Spack CONSULTING
ENGINEERING TRAFFIC FORWARD

Traffic Impact Study

NORTHLAND LINDSTROM
LINDSTROM, MINNESOTA

I hereby certify this report was prepared by me or under my direct supervision, and I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

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Executive Summary

Background: A redevelopment for a new apartment building and restaurant is proposed in the area north and west of the Bronson Avenue/Vine Street intersection and south of Lake Boulevard in Lindstrom, Minnesota. The purpose of this study is to determine the traffic impacts associated with the build out of the proposed development on the study roads and intersections where significant impact is anticipated.

Results: The principal findings of this study are:

- The proposed development is expected to generate 732 new trips during an average weekday, 69 new trips during the weekday p.m. peak hour and 65 new trips during the Saturday peak hour.
- The actual driveway trips, when accounting for pass-by trips, are 973 weekday daily trips, 91 weekday p.m. peak hour trips, and 87 Saturday peak hour trips.
- Most roadways and intersections have acceptable delays based on the capacity analysis. The only exception is Lake Boulevard west of the site which has a daily volume higher than the capacity of a two-lane road. This is an existing issue.
- Linden Street, Bronson Avenue, Park Street and Newell Avenue area all forecast to have less than 1,000 daily vehicles on them through the 2020 Build scenario.
- The proposed 162 vehicle parking stalls on site fall short of the 245 parking stalls City Ordinances would require for an individual restaurant and apartment building.
- The forecast peak period parking demand for the site is 133 vehicles which can be accommodated within the proposed parking area.

Recommendations: The following items are recommended based on the analyses contained in this study:

- Enforce the right-in/right-out at the site access intersection with either a median and signage as shown in Figure 1 or with bollards as shown in Figure 2.
- Place bollards east of the U-turn on Lake Boulevard, as shown in Figure 3, to prevent quick right turns onto Linden Street.
- Shift the trail on the south side of Lake Boulevard to be able to accommodate the new right turn lane into the western surface parking area while avoiding any disconnection in the trail. Include ADA compliant curb ramps on the trail at the site access point and create an unobstructed path through the porkchop island at that point.
- Schedule and conduct any truck loading operations outside of peak periods for the site to reduce conflicts with vehicles in the parking areas.
- Include secure bicycle parking on site accessible for the restaurant use. Include a bicycle parking area in the underground parking area for resident use along with a bicycle maintenance station.

This study is based upon a concept development plan dated December 17, 2017. Assuming the general characteristics of the proposed development remain approximately the same as documented, minor changes in the final design are not expected to alter the results or recommendations of this study.

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1. Introduction

a. Proposed Development

A redevelopment is proposed in the area north and west of the Bronson Avenue/Vine Street intersection and south of Lake Boulevard in Lindstrom, Minnesota. Following are the proposal's key attributes:

i. Three accesses are proposed for the site. One access on Bronson Avenue will lead to a surface parking lot and one access on Vine Street will lead to the same surface parking lot as well as an underground parking area. A right-in/right-out access is proposed on eastbound Lake Boulevard that will lead to a second surface parking lot. The access points are shown in the concept development plan shown in the Appendix.
ii. The proposed development will be a three-story building with 105 apartment units and a 4,334 square foot restaurant.
iii. The development is expected to be fully occupied by 2020 for the purposes of this study.
iv. A total of 162 vehicle parking stalls are proposed; 71 on two surface level lots and 91 in an underground parking area.

b. Purpose of Study

The purpose of this study is to determine the traffic impacts associated with the build out of the proposed development. The traffic impacts are studied on the roads and intersections where significant impact is anticipated and improvements are recommended where mitigation is needed. For those not familiar with the general concepts and terms associated with traffic engineering, *The Language of Traffic Engineering* guide is included in the Appendix.

c. Study Objectives

The objectives of this study are:

i. Document how the study intersections and roadways currently operate.
ii. Forecast the amount of traffic expected to/from the proposed development.
iii. Determine how the study intersections and roadways will operate in the future with and without the proposed development.
iv. Recommend appropriate mitigation measures if poor operations are identified.
v. Forecast the parking demand on site and compare that to the proposed supply.
vi. Review multi-modal facilities around the site.

The roadways corridors studied in this document include those surrounding the proposed site, which are:

i. Lake Boulevard/1st Avenue
ii. Linden Street
iii. Bronson Avenue
iv. Vine Street

v. Newell Avenue
vi. Park Street
vii. North Lakes Trail

For the purposes of this traffic study, the study intersections closest to the proposed development and where the greatest impact is expected were chosen for review and include:

i. Lake Boulevard/1st Avenue Turnaround
ii. Lake Boulevard/Linden Street
iii. Linden Street/Bronson Avenue
iv. Lake Boulevard/Site Access
v. Newell Avenue/Park Street
vi. Lake Boulevard/North Lakes Trail
vii. 1st Avenue/North Lakes Trail
viii. Bronson Avenue/Site Access
ix. Vine Street/Site Access

Furthermore, this study does not account for the existing roadway conditions such as pavement quality or appropriate drainage.

2. Existing Conditions

a. Corridor Characteristics

As mentioned, the proposed site is located north and west of the Bronson Avenue/Vine Street intersection and south of Lake Boulevard. Table 1 shows the characteristics of the key roadway corridors around this site and within the study area.

Table 1 – Study Corridor Characteristics

Name	Designation[1]	Classification[2]	Speed Limit	Lanes	Fixed-Route Transit	Peds/ Bicycles
Lake Boulevard/ 1st Avenue	TH 8	Principal Arterial	30 mph[3]	2 undivided	None	Sidewalks both sides, trail west of Linden
Linden Street	Local	Local	30 mph	2 undivided	None	Sidewalks both sides
Bronson Avenue	Local	Local	30 mph	2 undivided	None	Sidewalk south side
Vine Street	Local	Local	30 mph	2 undivided	None	Sidewalk west side
Newell Avenue	Local	Local	30 mph	2 undivided	None	Sidewalk south side
Park Street	Local	Local	30 mph	2 undivided	None	Sidewalks both sides
North Lakes Trail	Chisago CSAH 20	Minor Collector	30 mph	2 undivided	None	Sidewalks both sides[4]

[1] TH = Trunk Highway, CSAH = County State Aid Highway.
[2] Lindstrom Comprehensive Plan – 2017 Draft.
[3] 40 mph west of site.
[4] Between Lake Boulevard and 1st Avenue only.

b. Traffic Volumes

Intersection video was collected at the existing study intersections under normal weekday conditions and on a Saturday in May 2018. Using these videos, 24-hour turning movement counts were obtained at the study intersections on a weekday and 24-hour turning movement counts were obtained at the study intersections on a Saturday.

