



March 9, 2020

Mr. Mark Hungerford, ACIP  
City of Fremont  
39550 Liberty Street  
Fremont, CA 94537-5006

## Transportation Operations Analysis for the Osgood II Multifamily Development

Dear Mr. Hungerford;

As requested, W-Trans has prepared a Transportation Operations Analysis for the proposed Osgood II Multifamily Development project to be located at 41911, 41965 and 42021 Osgood Road in Fremont. The purpose of this study is to evaluate traffic operations on the adjacent transportation facilities and any changes that would result from adding traffic from the proposed development.

### Project Description

The proposed project would be located within the Irvington Community Station Plan Area of Fremont and is comprised of 284 multifamily residential units (162 apartments and 122 condominiums) in a pair of five-story buildings on 3.51 acres. There would be a total of 445 off-street parking spaces provided within two dedicated parking levels of each building. Vehicular access to the site would be provided via two existing driveways on Osgood Road. The north driveway would be limited to right-turn ingress/egress only. The south driveway would be shared with the adjacent development (Osgood Residences at 42111 & 42183 Osgood Road) and is currently restricted to right-turn movements only for both ingress and egress. For the purposes of this study, various access control alternatives were evaluated for the south driveway access.

### Study Locations and Periods

The following intersections of public streets and driveways with public streets comprised the study area:

1. Osgood Road/41655 Osgood Road
2. Osgood Road/South Project Driveway
3. Osgood Road/Blacow Road

Operating conditions during the a.m. and p.m. peak periods were evaluated to capture the highest potential impacts for the proposed project as well as the highest volumes on the local transportation network. The morning peak hour occurs between 7:00 and 9:00 a.m. and reflects conditions during the home to work or school commute, while the p.m. peak hour occurs between 4:00 and 6:00 p.m. and typically reflects the highest level of congestion during the homeward bound commute. Intersection counts are enclosed. The analysis is based on existing peak hour volumes, lane geometry, and traffic control (e.g., signal timing, signal phasing, etc.) plus trips from approved but not yet constructed developments within the study area plus net-new Project-generated trips, with the access scheme changed for the two scenarios analyzed. The following scenarios were evaluated:

- A. **Existing plus Approved Projects plus Project Conditions – Alternative A.** Alternative A assumes the south project driveway is restricted to right turn egress and ingress only.
- B. **Existing plus Approved Projects plus Project Conditions – Alternative B.** Alternative B assumes that the median in Osgood Road would be modified so that the south project driveway would have full access.

## Existing Setting

Traffic counts were obtained at each study intersection on Wednesday May 30, 2018, while local schools were in session, so represent typical conditions. Field observations were also conducted in April 2018 to confirm roadway characteristics and motorist behavior within the study area.

**Osgood Road** is a north-south primary arterial with two lanes in each direction. This road provides access between Washington Boulevard and Grimmer Boulevard. The posted speed limit of Osgood Road is 40 mph.

## Study Locations

**Osgood Road/41655 Osgood Road** is the location of a break in the median where northbound vehicles can either turn left into the driveway serving 41655 Osgood Road or complete a U-Turn and return southbound on Osgood Road. This is the planned location for the main entrance to the Irvington BART station.

**Osgood Road/South Project Driveway** has a median opening which currently enables southbound left turns into the building located at 42080-42088 Osgood Road. At present, northbound left or U-turns are prohibited. The driveway serving the Osgood Residences as proposed would be located at this median opening. Access to this driveway would be shared between the Osgood Residences and the Osgood II projects.

**Osgood Road/Blacow Road** is a three-legged signalized intersection with protected left-turn phasing along Osgood Road. All right turns are channelized by "pork-chop" median islands. Crosswalks are provided spanning the west and north legs only.

## Alternative Modes

### *Existing Facilities*

Pedestrian facilities include sidewalks, crosswalks, pedestrian signal phases, curb ramps, curb extensions, and various streetscape amenities such as lighting, benches, etc. In general, a complete and connected network of sidewalks, crosswalks, pedestrian signals, and curb ramps provide access for pedestrians in the vicinity of the proposed project.

### **Pedestrians**

The City of Fremont adopted the *Pedestrian Master Plan* in December 2016. This Plan identifies goals in the areas of activity, safety, infrastructure and design, connectivity and accessibility and land development that is intended to inspire people of all ages and abilities to walk for everyday transportation, recreation, and health. Within the project area, the Plan recommends construction of a network of pedestrian friendly facilities such as well-developed sidewalks and crosswalks with curb extensions as well as the elimination of channelized "free" right-turn movements at intersections, to minimize pedestrian exposure to vehicle traffic. A brief inventory of existing facilities is described below.

**Osgood Road** – Continuous sidewalk coverage is provided on Osgood Road on both sides of the street within the study area. Curb ramps and crosswalks are provided at side street approaches near the project site. However, the removal of right-turn channelization at the intersection with Blacow Road has been identified as an opportunity for improvement.

### **Bicycle Network**

The City of Fremont *Bicycle Master Plan* (2018), classifies bikeways into four categories:

- **Class I (Bike Path)** – a completely separated right-of-way for the exclusive use of bicycles and pedestrians with cross flows of motorized traffic minimized.
- **Class II (Bike Lane)** – a striped and signed lane for one-way bike travel on a street or highway, sometimes with a buffer.
- **Class III (Signed Bike Route)** – signing and striping only for shared use with motor vehicles within the same travel lane on a street or highway.
- **Class IV (Separated Bikeway)** – have a raised element such as a curb, plastic bollard, or parking that separates and protects the bicycle lane from auto traffic or may be a bikeway that is raised to curb level.

In the project study area, Class II Bike Lanes exists on Osgood Road between Auto Mall Parkway and Washington Boulevard. These bike lanes are striped with a buffer in the southbound direction only along Osgood Road. Bicyclists ride in the roadway and/or on sidewalks along all other streets within the project study area. Table 1 summarizes a list of existing and proposed bicycle facilities within the vicinity of the project. A comprehensive list of citywide facilities is provided in Chapters 3 and 4 of the Fremont Bicycle Master Plan (2018)

**Table 1 – Bicycle Facility Summary**

Status Facility	Class	Length (miles)	Begin Point	End Point
<b>Existing</b>				
Washington Blvd	II	0.8	I-680	Roberts Ave
Auto Mall Pkwy	II	1.2	Osgood Rd	Grimmer Blvd
Driscoll Rd - Osgood Rd-Warm Springs Blvd (stripped buffer in southbound direction only)	II	6.8	Mission Blvd (SR 238)	City Limit with Milpitas
<b>Proposed</b>				
Driscoll Rd - Osgood Rd	II (Buffered)	2.8	Mission Blvd	Auto Mall Pkwy
Auto Mall Pkwy	IV	2.4	I-680	Boyce Rd
Washington Blvd – Fremont Blvd	IV	7.2	Olive Ave	City Limit with Union City

Source: *City of Fremont Bicycle Master Plan, 2018*

## Transit Facilities

### *Alameda-Contra Costa Transit District (AC Transit)*

Alameda-Contra Costa County (AC) Transit provides bus transit service throughout the East Bay. There are numerous bus routes that run along major streets in Fremont, connecting to the adjacent cities of Union City and Newark. The following bus routes currently operate in the project study area.

