turn lane due to the additional northbound through traffic created by this project, though the existing evening turning movement counts would require a right turn lane by City policy.

Although it is projected to continue operating at a LOS B in the morning and D in the evening with no signal, Black Twig Lane and Chipman Road was evaluated for signal warrants using the phase four and five traffic generation volumes. None of the peak hours met any of the hourly warrants and therefore no signal is warranted for this intersection due to the development.

5.1.6 Operations and Design within the Development

The right-in, right-out proposed entrance built with phase one of the development was analyzed to ensure queues did not back up into nearby intersections. When consulting the Lee's Summit Access Management Code, it states that "driveways serving over 400 vehicles per hour (two-way traffic volumes) adequate throat length shall be determined by a transportation impact study". This stipulation is met at the right-in, right-out intersection, and therefore, an analysis was completed. It was assumed in this analysis that the four-leg intersection between the right-in/right-out roadway and the cross road providing access to the grocery store to the south and restaurants/apartments to the north will be minor-road stop

controlled, so that the vehicles on the right-in/right-out leg of the inner-development intersection will move freely and not back up to Pryor Road due to stopping.

When examining the 95% queue lengths of vehicles exiting to Pryor Road, the queue lengths were found to be low, usually less than the length of one vehicle, as can be seen in Table 8. These were calculated using the Highway Capacity Manual's 2010 Two Way Stop Control (TWSC) software and the assumption of average vehicle length of 25 feet. The queue is not expected to back up into the interior intersection.

Table 8 - Queue Lengths for Eastbound Vehicles Exiting to Pryor Road

Phase	95% Queue Length AM TWSC (feet)	95% Queue Length PM TWSC (feet)
1	5	18
2	5	18
3	10	20
4&5	13	25

5.2 Lowenstein Drive Review of Lee's Summit Access Management Policy

The City of Lee's Summit's Access Management Policy was not only reviewed to ensure that the access points on Pryor Road would meet City policy, but it was also reviewed to ensure the driveways on Lowenstein Drive also meet the policy.

Both southbound right-turn lanes, at the right-in/right-out driveway and at Lowenstein Road meet the City policy of a minimum 150 ft lane length plus taper.

The connection spacing required on industrial/commercial collectors is 300 feet. This is met between all driveways on Lowenstein Drive, including the existing driveways to the park.

The turning movements into and out of the grocery area of the proposed development onto Lowenstein Drive were also analyzed using the volumes produced with phase one of the development, where the bulk of the traffic in this area is created. The turning movement directions were estimated using the overall estimated distributions – in which vehicles would go towards Black Twig Lane as well as Pryor Road.

The City's Access Management Policy requires right turn lanes when over 100 vehicles will be turning right in any hour. It does not specify any volume requirements for left turn lanes, only stating that they "should be provided on collector streets at the intersection with a connector serving non-residential development."

Using the estimated volumes, the right turning movement into the grocery store parking lot and the delivery entrance produces 180 right turns during the morning peak hour and 122 right turns during the evening peak hour. While some of these vehicles may turn right into the delivery entrance, it is unlikely that many customers or those going through to buildings further to the north would prefer that entrance. The estimated queues exiting the north access point are 60 ft during the morning peak hour and 88 ft during the evening peak hour, less than the 150 ft throat length provided. The Access Management Guide also recommends a 125 ft throat when 100-400 vehicles travel through the throat area during the peak hour. The proposed geometrics of this driveway satisfy this requirement.

5.3 Review of Lee's Summit Unimproved Road Policy

A review of Lee's Summit Unimproved Road Policy was completed for Black Twig Lane and Lowenstein Road, west of Black Twig Lane. The policy states that "no residential subdivision (preliminary plat or major plat), industrial or commercial developments will be permitted on unimproved roads." In discussion with city staff, as this roadway will be used by development-related traffic, it is understood the eastern portion of Black Twig Lane, which is currently open ditch, will need to be updated to curb and gutter that connects with existing storm water system. Lowenstein Drive will also need to be updated to current standards.

5.4 Recommendations by Phase

Each phase will impact the one existing and two proposed access points along the Pryor Road corridor in the study area due to the traffic increase caused by the development.