The average weekday and Saturday peak hours were found to be from 4:30 to 5:30 p.m. on a weekday and 1:30 to 2:30 p.m. on a Saturday. The counts from these two peak hours were used at the study intersections for analysis. The turning movement count data from the counts are contained in fifteen-minute intervals in the Appendix.

Based on the turning movement volumes, the current weekday daily traffic volumes on each study corridor are:

i. 23,200 vehicles per day on Lake Boulevard/1st Avenue west of the site
ii. 12,200 vehicles per day on Lake Boulevard east of the site
iii. 12,200 vehicles per day on 1st Avenue east of the site
iv. 300 vehicles per day on Linden Street
v. 100 vehicles per day on Bronson Avenue
vi. 300 vehicles per day on Park Street
vii. 600 vehicles per day on Newell Avenue
viii. 1,400 vehicles per day on North Lakes Trail

3. Forecasted Traffic

a. Site Traffic Forecasting

A trip generation analysis was performed for the development site based on the methods published in the *Institute of Transportation Engineers (ITE) Trip Generation Manual, 10th Edition*. Trip generation rates are provided by this ITE manual as well as local data collected by Spack Consulting.

The ITE manual compiles studies from across the country to provide a national average traffic for various land uses. Spack Consulting collects current average traffic volumes for various land uses in the Twin Cities regional area for use in our studies. Local data is considered more relevant than the ITE national data as it is generally newer and accounts for our area's specific characteristics. Per the procedure in the *Trip Generation Manual*, local trip generation data is used when possible and supplemented with national ITE data when local data is not available.

For each analysis, the raw trip generation was divided among three types of trips – new, pass-by, and internal. Pass-by trips are those vehicles already on the roads which will stop at the development site in the future. Pass-by trips only apply to the restaurant portion of this site. Internal trips are those vehicles within the site visiting the restaurant and residential portions of the site. New trips represent traffic increasing the overall number of vehicles at the study intersections.

The resultant new trips generated by the proposed development are shown in Table 2 for weekday data and Table 3 for Saturday data based on both the ITE data and Spack Consulting data. Detailed trip generation tables showing the exact breakdowns are provided in the Appendix.

Table 2 – Weekday Trip Generation

Land Use Code – Source[1]	Description & Size	Daily		AM Peak Hour		PM Peak Hour	
		In	Out	In	Out	In	Out
221 - ITE	Multifamily Housing (Mid-Rise) (105 dwelling units)	263	263	8	24	24	15
932 - ITE	High-Turnover Sit-Down Restaurant (4,334 square feet)	127	127	11	9	13	8
Total (ITE)		**390**	**390**	**19**	**33**	**37**	**23**
Local	Apartment (105 dwelling units)	206	206	5	27	27	13
Local	Restaurant (4,334 square feet)	160	160	4	3	19	10
Total (Local)		**366**	**366**	**9**	**30**	**46**	**23**

[1] Local = Trip generation data collected by Spack Consulting in this regional area.

Table 3 – Saturday Trip Generation

Land Use Code – Source[1]	Description & Size	Daily		Peak Hour	
		In	Out	In	Out
221 - ITE	Multifamily Housing (Mid-Rise) (105 dwelling units)	227	227	19	20
932 - ITE	High-Turnover Sit-Down Restaurant (4,334 square feet)	133	133	12	11
Total (ITE)		**360**	**360**	**31**	**31**
Local	Apartment (105 dwelling units)	210	210	20	16
Local	Restaurant (4,334 square feet)	114	114	15	14
Total (Local)		**324**	**324**	**35**	**30**

[1] Local = Trip generation data collected by Spack Consulting in this regional area.

As the tables show, the trip generation forecasts based on the ITE data and locally collected data are relatively close. Since ITE recommends using local data when available, the trip generation rates based on locally collected data are used in the analysis.

A trip distribution pattern was developed for the generated traffic going to and from the proposed development. This pattern is based on the existing traffic volumes and access to the regional transportation system. The general trip distribution pattern for this study is:

- 50% of the generated traffic to/from the west on Lake Boulevard.
- 40% of the generated traffic to/from the east on Lake Boulevard.
- 5% of the generated traffic to/from the north on North Lakes Trail.
- 5% of the generated traffic to/from the south and east on Newell Avenue/Oak Street.

Traffic generated by the site development was assigned to the area roadways per this distribution pattern.

b. Non-site Traffic Forecasting

To forecast future traffic volumes for the future build-out year of 2020 in the study area outside of the proposed development's traffic, general growth in traffic was added as well as traffic from a specific nearby development. The Rose Hill Senior Living Facility is proposed on the west side of the lake from the Northland Lindstrom development. To account for traffic from that development, a trip generation forecast was conducted and those trips were applied to the study network per a modified trip distribution.

Using MnDOT's traffic projection factors aids in determining general growth for the area. For Chisago County, MnDOT has a 20-year growth projection of 1.3, meaning

a 30 percent increase in traffic in 20 years. For the two years between 2018 and 2020, that leads to a three percent increase in traffic volumes. This growth was applied to all existing movements in the study network to establish the No-Build forecasts.

c. Total Traffic

Traffic forecasts were developed for the 2020 Build scenarios by adding the traffic generated by the proposed residential development to the No-Build forecast volumes. Peak hour forecasts are shown in the Appendix.

4. Analyses

a. Corridor Vehicular Analysis

While many factors contribute to a road feeling congested, the two biggest factors are volume, how many vehicles are using the road, and capacity, how many vehicles the road can accommodate a day. Transportation professionals use these pieces of information to create a ratio of volume to capacity. For example, a road with a volume to capacity ratio of 1.0, where the traffic demand is nearly equal to the traffic supply, will feel congested to motorists.