Route 215 operates between Bay Area Rapid Transit's (BART) Fremont Station and the Northwestern Polytechnic University via Osgood Road. The nearest bus stop is located approximately 1,300 feet south of the proposed project at the intersection of Osgood Road/Blacow Road. Route 215 operates between 6:00 a.m. and 10:00 p.m. on weekdays only with 60-minute headways.

Route 210 connects the Union Landing Transit Center and Ohlone College via Washington Boulevard in the project study area. The bus stop nearest the proposed project site is located approximately 1,800 feet to the north at the intersection of Osgood Road/Washington Boulevard. Route 210 operates with 30-minute headways between 5:30 a.m. and 11:30 p.m. on weekdays. On weekends Route 210 operates from 5:00 am to 10:30 pm also with 30-minute headways.

### *Bay Area Rapid Transit (BART)*

The BART system provides rail service between San Mateo, San Francisco, Alameda, and Contra Costa counties, with stations in Fremont near Mowry Avenue and Civic Center Drive and on Warm Springs Boulevard near South Grimmer Boulevard. The project site is located approximately 2.5 miles from the Fremont BART Station and approximately 2.0 miles from the Warm Springs/South Fremont BART Station. The future Irvington BART Station will be located on Osgood Road approximately 1,400 feet north of the project site and has an anticipated opening by the year 2026. Presumably once the new Irvington BART Station is operational other transit agencies, such as AC Transit, would alter existing routes or create new ones to serve the new station, thereby further increasing potential transit options within the study area.

## **Approved Projects**

Included with the analysis of project conditions are vehicle trips from approved or pending developments in the study area. The following projects were identified by the City of Fremont staff.

**Serra Apartments** is an approved residential development consisting of 179 apartment units that would be located at 42000 Osgood Road. As described in the *Traffic Operations Report for Osgood Heights Residential Project at 42000 Osgood Road* (by Hexagon Transportation Consultants, Inc., April 2016), the Serra Apartments project is expected to generate 1,042 trips per day, including 77 trips during the morning peak hour and 95 trips during the evening peak hour. The trip distribution identified in the Osgood Heights study was used for this analysis.

**Osgood Residences** is an approved residential development consisting of 93 condominiums that would be located at 41111 & 42183 Osgood Road. As contained in the Osgood Residences Initial Study, the Osgood Residences project is expected to generate 540 trips per day, including 41 trips during the morning peak hour and 48 trips during the evening peak hour. The trip distribution as identified in the Osgood Heights Study was applied for this analysis.

## **Trip Generation**

The anticipated trip generation for the proposed project was estimated using standard rates published by the Institute of Transportation Engineers (ITE) in *Trip Generation Manual*, 10<sup>th</sup> Edition, 2017 for "Multifamily Housing (Mid-Rise)" (ITE LU #221). Because the site is currently occupied by a single-family home and two buildings with an industrial land use, the trip generations for "Single Family Detached Homes" (ITE LU #210) and "Manufacturing" (ITE LU #140) were used to estimate the existing trips at the site.

The project would be located within 2,000 feet of the future Irvington BART Station, and it would be reasonable to assume that some residents would want to walk or ride a bicycle to the BART Station once the station is open for operation. However, since the Irvington BART Station may not be operational until 2026, and to provide a conservative approach, no trip reduction resulting from nearby transportation options was assumed. Additionally, the project is not anticipated to generate any internal capture, pass-by or any other trip reductions.

The expected trip generation potential for the proposed project is indicated in Table 2. The proposed project is expected to generate an average of 1,354 net-new trips per day, including 72 trips during the a.m. peak hour and 93 during the p.m. peak hour; these net-new trips represent the increase in traffic associated with the project.

**Table 2 – Trip Generation Summary**

Land Use	Units	Daily		AM Peak Hour				PM Peak Hour			
		Rate	Trips	Rate	Trips	In	Out	Rate	Trips	In	Out
<b>Existing</b>											
Manufacturing	-46.41 ksf	3.93	-182	0.62	-29	-22	-7	0.67	-31	-10	-21
Single Family Detached Housing	-1 d.u.	9.44	-9	0.74	-1	0	-1	0.99	-1	-1	0
<b>SUBTOTAL</b>		<b>-191</b>		<b>-30 -22 -8</b>				<b>-32 -11 -21</b>			
<b>Proposed</b>											
Multifamily Residential (Mid-Rise)	284 d.u.	5.44	1,545	0.36	102	27	75	0.44	125	76	49
<b>TOTAL</b>		<b>1,354</b>		<b>72 5 67</b>				<b>93 65 28</b>			

Note: ksf = 1,000 square feet; d.u. = Dwelling Unit

### Trip Distribution

The trip distribution pattern used to allocate new project trips to the street network was based on assumptions applied in the *Traffic Operations Report for Osgood Heights Residential Project at 42000 Osgood Road* (by Hexagon Transportation Consultants, Inc., April 2016). The applied distribution assumptions (with manual adjustments for rounding) and resulting trips are shown in Table 3.

**Table 3 – Trip Distribution Assumptions**

Route	Percent	Daily	AM Trips	PM Trips
To/From North via Osgood Rd	40%	541	29	37
To/From South via Osgood Rd	60%	813	43	56
<b>TOTAL</b>	<b>100%</b>	<b>1,354</b>	<b>72</b>	<b>93</b>

### Level of Service Methodology

The Level of Service (LOS) analysis was conducted using the Synchro analysis software package. LOS is defined as a qualitative measure describing operating conditions within a traffic stream. It is generally described in terms such as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience. The LOS evaluation indicates the degree of congestion that occurs during peak travel periods and is the principal measure of roadway and intersection performance. Levels of Service can range from "A" representing free-flow conditions to "F" representing extremely long delays. LOS B and C signify stable conditions with acceptable delays. LOS D is typically considered acceptable for a peak hour in urban areas. LOS E is approaching capacity and LOS F represents conditions at or above capacity.

### Intersection Level of Service Results

Peak hour turning movement counts were conducted on Wednesday, May 30, 2018 at the intersection Osgood Road/Blacow Road and at the 41655 Osgood Road driveway. In lieu of a traffic count, the northbound and southbound vehicle flows along Osgood Road adjacent to the south project driveway were approximated by applying the averages of the arrivals and departures of the observed counts at each neighboring count location. The 41655 Osgood Road and South Project driveways would operate in a similar manner to a typical unsignalized intersection with side-street stop-control, and as such were analyzed using the HCM 2000 methodology for unsignalized intersections. However, as they do not satisfy the definition of an intersection as defined by the California Vehicle Code (CVC Section 365) only the calculated average delay is reported in this study.