5.4.1 Phase One Recommendations

Phase one of the development uses the existing intersection at Lowenstein Drive and the proposed new right-in, right-out Developer's Road intersection to the north of it, approximately 450 ft north of the Lowenstein Drive and Pryor Road intersection.

It is recommended to convert Lowenstein Drive's current minor road stop control at the Pryor Road intersection to a signalized intersection. The increase in traffic from the restaurants, medical/retail and grocery development will cause the side road delay to greatly increase without signalization. The current northbound left turn lane is an adequate length for the estimated volumes due to phase one. However, it is recommended to add a right-turn lane at the Lowenstein Drive intersection. The spacing of the signal, at 760 feet north of another signalized intersection at Chipman and Pryor Roads, is less than ideal. A spacing of at least 1,320 feet is more desirable. However, this segment of the Pryor Road corridor, located adjacent to an I-470 interchange, is heavily developed for commercial use. The majority of trips exiting the proposed development will desire to turn left onto Pryor Road to access the interchange. Without signalized control, the intersection is shown to have a failed level of service, with extremely long delays on the side roads. All three of the volume based signal warrants are projected to be met with the additional traffic from the proposed development. For these reasons, signalization is of significant importance in providing safe and efficient access for this development. There are other signalized intersections in the vicinity that are spaced at similar, or even closer spacing. Coordinated signal operations, utilizing adaptive traffic control, will work to minimize delays for through traffic along Pryor Road.

5.4.2 Phase Two Recommendations

Phase two of the development adds an additional access point at the existing three-leg intersection at Pryor Road and Summit Woods Crossing, seen in Figure 5. A fourth leg with one left turn lane and one through/right turn lane for eastbound vehicles, and one eastbound through lane (removing one of the two left-turn lanes) would be added to this intersection, providing access to the northern area of the development property. A left turn lane of 300 ft in length or two left-turn lanes, each 150 ft in length will be needed on the new, west intersection leg. In addition to adding the fourth leg, signal upgrades would be needed as well as dedicated right and left turn lanes for southbound and northbound vehicles respectively wanting to access the development. These should at minimum meet the City of Lee's Summit

access management requirements of 150 feet for a right turn bay length and 200 feet for a left turn bay length plus taper length.

Figure 5 - Existing Intersection at Pryor Road and Summit Woods Crossing, Facing West

5.4.3 Phases Three, Four and Five Recommendations

The recommendations in the previous phases cover the majority of the improvements needed for the development. The remaining traffic added by the last three phases is minimal and spread out throughout the entrances. The biggest improvement will be the extension of Black Twig Lane to the north.

5.5 Summary of Recommendations

The following is a summary of recommendations for accommodating the traffic generated by the Lowenstein Drive development.

- For phase one of the development, install a traffic signal at the intersection of Lowenstein and Pryor Roads and improve the intersection as shown in the site plan with a continuous right turn lane for southbound vehicles. This will improve the function of the intersection with the expected increase in traffic. The developer's proposed length for two eastbound left turn lanes 150 feet long with a 100 foot long taper will be adequate. The existing northbound left turn lane onto Lowenstein Drive is also adequate.
- For phase one, construct the proposed 150 feet long right-turn only lane with a 100 feet long taper at the proposed right-in, right-out access point, as shown in the site plan.
- For phase one, add a 150 feet long right-turn lane with a 100 foot long taper on Lowenstein Drive at the eastern development access point to the grocery store, as shown in the site plan.
- For phase two, upgrade the existing signal at Summit Woods Crossing to accommodate a fourth leg for the intersection and the increase in traffic.
- For phase two, add a 150 ft long right-turn only lane with a 100 ft long taper on southbound Pryor Road and a 200 ft long left-turn only lane with a 100 ft long taper on northbound Pryor Road.

- For phase two, have a three lane section on the fourth (west) leg of the Summit Woods Crossing intersection, with one left turn lane with a minimum length of 300 ft long with a taper (or two left-turn lanes of 150'), one through/right turn lane and one through lane for westbound vehicles to enter.
- Improve Lowenstein Drive and Black Twig Lane to City standards.

Following these recommendations will help Pryor Road continue to operate at acceptable levels while appropriately meeting the City of Lee's Summit Access Management Code and Unimproved Road Policy.