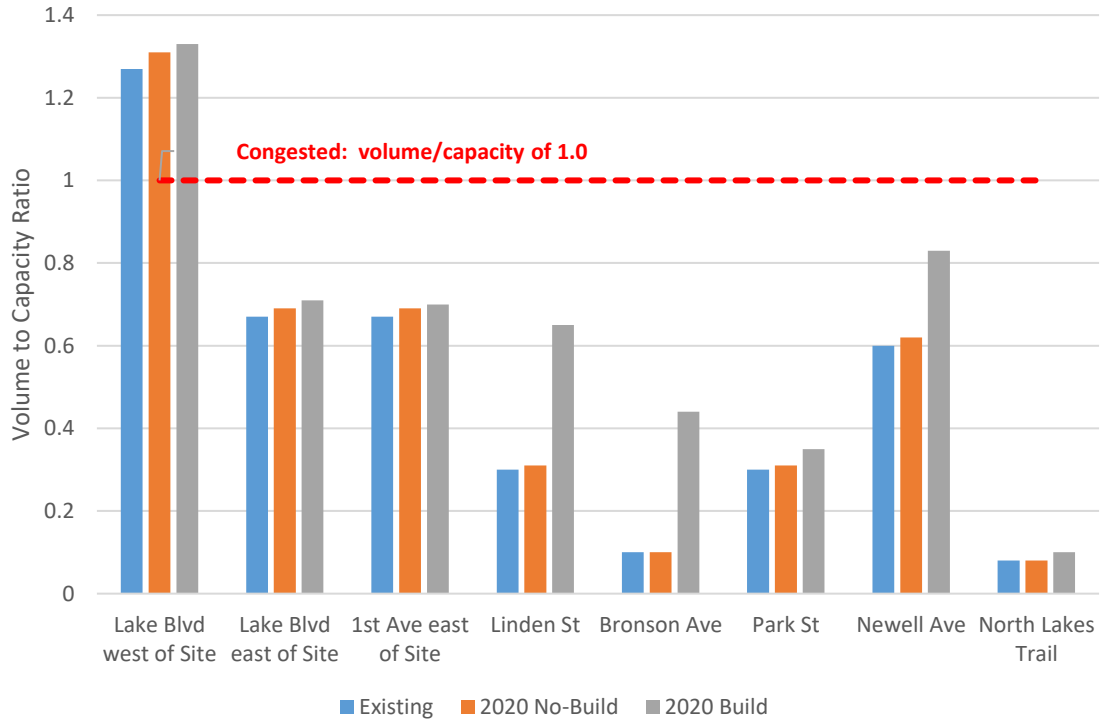
Below is a rough guide of the daily traffic volumes different types of roads can accommodate based on Exhibits 16-16 and 12-39 of the *Highway Capacity Manual, 6th Edition*. If the Average Daily Traffic (ADT) volume on a roadway is below the threshold, then it is considered un-congested. If the daily volume falls inside the range, the road is almost congested, and if the daily volume is over the threshold the road is congested.

- 2-Lane (one in each direction with left turn lanes at busy intersections and coordinated signals), undivided street, are considered congested with a volume between 8,900 to 18,300 vehicles per day.
- 4-Lane, undivided street (two in each direction with left turn lanes at busy intersections and coordinated signals), – 18,600 to 36,800 vehicles per day.

The above capacities represent physical capacity in ideal roadway conditions. Research from UC Berkley, for example, indicates quality of life along a residential street is negatively impacted when the ADT exceeds 1,000 vehicles per day. Therefore, the 1,000 vehicle per day threshold is used for the capacity along neighborhood two lane roads (Linden Street, Bronson Avenue, Park Street and Newell Avenue) even though their physical capacity is approximately ten times larger.

To provide an initial planning level screening, Chart 1 provides volume to capacity ratios of the study corridors during each of the study years to determine if any of the roadway corridors are candidates for additional through lanes. As shown, on a planning-level analysis the study roadways can accommodate the expected increase in traffic even with the reduced 1,000 vehicle per day threshold on several of the roadways. The one roadway that is over capacity, both now and in the future, is Lake Boulevard west of the site. This roadway is currently over capacity and any modifications or improvements to the roadway would be due to factors outside of this development.

Chart 1 – Study Corridor Volume to Capacity



b. *Intersection Vehicular Analysis*

Individual intersections can perform poorly during peak periods while the overall roadway corridor is operating with an uncongested daily volume to capacity ratio lower than 1.0. Therefore, capacity analyses are performed for the study intersections to determine if they need improvements such as turn lanes or an upgrade in traffic control.

The existing and forecasted turning movement volumes along with the existing intersection configurations and traffic control were used to develop the average delay per intersection in each study scenario. The delay calculations were done in accordance with the *Highway Capacity Manual, 6th Edition* using the Vistro software package. The full calculations for each study scenario, including Level of Service (LOS) grades and queue lengths, are included in the Appendix. Also, included in the Appendix is a guide explaining the Level of Service grade concept.

Chart 2 (weekday p.m. peak hour) and Chart 3 (Saturday peak hour) show the average peak hour delay per traffic signal-controlled intersection for each study scenario. The LOS D/E boundary of 55 seconds of delay per vehicle is considered the threshold between acceptable and unacceptable traffic signal operation in Minnesota.