The intersection of Osgood Road/Blacow Road currently operates at acceptable levels of service (LOS) during both the a.m. and p.m. peak hours. The results of the intersection analysis for existing plus approved project plus project trips conditions are summarized in Table 4. The table reports overall average delay per vehicle and overall LOS for each study location. The detailed analysis is provided in the enclosed Level of Service Calculations.

**Table 4 – Existing plus Approved Projects plus Project Condition Intersection Level of Service**

Study Intersection <i>Approach</i>	Alternative A				Alternative B			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1. Osgood Rd/41655 Osgood Rd <i>Eastbound (Driveway) Approach</i>	0.5	-	0.6	-	0.4	-	0.3	-
	<i>14.8</i>	-	<i>50.4</i>	-	<i>14.8</i>	-	<i>39.2</i>	-
2. Osgood Rd/South Project Driveway <i>Eastbound (South Project Dwy) Approach</i>	0.7	-	0.1	-	1.6	-	0.4	-
	<i>17.6</i>	-	<i>11.0</i>	-	<i>29.6</i>	-	<i>13.0</i>	-
3. Osgood Rd/Blacow Rd	8.7	A	11.1	B	8.2	A	10.9	B

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; LOS E or F in Bold; Individual approaches shown in *Italics*.

**Finding** – The intersection of Osgood Road/Blacow Road would operate at acceptable levels of service during both the a.m. and p.m. peak hours under either Alternative A or B. If the access at the south project driveway were full access (Alternative B), the eastbound approach exiting the south project driveway would be expected to experience average delays of 29.6 seconds per vehicle during the a.m. peak hour. Alternative B would also result in less average vehicle delay at the signalized intersection of Osgood Road/Blacow Road and at the median opening at 41655 Osgood Road when compared with Alternative A.

## Queuing Analysis

Vehicle queuing analyses were conducted for the Existing plus Approved Projects plus Project scenario to determine whether the existing vehicle storage capacity would be adequate for the expected demand during the a.m. and p.m. peak hours. Queue lengths for selected movements were estimated using the *2000 Highway Capacity Manual* methodology as interpreted by the Synchro analysis software. A summary of estimated queue lengths is provided in Table 5, and Synchro queue estimating worksheets are enclosed.

**Table 5 – Vehicle Queue at Select Movements**

<b>Intersection Movement</b>	<b>Available Storage (feet)</b>	<b>AM Peak Hour (feet)</b>		<b>PM Peak Hour (feet)</b>	
		<b>ALT A</b>	<b>ALT B</b>	<b>ALT A</b>	<b>ALT B</b>
1. Osgood Rd/41655 Osgood Rd <i>Northbound Left Turn</i>	180	15	10	10	5
2. Osgood Rd/South Project Driveway <i>Southbound Left Turn</i>	130	5	5	5	5
<i>Northbound Left Turn</i>	50	N/A	5	N/A	10
3. Osgood Rd/Blacow Rd <i>Southbound Left Turn</i>	170	40	15	40	35

Notes: All values are in feet and have been rounded up to the nearest 5-foot increment

**Finding** – Vehicle stacking storage would be adequate to accommodate the expected 95<sup>th</sup> percentile queue lengths for either Alternatives A and B during the a.m. and p.m. peak hours for all turn locations.

### Vehicle Site Access

Vehicle access to the project would be provided via two driveways on Osgood Road that would replace five driveways currently serving the existing land uses. The southern driveway would be shared with the Osgood Residences located just south of the Osgood II project. The north driveway would be limited to right-turn egress and ingress only. To provide the City of Fremont staff with alternatives for the south driveway, this study evaluated two potential access control scenarios for the south driveway:

- Alternative A assumes the south project driveway is restricted to right-turn egress and ingress only.
- Alternative B assumes the median in Osgood Road would be modified so that the south project driveway has full access.

### Sight Distance

Sight distances along Osgood Road at each project driveway were evaluated based on sight distance criteria contained in the *Highway Design Manual* published by Caltrans. The recommended sight distances for driveways are based on stopping sight distance, with approach travel speeds used as the basis for determining the recommended sight distance. For the posted speed limit of 40 mph, the recommended stopping sight distance is 440 feet. Based on a review of field conditions, sight distance at the driveways exceeds 700 feet looking in either direction, which is adequate for the posted speed limit.

Additionally, sight distance for drivers on northbound Osgood Road was evaluated to determine if adequate stopping sight distance would be available for users entering the site from northbound Osgood Road via a two-way left-turn lane. Based on a review of field conditions, sight distance for this approach also exceeds 700 feet, which is adequate for the posted 40-mph speed limit.

**Finding** – Adequate sight distance would be available at both project driveways to accommodate all turns.

### Site Circulation, Safety and Access

On-site geometrics were evaluated to determine if the layout would provide adequate circulation and room for interactions between pedestrians walking and vehicles maneuvering through the parking lot or drive aisles. Based

on a review of the site plan, the internal drive aisles are expected to provide acceptable circulation for motorized vehicles and there would be clearly marked paths for all pedestrians (including those with disabilities) between the building entrances, all areas of the parking lot and sidewalks along Osgood Road. All curb ramps would include tactile warning strip surfaces.

The Fremont Fire Department requires that Fire Lane access roadways shall have a minimum 26-foot unobstructed linear width and minimum inside turn radii of 22.5 feet and an outside radius of 37.5 feet (measured from the same point). A review of the site plan shows that the roadways serving the project would satisfy these requirements for Emergency Vehicle Access.

**Finding** – Heavy vehicle access (such as is commonly used for fire response or waste) would be adequate as they would be able to enter, exit and maneuver through the site without striking permanent fixtures or parked vehicles. Pedestrian access between the building and all areas of the parking lot would be adequate. Vehicle circulation in the parking lot is anticipated to be adequate.

## Vehicle Parking

The proposed project's off-street parking supply was analyzed to determine whether it would be sufficient to accommodate the anticipated parking demand. The project includes a total of 445 parking stalls for the exclusive use of project residents.

Parking supply requirements were determined by referencing the City of Fremont Municipal Code, Title 18, Chapter 18.152.070: Parking; Table 18.152.070 for Transit-Oriented Development (TOD) Overlay Districts. The City requirement states that one covered parking space plus 0.25 guest parking spaces are required per dwelling unit. This translates to 355 spaces for the proposed project.

Parking demand for the proposed project was estimated using standard rates published by ITE in *Parking Generation*, 5<sup>th</sup> Edition, 2019. The parking demand of the project was estimated using the published 85<sup>th</sup>-percentile rates for Multifamily Housing (Mid-Rise) (ITE LU #221) in a general urban/suburban setting located within one-half mile of rail transit. The projected demand is 361 spaces.