Chart 2 – P.M. Peak Hour Delays: Signal Controlled Intersections

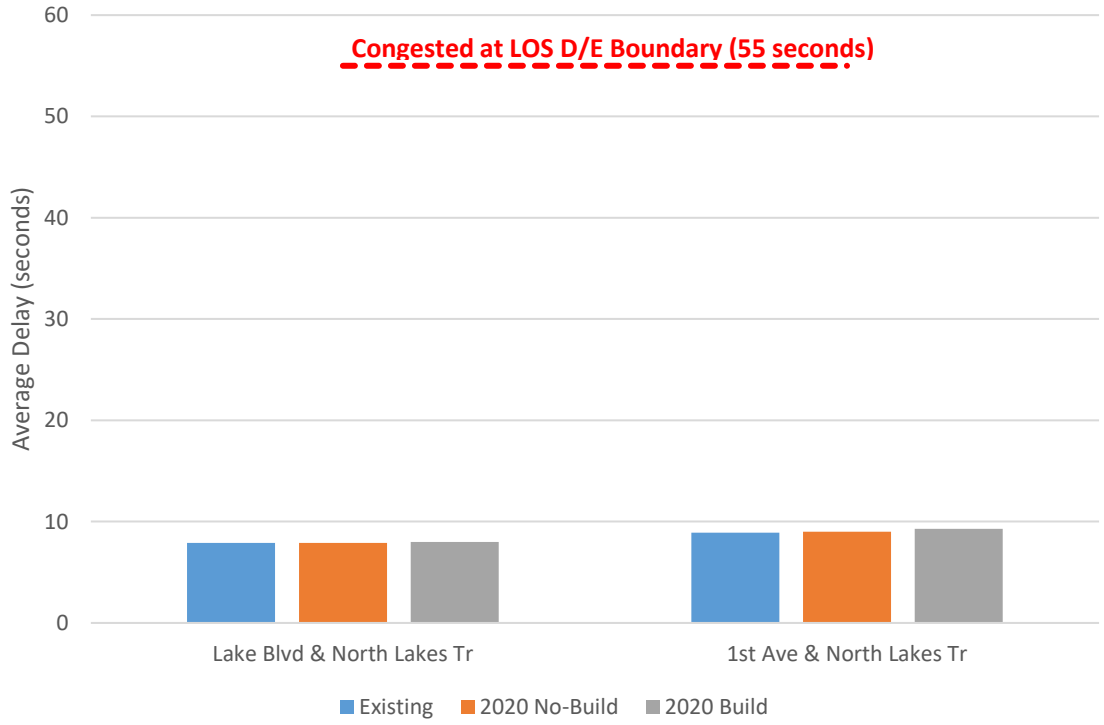


Chart 3 – Saturday Peak Hour Delays: Signal Controlled Intersections

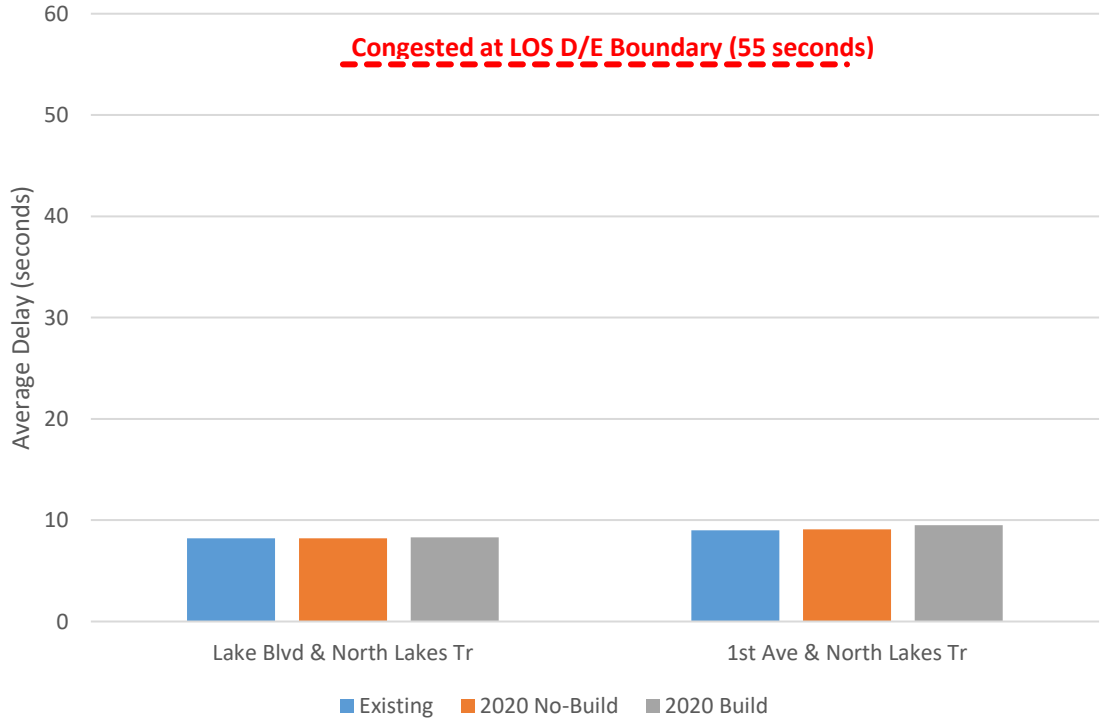


Chart 4 (weekday p.m. peak hour) and Chart 5 (Saturday peak hour) show the 95th percentile queue lengths on the busiest stop sign controlled approach at intersections with side street stop sign control. Average delays are not considered a quality metric for intersections with side street stop sign control because the vast majority of vehicles going through the intersection are on the main roadway and have zero delay, which leads to low overall average delays. At side street stop sign controlled approaches to busy roadways, the average delay for all the vehicles on the approach often exceeds 60 seconds. This can be the case for a few vehicles waiting at the stop sign where improvements would not be justified for the low traffic volume. Based on our experience, improvements are not warranted at these types of intersections until the 95th percentile queue at a stop sign is in the five to ten vehicle range.

Chart 4 – P.M. Peak Hour Queues: Side Street Stop Sign Controlled Intersections

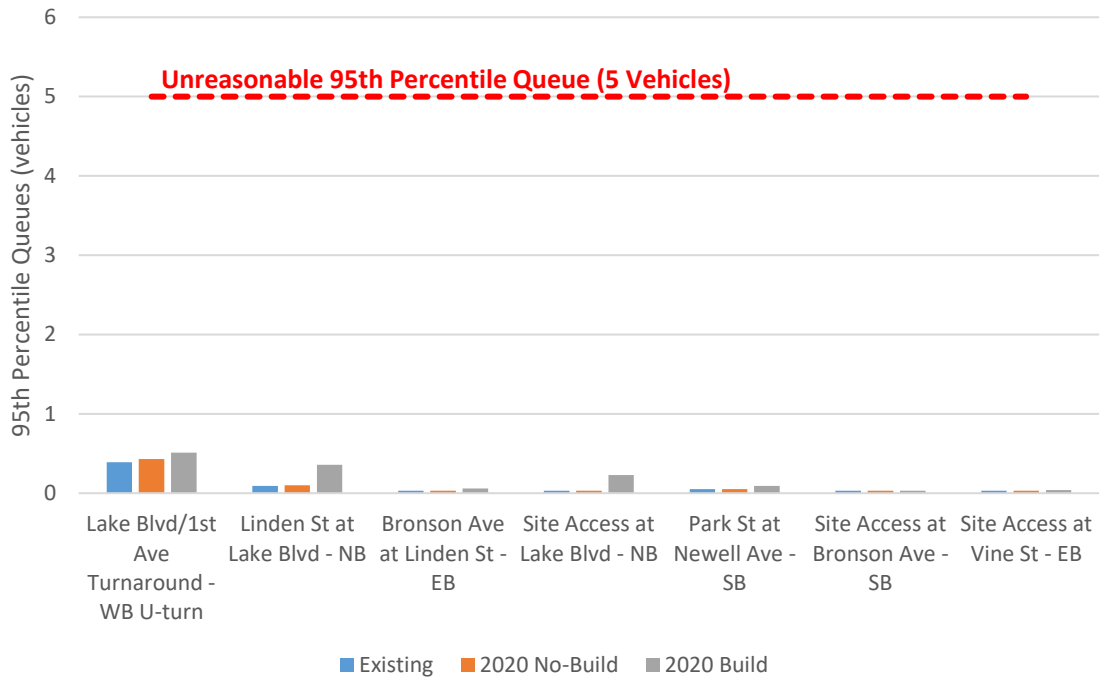
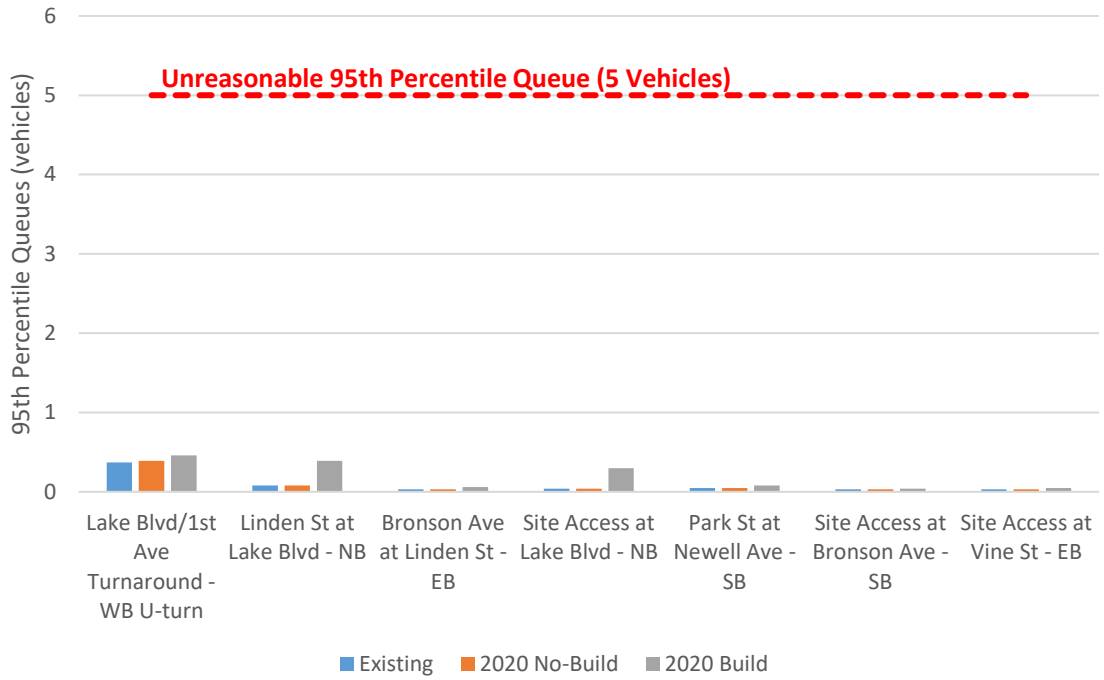


Chart 5 – Saturday Peak Hour Queues: Side Street Stop Sign Controlled Intersections



Per the above analyses, all study intersections will operate acceptably throughout the study scenarios. No additional modifications to the existing network are needed to accommodate this development.

c. *Automobile Parking Forecasting & Analysis*

Parking to be Provided On Site

On-site automobile parking will be provided at two surface level lots and one underground parking area. The surface lot accessible from eastbound Lake Boulevard will have 34 parking stalls, the surface lot accessible from Bronson Avenue and Vine Street will have 37 parking stalls and the underground parking area accessible from Vine Street will have 91 parking stalls. That provides a total of 162 automobile parking stalls with 91 below grade for residential use.

Parking Required by Lindstrom Code

According to Section 154.249 of the City of Lindstrom Code of Ordinances, minimum parking requirements are:

- Multiple-family dwelling: 1.5 stalls per dwelling unit with 0.5 stalls per unit in an enclosed garage.
- Restaurant: 1 stall per 40 square feet of dining area and one stall per 80 square feet of kitchen area.

With 105 apartment units, the requirement is for 158 parking stalls, 53 of which need to be in an enclosed garage. For the 4,334 square foot restaurant, assuming 60%

is devoted to the dining area and 40% is devoted to the kitchen area, to the requirement is for 87 parking stalls needed. Overall, to meet City Ordinances, 245 parking stalls are needed on site which exceeds the 162 stalls proposed to be provided.

Section 154.250 of the City of Lindstrom Code of Ordinances states that "a conditional use permit for one or more businesses to provide the required off-street parking facilities by joint use of one or more sites where the total number of spaces provided are less than the sum of the total required for each business" is allowed. To comply with this Ordinance, the following conditions will be met if it can be shown that there is no substantial conflict in the operating hours of the two buildings or uses for which joint use of off-street parking facilities is proposed. With the restaurants peak period for parking during lunch or dinner hours and the apartments peak period for parking overnight, this condition will need to be explored further to see if it can be met.