The proposed supply of 445 spaces is greater than either the City requirement or the ITE calculated demand. The proposed parking supply, expected demand, and minimum City requirements are summarized in Table 6.

Land Use	No. of Dwelling Units	Supply (spaces)	Minimum City Requirements			ITE Parking Generation		
			Rate <sup>1</sup>	Covered (spaces)	Guest (spaces)	Total (spaces)	Rate <sup>2</sup>	Est. Parking Demand
Multifamily Residential (per unit)	284	445	1 covered space plus 0.25 guest spaces per dwelling unit	284	71	355	1.27	361

Notes: <sup>1</sup>City of Fremont Municipal Code, Table 18.152.070

<sup>2</sup>Parking Generation 5<sup>th</sup> Edition, Institute of Transportation Engineers, 2019 (85<sup>th</sup> percentile Rate)

**Finding** – The project would provide an adequate number of parking spaces to accommodate the anticipated demand per ITE rates and also satisfy the City requirements.

## Multimodal Circulation Pattern Evaluation

The proposed project would generate walking and bicycle trips between the retail centers in the Irvington District, the future Irvington BART Station and other destinations near Auto Mall Parkway. The existing network of sidewalks, crosswalks and Class II bicycle lanes along Osgood Road would adequately serve these local trips.

According to the 2018 Fremont *Bicycle Master Plan*, a Class II Buffered Bicycle Lane is proposed for the segment of Osgood Road north of Auto Mall Parkway. A previous development project in the area installed a stripped buffer in the southbound direction of Osgood Road between Auto Mall Parkway and Washington Boulevard. Installation of a similar stripped buffer in the northbound direction would further enhance the mobility options in the study area.

Existing transit routes are adequate to accommodate potential project-generated transit trips based on the number of routes and frequency of service. Existing bus stops located on Osgood Road are within 1,400 feet of the site and are accessible by the existing pedestrian facility network. Based on field observations, ridership on buses serving Routes 210 and 215 is relatively low, with many seats observed to be unoccupied. If 20 percent of peak hour trips were made by transit, there would be 14 (a.m.) and 18 (p.m.) additional transit riders, spread out over several routes and times. The volume of riders expected to be generated by the project would therefore be unlikely to exceed the carrying capacity of the existing bus service near the project site.

To improve the safety for pedestrians and bicyclists alike, the City of Fremont *Pedestrian Master Plan* (2016) and the *Bicycle Master Plan* (2018) encourage the removal of existing channelized right turn movements (aka "pork chops") at all intersections within the City, wherever feasible. This type of right-turn treatment currently exists at the nearby intersection of Osgood Road/Blacow Road. Removal of the existing channelized right-turn treatments would improve pedestrian and bicycle safety. Additional treatments that would improve pedestrian safety include reducing curb radii and pedestrian crossing distances by installing sidewalk curb extensions (aka "bulb outs") at the intersection of Osgood Road/Blacow Road.

**Finding** – Existing and proposed pedestrian, bicycle and transit facilities serving the project area would be generally adequate. The inclusion of a buffered bike lane in the northbound direction along Osgood Road would enhance mobility options in the area and mirror improvements recently completed in the southbound direction.

**Recommendations** – An opportunity has been identified to remove the existing channelized right-turn treatments at the intersection of Osgood Road/Blacow Road in favor of sidewalk curb extensions. Striping along northbound Osgood Road should be modified to include a buffered Class II Bike Lane.

## Conclusions

- The proposed project is expected to generate an average of 1,354 trips per day, including 72 trips during the a.m. peak hour and 93 during the p.m. peak hour.
- All study intersections are expected to continue operating acceptably under the Existing plus Approved Projects plus Project conditions.
- If the access at the south project driveway were full access (Alternative B), the eastbound approach exiting the south project driveway would be expected to experience average delays of 29.6 seconds per vehicle during the a.m. peak hour. Alternative B would also result in less average vehicle delay at the signalized intersection of Osgood Road/Blacow Road and at the median opening at 41655 Osgood Road when compared with Alternative A.

- Average vehicle delays and queue lengths would continue to operate at satisfactory levels at each study location under either Alternative A or B, and therefore either access control strategy is feasible. Alternative B may be more desirable as it results in fewer U-Turn maneuvers at adjacent intersections thereby also resulting in lower average vehicles delays at those locations.
- Left-turn lanes along Osgood Road are anticipated to have adequate storage to accommodate the 95<sup>th</sup> percentile queue lengths under each scenario considered.
- Pedestrian, bicycle, and transit facilities are generally adequate to serve the project as proposed.
- Sight lines at the project driveways are adequate.
- On-site vehicle and pedestrian access between the buildings is adequate.
- The proposed parking supply of 445 spaces exceeds both the City parking requirement of 355 spaces and the estimated parking demand of 361 spaces based on standard rates.
- An opportunity has been identified to remove the existing channelized right-turn treatments at the intersection of Osgood Road/Blacow Road in favor of sidewalk curb extensions.
- Pavement striping along northbound Osgood Road should be modified to include a buffered Class II Bike Lane.

Thank you for giving W-Trans the opportunity to provide these services. Please call if you have any questions.