Expected Parking Demand - ITE

The Institute of Transportation Engineers (ITE) has put together a document, *ITE Parking Generation, 4th Edition,* that compiled parking demand data from different land uses. Using that data, peak period parking demands were calculated for each land use of this development for a non-Friday weekday, a Friday and a Saturday. Those peak period parking demands are summarized in Table 4.

Table 4 – Peak Period Parking Demands

Land Use	Peak Period Vehicle Parking Demand		
	Weekday	Friday	Saturday
Apartments	129	129	108
Restaurant	46	46	71
TOTAL	**175**	**175**	**179**

As seen in Table 4, the combined apartment and restaurant may exceed the provided 162 stalls at some times. However, with these different land uses, it is unlikely that all will experience their peak parking demand at the same time. For example, an apartment will have its highest parking demand in the middle of the night while a restaurant will have its highest parking demand during lunch or dinner. To determine the total number of parking demand on site during different times, a time-of-day analysis was done.

In addition to ITE, Spack Consulting has collected parking and trip generation data for land uses in the Twin Cities. Using this information, the percentage of peak parking demand can be found for each hour over the course of a day. Using data collected on different days, these percentages are unique for weekdays, Fridays and Saturdays.

Hourly results of the time-of-day parking analysis are attached. This analysis forecasts that the peak parking demand for the entire site for a weekday, Friday and Saturday will be:

- 133 vehicles on a weekday at 10:00 p.m.
- 129 vehicles on a Friday at 4:00 a.m.
- 108 vehicles on a Saturday at 4:00 a.m.

Based on these numbers the 162 provided stalls will be able to accommodate apartment and restaurant parking on weekdays, Fridays and Saturdays with stalls to spare. Based on these results, the amount of provided parking should be able to accommodate parking demand at the site to qualify for the conditional use permit. With these numbers, keeping the western parking lot for restaurant use only and the underground parking area for residential use only, some of the restaurant parking will need to use the eastern surface parking lot as well as some of the apartment parking.

For further comparison, using the locally collected parking generation data from Spack Consulting, the combined peak parking demand for the site will be approximately 25% less than the ITE data.

Encouraging multi-modal transport to the site can reduce the vehicle parking demand. Other strategies to curb parking stall needs include having guaranteed parking stalls rather than reserved parking stalls for residents and not including parking for all residents.

d. Bicycle Parking

With trail access to the site, having secure bicycle parking for both restaurant and apartment use will aid in reducing vehicle parking demand at the site. It is recommended that convenient bicycle parking spaces be included near the entrance to the restaurant and that a bicycle parking area be located in the underground parking area for residents. It is recommended that additional bicycle parking be added to the site as needed. Including a bicycle maintenance station on site will further encourage residents to use bicycling as a form of transportation whenever possible.

e. Concept Site Plan & Multi-Modal Review

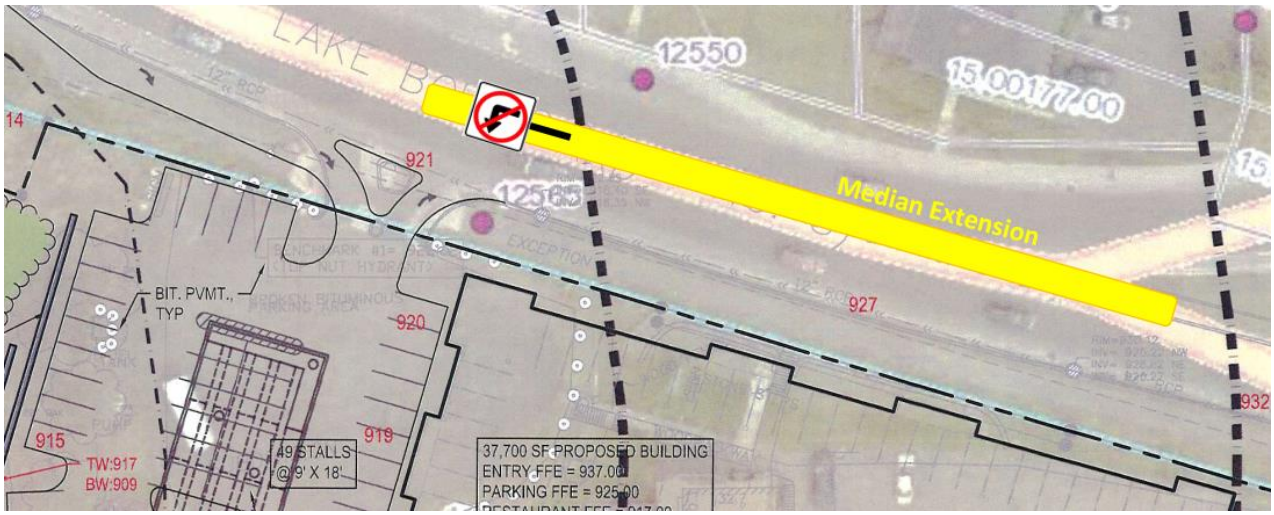
The concept site plan contained in the Appendix was reviewed to determine if the plan provides appropriate circulation and minimizes conflicts. Following are key transportation elements of the concept site plan:

i. **Vehicle Circulation – Western Parking Area:** The western surface parking area is separated from the other surface parking area and the underground parking area by the building. This western parking area adjacent to the restaurant is serviced by a right-in/right-out access on Lake Boulevard. This access allows only eastbound vehicles to enter the site and vehicles can only exit to the east. Due to the location and the high volumes on Lake Boulevard, this type of access is reasonable, though it does prohibit westbound vehicles from entering the site as well as prohibiting vehicles exiting the site to head to the west.

Vehicles wishing to enter this parking area from the east will need to drive past the access and turn around downstream. This can be accommodated at Lincoln Road. To prevent westbound vehicles from entering the parking lot directly, a porkchop island will be included at the access making left turns into the site challenging. This porkchop will also direct exiting vehicles to make a right turn to head east. Vehicles wishing to exit the site and head west will need to turn around further down the road at North Lakes Trail.

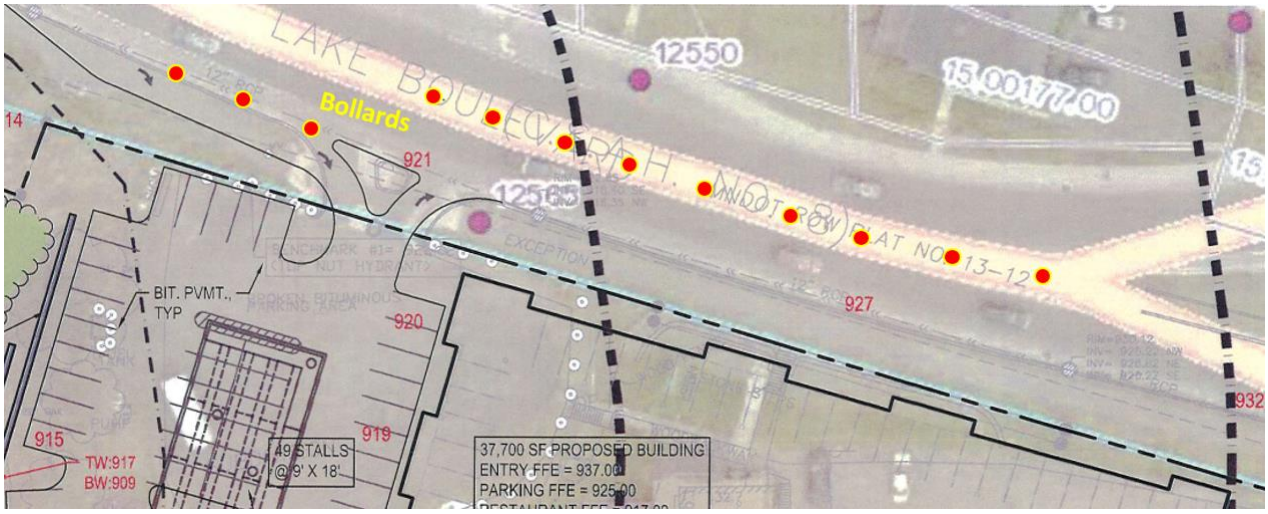
Though a porkchop island will prevent many vehicles from making left turns into and out of the site, there are likely to be a number of vehicles that still make these movements due to not wanting to take a longer path into or out of the site. To discourage these left turn, it is recommended that the median between 1st Avenue and Lake Boulevard east of the site access be extended west to just past the end of the porkchop. Since the northern leg of this intersection still has full access, the median cannot be pulled through the intersection, but pulling it past the end of the porkchop will essentially force exiting vehicles from the site to make a right turn. Access for a single home on the north side of Lake Boulevard would be impacted by this median extension. Signage (MUTCD sign R3-2) can be placed on the median informing drivers they cannot make a left turn into the site which should further increase driver compliance. See Figure 1 for a sketch of this on the concept site plan.

Figure 1 – Median Extension on Lake Boulevard at Site Access



Alternatively, rather than extend the median and add signage, the use of bollards in place of the median could be used to guide vehicles exiting the site to make a right turn. To encourage vehicles coming from the east to not make a left turn into the site, bollards could be placed along the eastbound right turn lane line. See Figure 2 for a sketch of this on the concept site plan.

Figure 2 – Bollards on Lake Boulevard at Site Access

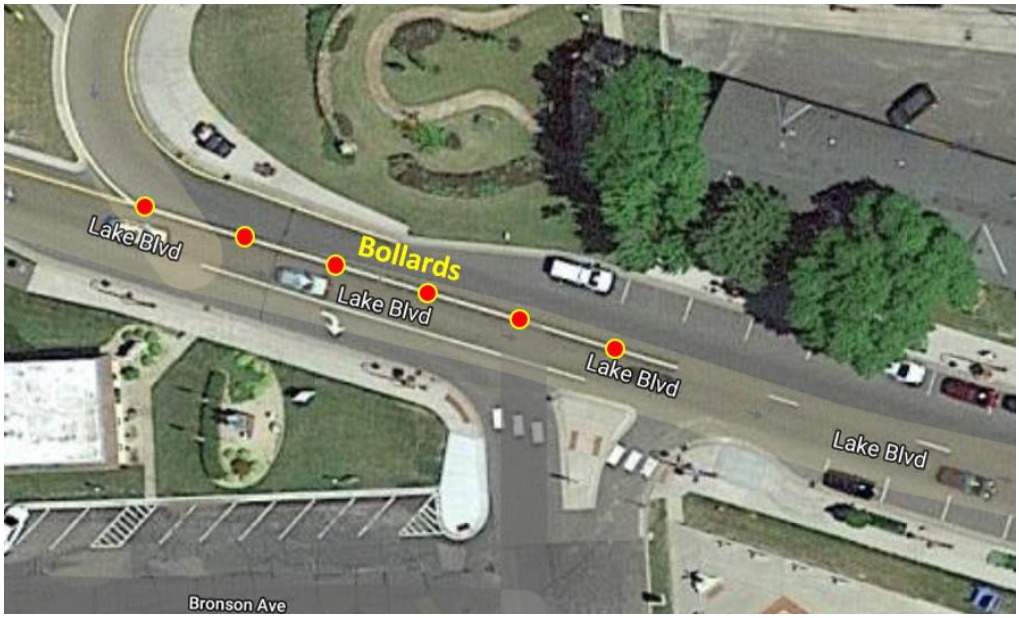


ii. **Vehicle Circulation – Eastern Parking Area:** The eastern surface parking area and underground parking area are accessible from Bronson Avenue and Vine Street. Vehicles coming to these areas from the west will use Lake Boulevard to Linden Street. Vehicles coming to these areas from the east will either use Newell Avenue or 1st Avenue to the U-turn onto Lake Boulevard. Vehicles coming from this U-turn onto Lake Boulevard will likely stop and merge over quickly to turn onto Linden Street rather than go down to Park Street to Newell Avenue.

The volumes making this U-turn movement are forecast to be approximately 75 vehicles in peak hours. As shown in the capacity analysis results, the queues for this movement are small and not expected to stack back to 1st Avenue to block a through lane. The only concern raised from vehicles trying to turn onto Linden Street from the U-turn is if a vehicle needs to stop and wait for traffic on Lake Boulevard to clear and another vehicle behind that first one comes through the U-turn expecting to continue into it's designated lane causing a rear end collision.