Sincerely,



Kenny Jeong, TE  
Traffic Engineer



Mark Spencer, TE  
Senior Principal



MES/kbj/FRM041.L1

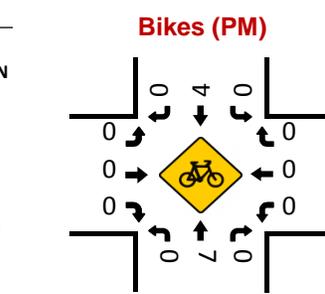
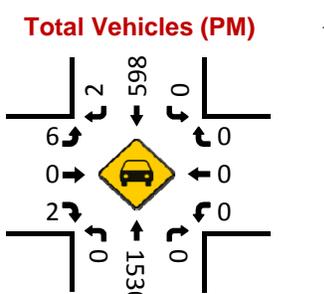
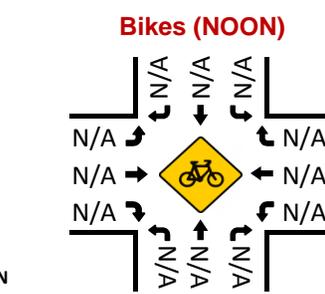
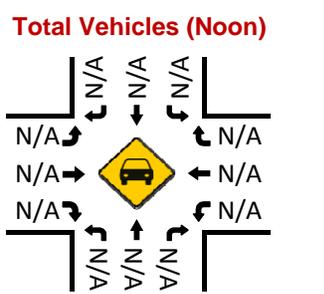
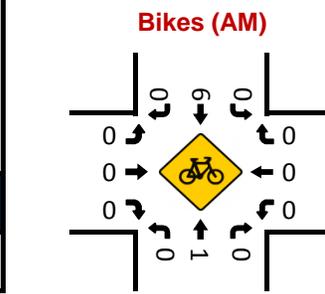
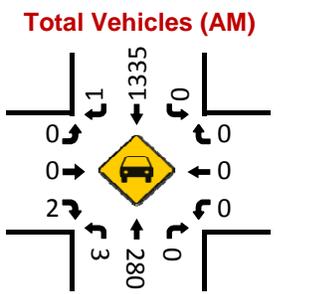
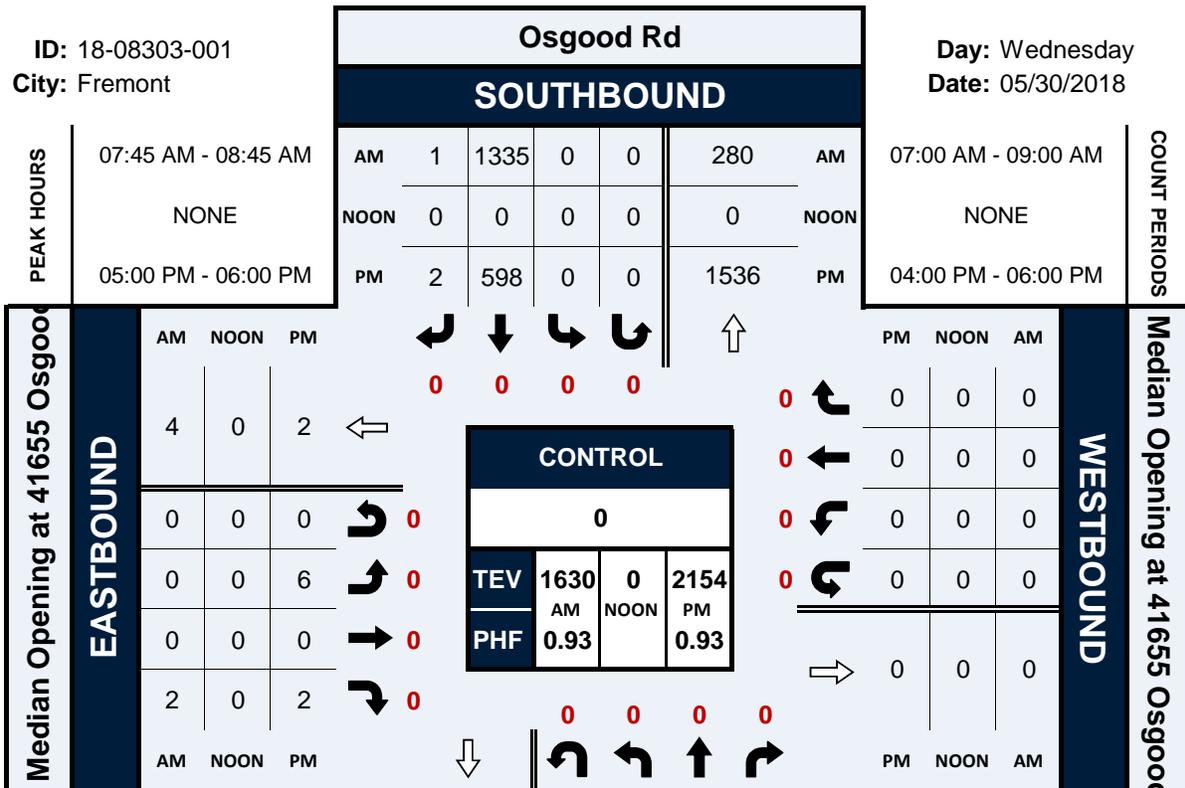
Enclosures: Traffic Counts, Level of Service Calculations, Queue Worksheet Summary