To reduce the possibility of this type of collision, vehicles should be directed to go to Park Street from the U-turn rather than try and make the quick turn onto Linden Street. To prevent this movement, bollards could be placed along the lane line between the U-turn lane and the eastbound through lane on Lake Boulevard from the U-turn to Linden Street. This would prevent several of the on-street parking spaces on Lake Boulevard from being accessible from the through lane. See Figure 3 for a sketch of this.

Figure 3 – Bollards on Lake Boulevard at Linden Street



Vehicles exiting the site wishing to go east can use either Newell Avenue or Linden Street to Lake Boulevard. Vehicles wishing to go west can do the same and turn around at North Lakes Trail. The movement from Bronson Avenue to Linden Street to Lake Boulevard goes through two closely spaced intersections; Linden Street/Bronson Avenue and Lake Boulevard/Linden Street. While having intersections this closely spaced is not ideal, the one-way traffic on Lake Boulevard and the low volumes on Linden Street and Bronson Avenue mitigate some potential conflicts. Significant queueing is not expected on northbound Linden Street at Lake Boulevard so the number of times vehicles are stacked along Linden Street down Bronson Avenue is expected to be limited. However, conflicts could occur if vehicles are stacked waiting to turn onto Lake Boulevard and blocking the southbound lane of Linden Street. A “Do Not Block Intersection” sign (MUTCD sign R7-10) may be useful on Bronson Avenue at Linden Street to remind drivers to wait to turn left onto northbound Linden Street until there is room for their vehicle.

iii. Right Turn Lane at Site Access on Lake Boulevard

As discussed in a previous memorandum for the site by Spack Consulting, the eastbound right turn lane on Lake Boulevard into the western parking area is recommended. Due to the high volumes on Lake Boulevard, separating the right turning movements at this intersection allows for better operations along Lake Boulevard. Also, as shown in Figure 2, the added lane allows for the potential to aid in restricting westbound left turns into the site through the use of bollards.

The right turn volumes are anticipated to be low, so having a shorter right turn lane plus a taper that does not extend onto the nearby bridge should be sufficient.

With the trail along the south side of Lake Boulevard at this location, the trail will need to be moved to accommodate the added lane. This is not shown in the site plan.

iv. Loading

Loading areas are not indicated in the site plan. Loading for the restaurant could be accommodated in the western surface parking lot, however trucks in there would block some parking stalls and may need some of the stalls to be empty to make complete turning movements inside the lot. Similarly for the apartment building, loading could be done in the eastern surface lot or along Vine Street.

Because loading operations would conflict with some of the parking stalls, loading operations should be scheduled and conducted outside of peak periods for the site (morning and afternoon peaks for the apartment and meal time peaks for the restaurant).

v. **Bicycle and Pedestrian Infrastructure:** The site plan does not show pedestrian or bicycle facilities.

As previously mentioned, the trail on the north end of the site along the south side of Lake Boulevard will need to be shifted and accounted for with the addition of a right turn lane into the western parking area. This includes having ADA compliant curb ramps at the site access point and making sure pedestrians and bicycles can continue unobstructed through the porkchop island.

Pedestrian facilities are not proposed in the parking areas meaning that people walking to/from parked vehicles will need to walk in the drive aisles. With both surface parking areas being relatively small, this is not of significant concern at this time. If vehicle/pedestrian conflicts appear that they could occur in the parking area, traffic calming measures such as speed bumps could be implemented. Additionally, sidewalks along the outsides of the parking lots could be constructed to keep pedestrians out of the drive aisles of the parking lots.

Also as previously mentioned, it is recommended that convenient bicycle parking spaces be included near the entrance to the restaurant and that a bicycle parking area be included in the underground parking area for residents. It is recommended that additional bicycle parking be added to the site as needed. Including a bicycle maintenance station on site will further encourage residents to use bicycling as a form of transportation whenever possible.

5. Conclusions and Recommendations

The traffic impacts of the proposed development were studied and the principal findings are:

- The proposed development is expected to generate 732 new trips during an average weekday, 69 new trips during the weekday p.m. peak hour and 65 new trips during the Saturday peak hour.
- The actual driveway trips, when accounting for pass-by trips, are 973 weekday daily trips, 91 weekday p.m. peak hour trips, and 87 Saturday peak hour trips.
- Most roadways and intersections have acceptable delays based on the capacity analysis. The only exception is Lake Boulevard west of the site which has a daily volume higher than the capacity of a two-lane road. This is an existing issue.
- Linden Street, Bronson Avenue, Park Street and Newell Avenue area all forecast to have less than 1,000 daily vehicles on them through the 2020 Build scenario.
- The proposed 162 vehicle parking stalls on site falls short of the 245 parking stalls City Ordinances would require for an individual restaurant and apartment building.
- The forecast peak period parking demand for the site is 133 vehicles which can be accommodated within the proposed parking area.

The following recommendations are made based on the above findings:

- Enforce the right-in/right-out at the site access intersection with either a median and signage as shown in Figure 1 or with bollards as shown in Figure 2.
- Place bollards east of the U-turn on Lake Boulevard, as shown in Figure 3, to prevent quick right turns onto Linden Street.
- Shift the trail on the south side of Lake Boulevard to be able to accommodate the new right turn lane into the western surface parking area while avoiding any disconnection in the trail. Include ADA compliant curb ramps on the trail at the site access point and create an unobstructed path through the porkchop island at that point.
- Schedule and conduct any truck loading operations outside of peak periods for the site to reduce conflicts with vehicles in the parking areas.
- Include secure bicycle parking on site accessible for the restaurant use. Include a bicycle parking area in the underground parking area for resident use along with a bicycle maintenance station.

6. Appendix

A. Site Plan

B. The Language of Traffic Engineering

C. Traffic Counts

D. Trip Generation Table

E. Time of Day Parking Generation

F. Level of Service (LOS)

G. Capacity Analysis Backup

- Weekday PM Existing
- Saturday Midday Existing
- Weekday PM 2020 No-Build
- Saturday Midday 2020 No-Build
- Weekday PM 2020 Build
- Saturday Midday 2020 Build