# Osgood Rd & Median Opening at 41655 Osgood Rd

## Peak Hour Turning Movement Count

ID: 18-08303-001  
City: Fremont

Day: Wednesday  
Date: 05/30/2018

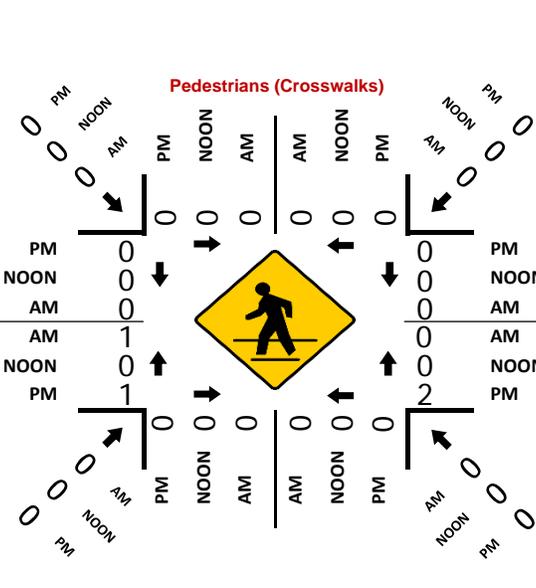


**Osgood Rd SOUTHBOUND**

PM	616	16	0	1530	0	PM
NOON	0	0	0	0	0	NOON
AM	1346	9	3	280	0	AM

**Osgood Rd NORTHBOUND**

PM	0	0	0	0	0	PM
NOON	0	0	0	0	0	NOON
AM	0	0	0	0	0	AM

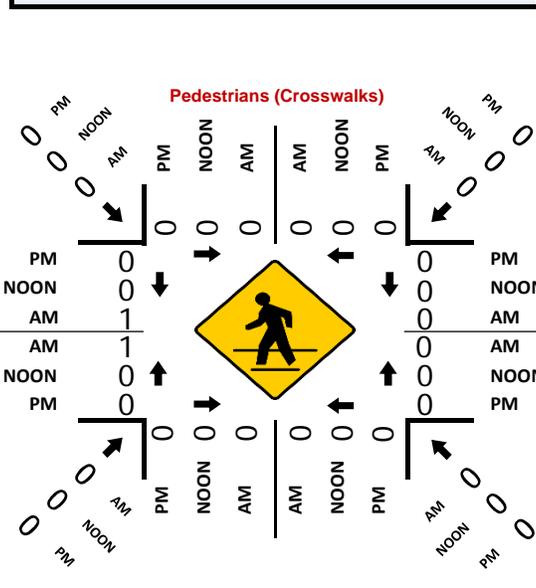
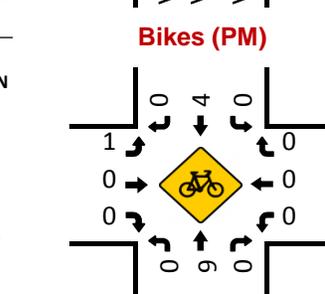
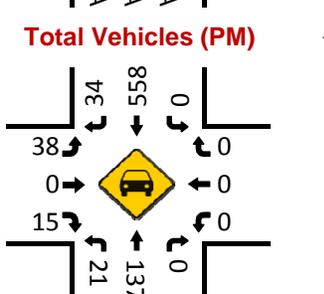
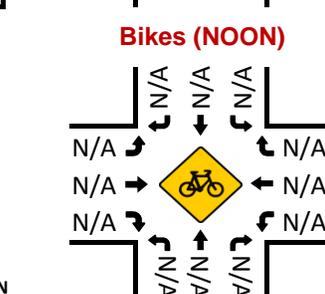
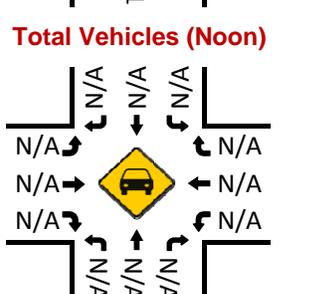
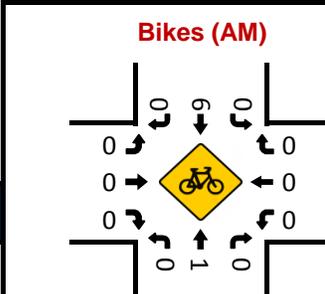
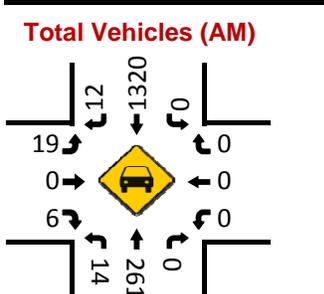
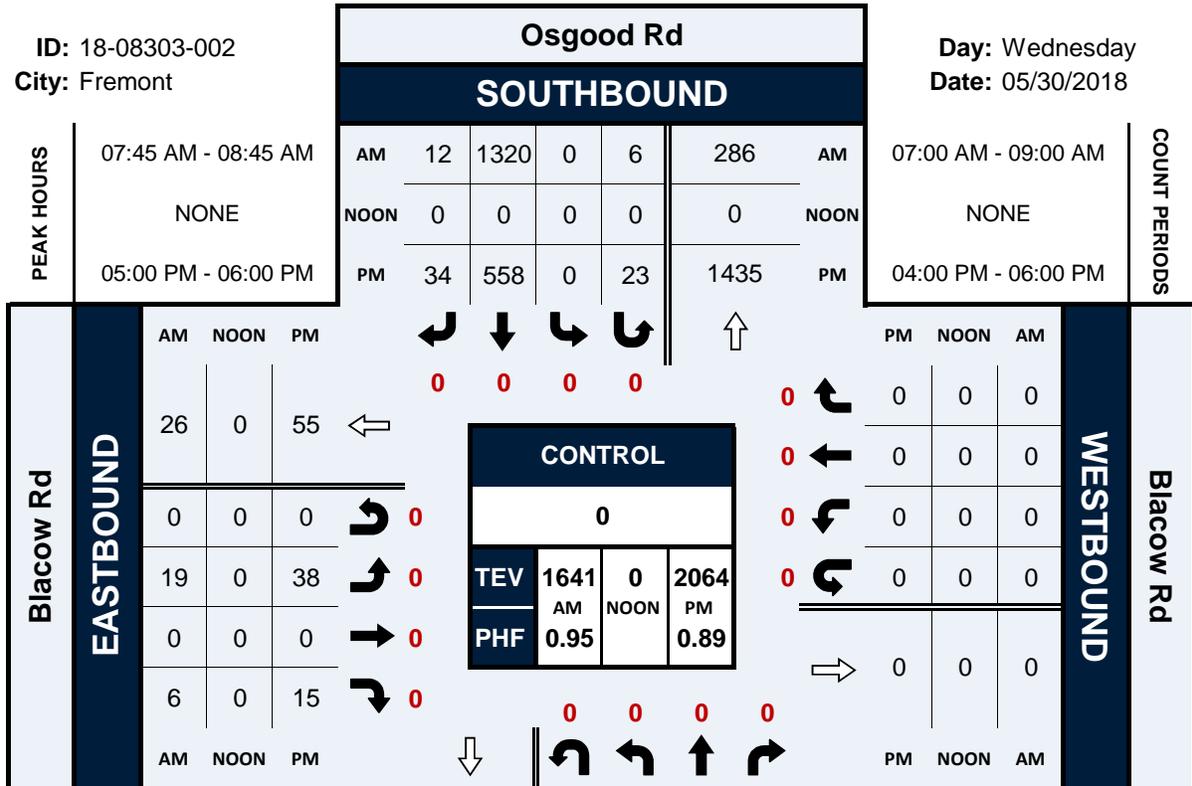


# Osgood Rd & Blacow Rd

## Peak Hour Turning Movement Count

ID: 18-08303-002  
City: Fremont

Day: Wednesday  
Date: 05/30/2018



# HCM Unsignalized Intersection Capacity Analysis

## 1: Osgood Rd & Driveway

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	2	59	347	1345	1
Future Volume (Veh/h)	0	2	59	347	1345	1
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	2	63	373	1446	1
<b>Pedestrians</b>						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None	None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1759	724	1447			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1759	724	1447			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	99	86			
cM capacity (veh/h)	65	368	464			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	2	63	186	186	964	483
Volume Left	0	63	0	0	0	0
Volume Right	2	0	0	0	0	1
cSH	368	464	1700	1700	1700	1700
Volume to Capacity	0.01	0.14	0.11	0.11	0.57	0.28
Queue Length 95th (ft)	0	12	0	0	0	0
Control Delay (s)	14.8	14.0	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	14.8	2.0	0.0			
Approach LOS	B					
<b>Intersection Summary</b>						
Average Delay			0.5			
Intersection Capacity Utilization			53.9%	ICU Level of Service	A	
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 2: Osgood Rd & Shared Driveway

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations		↗		↕	↘	↕	↗
Traffic Volume (veh/h)	0	68	0	286	19	1388	10
Future Volume (Veh/h)	0	68	0	286	19	1388	10
Sign Control	Stop			Free		Free	
Grade	0%			0%		0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	0	72	0	304	0	1477	11
<b>Pedestrians</b>							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type				None	None		
Median storage (veh)							
Upstream signal (ft)	1119						
pX, platoon unblocked					0.00		
vC, conflicting volume	1634	744	1488				0
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	1634	744	1488				0
tC, single (s)	6.8	6.9	4.1				0.0
tC, 2 stage (s)							
tF (s)	3.5	3.3	2.2				0.0
p0 queue free %	100	80	100				0
cM capacity (veh/h)	92	357	448				0
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>NB 2</b>	<b>SB 1</b>	<b>SB 2</b>	<b>SB 3</b>	
Volume Total	72	152	152	985	503	0	
Volume Left	0	0	0	0	0	0	
Volume Right	72	0	0	0	11	0	
cSH	357	1700	1700	1700	1700	1700	
Volume to Capacity	0.20	0.09	0.09	0.58	0.30	0.00	
Queue Length 95th (ft)	19	0	0	0	0	0	
Control Delay (s)	17.6	0.0	0.0	0.0	0.0	0.0	
Lane LOS	C						
Approach Delay (s)	17.6	0.0					0.0
Approach LOS	C						
<b>Intersection Summary</b>							
Average Delay	0.7						
Intersection Capacity Utilization	49.6%			ICU Level of Service		A	
Analysis Period (min)	15						

# HCM Signalized Intersection Capacity Analysis

## 3: Osgood Rd & Blacow Rd

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	19	6	17	276	34	1421	12
Future Volume (vph)	19	6	17	276	34	1421	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6	4.5	5.5	4.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	1.00	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	1770	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	20	6	18	291	36	1496	13
RTOR Reduction (vph)	0	5	0	0	0	0	3
Lane Group Flow (vph)	20	1	18	291	36	1496	10
Turn Type	Perm	Perm	Prot	NA	Prot	NA	Perm
Protected Phases			5	2	1	6	
Permitted Phases	8	8					6
Actuated Green, G (s)	7.2	7.2	1.6	44.5	2.8	45.7	45.7
Effective Green, g (s)	7.2	7.2	1.6	44.5	2.8	45.7	45.7
Actuated g/C Ratio	0.10	0.10	0.02	0.64	0.04	0.66	0.66
Clearance Time (s)	4.6	4.6	4.5	5.5	4.5	5.5	5.5
Vehicle Extension (s)	2.0	2.0	1.0	4.0	1.0	4.0	4.0
Lane Grp Cap (vph)	184	164	40	2279	71	2340	1046
v/s Ratio Prot			0.01	0.08	c0.02	c0.42	
v/s Ratio Perm	c0.01	0.00					0.01
v/c Ratio	0.11	0.00	0.45	0.13	0.51	0.64	0.01
Uniform Delay, d1	28.0	27.7	33.3	4.8	32.5	6.9	4.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.0	2.9	0.1	2.1	1.4	0.0
Delay (s)	28.1	27.7	36.2	4.9	34.5	8.2	4.0
Level of Service	C	C	D	A	C	A	A
Approach Delay (s)	28.0			6.7		8.8	
Approach LOS	C			A		A	

### Intersection Summary

HCM 2000 Control Delay	8.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	69.1	Sum of lost time (s)	14.6
Intersection Capacity Utilization	54.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 1: Osgood Rd & Driveway

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	6	2	94	1558	663	2
Future Volume (Veh/h)	6	2	94	1558	663	2
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	6	2	101	1675	713	2
<b>Pedestrians</b>						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1754	358	715			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1754	358	715			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	91	100	89			
cM capacity (veh/h)	68	639	881			
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>NB 1</b>	<b>NB 2</b>	<b>NB 3</b>	<b>SB 1</b>	<b>SB 2</b>
Volume Total	8	101	838	838	475	240
Volume Left	6	101	0	0	0	0
Volume Right	2	0	0	0	0	2
cSH	87	881	1700	1700	1700	1700
Volume to Capacity	0.09	0.11	0.49	0.49	0.28	0.14
Queue Length 95th (ft)	7	10	0	0	0	0
Control Delay (s)	50.4	9.6	0.0	0.0	0.0	0.0
Lane LOS	F	A				
Approach Delay (s)	50.4	0.5	0.0			
Approach LOS	F					
<b>Intersection Summary</b>						
Average Delay			0.6			
Intersection Capacity Utilization			53.1%	ICU Level of Service	A	
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 2: Osgood Rd & Shared Driveway

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations							
Traffic Volume (veh/h)	0	22	0	1550	32	606	66
Future Volume (Veh/h)	0	22	0	1550	32	606	66
Sign Control	Stop			Free		Free	
Grade	0%			0%		0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	0	24	0	1703	0	666	73
<b>Pedestrians</b>							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type				None	None		
Median storage (veh)							
Upstream signal (ft)	1119						
pX, platoon unblocked	0.60				0.00		
vC, conflicting volume	1554	370	739				0
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	608	370	739				0
tC, single (s)	6.8	6.9	4.1				0.0
tC, 2 stage (s)							
tF (s)	3.5	3.3	2.2				0.0
p0 queue free %	100	96	100				0
cM capacity (veh/h)	258	628	863				0
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	SB 3	
Volume Total	24	852	852	444	295	0	
Volume Left	0	0	0	0	0	0	
Volume Right	24	0	0	0	73	0	
cSH	628	1700	1700	1700	1700	1700	
Volume to Capacity	0.04	0.50	0.50	0.26	0.17	0.00	
Queue Length 95th (ft)	3	0	0	0	0	0	
Control Delay (s)	11.0	0.0	0.0	0.0	0.0	0.0	
Lane LOS	B						
Approach Delay (s)	11.0	0.0				0.0	
Approach LOS	B						
<b>Intersection Summary</b>							
Average Delay	0.1						
Intersection Capacity Utilization	46.2%			ICU Level of Service	A		
Analysis Period (min)	15						

# HCM Signalized Intersection Capacity Analysis

## 3: Osgood Rd & Blacow Rd

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	19	15	22	1472	33	599	34
Future Volume (vph)	19	15	22	1472	33	599	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6	4.5	5.5	4.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	1.00	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	1770	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	1770	3539	1583
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	21	17	25	1654	37	673	38
RTOR Reduction (vph)	0	15	0	0	0	0	15
Lane Group Flow (vph)	21	2	25	1654	37	673	23
Turn Type	Perm	Perm	Prot	NA	Prot	NA	Perm
Protected Phases			5	2	1	6	
Permitted Phases	8	8					6
Actuated Green, G (s)	8.8	8.8	3.2	42.9	2.8	42.5	42.5
Effective Green, g (s)	8.8	8.8	3.2	42.9	2.8	42.5	42.5
Actuated g/C Ratio	0.13	0.13	0.05	0.62	0.04	0.62	0.62
Clearance Time (s)	4.6	4.6	4.5	5.5	4.5	5.5	5.5
Vehicle Extension (s)	2.0	2.0	1.0	4.0	1.0	4.0	4.0
Lane Grp Cap (vph)	225	201	81	2197	71	2176	973
v/s Ratio Prot			0.01	c0.47	c0.02	0.19	
v/s Ratio Perm	c0.01	0.00					0.01
v/c Ratio	0.09	0.01	0.31	0.75	0.52	0.31	0.02
Uniform Delay, d1	26.6	26.3	31.9	9.3	32.5	6.3	5.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.0	0.8	2.4	3.2	0.4	0.0
Delay (s)	26.7	26.4	32.7	11.8	35.6	6.7	5.2
Level of Service	C	C	C	B	D	A	A
Approach Delay (s)	26.5			12.1		8.1	
Approach LOS	C			B		A	

### Intersection Summary

HCM 2000 Control Delay	11.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	69.1	Sum of lost time (s)	14.6
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 1: Osgood Rd & Driveway

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	2	51	347	1345	1
Future Volume (Veh/h)	0	2	51	347	1345	1
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	0	2	55	373	1446	1
<b>Pedestrians</b>						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1743	724	1447			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1743	724	1447			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	99	88			
cM capacity (veh/h)	68	368	464			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	2	55	186	186	964	483
Volume Left	0	55	0	0	0	0
Volume Right	2	0	0	0	0	1
cSH	368	464	1700	1700	1700	1700
Volume to Capacity	0.01	0.12	0.11	0.11	0.57	0.28
Queue Length 95th (ft)	0	10	0	0	0	0
Control Delay (s)	14.8	13.8	0.0	0.0	0.0	0.0
Lane LOS	B	B				
Approach Delay (s)	14.8	1.8	0.0			
Approach LOS	B					
<b>Intersection Summary</b>						
Average Delay			0.4			
Intersection Capacity Utilization			52.4%	ICU Level of Service	A	
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 2: Osgood Rd & Shared Driveway

03/02/2020



Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations							
Traffic Volume (veh/h)	41	48	8	279	5	1382	4
Future Volume (Veh/h)	41	48	8	279	5	1382	4
Sign Control	Stop			Free		Free	
Grade	0%			0%		0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	44	51	9	297	0	1470	4
<b>Pedestrians</b>							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type				TWLTL		TWLTL	
Median storage (veh)				2		2	
Upstream signal (ft)				1119			
pX, platoon unblocked					0.00		
vC, conflicting volume	1638	737	1474	0			
vC1, stage 1 conf vol	1472						
vC2, stage 2 conf vol	166						
vCu, unblocked vol	1638	737	1474	0			
tC, single (s)	6.8	6.9	4.1	0.0			
tC, 2 stage (s)	5.8						
tF (s)	3.5	3.3	2.2	0.0			
p0 queue free %	74	86	98	0			
cM capacity (veh/h)	172	361	453	0			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	95	9	148	148	980	494	0
Volume Left	44	9	0	0	0	0	0
Volume Right	51	0	0	0	0	4	0
cSH	239	453	1700	1700	1700	1700	1700
Volume to Capacity	0.40	0.02	0.09	0.09	0.58	0.29	0.00
Queue Length 95th (ft)	45	2	0	0	0	0	0
Control Delay (s)	29.6	13.1	0.0	0.0	0.0	0.0	0.0
Lane LOS	D	B					
Approach Delay (s)	29.6	0.4			0.0		
Approach LOS	D						
<b>Intersection Summary</b>							
Average Delay			1.6				
Intersection Capacity Utilization			50.2%		ICU Level of Service		A
Analysis Period (min)			15				

# HCM Signalized Intersection Capacity Analysis

## 3: Osgood Rd & Blacow Rd

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	19	6	17	276	6	1421	12
Future Volume (vph)	19	6	17	276	6	1421	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6	4.5	5.5	4.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	1.00	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	1770	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	1770	3539	1583
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	20	6	18	291	6	1496	13
RTOR Reduction (vph)	0	5	0	0	0	0	3
Lane Group Flow (vph)	20	1	18	291	6	1496	10
Turn Type	Perm	Perm	Prot	NA	Prot	NA	Perm
Protected Phases			5	2	1	6	
Permitted Phases	8	8					6
Actuated Green, G (s)	7.2	7.2	1.6	45.9	1.4	45.7	45.7
Effective Green, g (s)	7.2	7.2	1.6	45.9	1.4	45.7	45.7
Actuated g/C Ratio	0.10	0.10	0.02	0.66	0.02	0.66	0.66
Clearance Time (s)	4.6	4.6	4.5	5.5	4.5	5.5	5.5
Vehicle Extension (s)	2.0	2.0	1.0	4.0	1.0	4.0	4.0
Lane Grp Cap (vph)	184	164	40	2350	35	2340	1046
v/s Ratio Prot			c0.01	0.08	0.00	c0.42	
v/s Ratio Perm	c0.01	0.00					0.01
v/c Ratio	0.11	0.00	0.45	0.12	0.17	0.64	0.01
Uniform Delay, d1	28.0	27.7	33.3	4.2	33.3	6.9	4.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.0	2.9	0.1	0.8	1.4	0.0
Delay (s)	28.1	27.7	36.2	4.4	34.1	8.2	4.0
Level of Service	C	C	D	A	C	A	A
Approach Delay (s)	28.0			6.2		8.3	
Approach LOS	C			A		A	

### Intersection Summary

HCM 2000 Control Delay	8.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	69.1	Sum of lost time (s)	14.6
Intersection Capacity Utilization	54.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 1: Osgood Rd & Driveway

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	6	2	35	1558	663	2
Future Volume (Veh/h)	6	2	35	1558	663	2
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	6	2	38	1675	713	2
<b>Pedestrians</b>						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1628	358	715			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1628	358	715			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	100	96			
cM capacity (veh/h)	89	639	881			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	8	38	838	838	475	240
Volume Left	6	38	0	0	0	0
Volume Right	2	0	0	0	0	2
cSH	113	881	1700	1700	1700	1700
Volume to Capacity	0.07	0.04	0.49	0.49	0.28	0.14
Queue Length 95th (ft)	6	3	0	0	0	0
Control Delay (s)	39.2	9.3	0.0	0.0	0.0	0.0
Lane LOS	E	A				
Approach Delay (s)	39.2	0.2	0.0			
Approach LOS	E					
<b>Intersection Summary</b>						
Average Delay			0.3			
Intersection Capacity Utilization			53.1%	ICU Level of Service	A	
Analysis Period (min)			15			

# HCM Unsignalized Intersection Capacity Analysis

## 2: Osgood Rd & Shared Driveway

03/02/2020



Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations							
Traffic Volume (veh/h)	16	17	59	1491	26	616	27
Future Volume (Veh/h)	16	17	59	1491	26	616	27
Sign Control	Stop			Free		Free	
Grade	0%			0%		0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	18	19	65	1638	0	677	30
<b>Pedestrians</b>							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type				TWLTL		TWLTL	
Median storage (veh)				2		2	
Upstream signal (ft)				1119			
pX, platoon unblocked	0.62			0.00			
vC, conflicting volume	1641	354	707	0			
vC1, stage 1 conf vol	692						
vC2, stage 2 conf vol	949						
vCu, unblocked vol	815	354	707	0			
tC, single (s)	6.8	6.9	4.1	0.0			
tC, 2 stage (s)	5.8						
tF (s)	3.5	3.3	2.2	0.0			
p0 queue free %	95	97	93	0			
cM capacity (veh/h)	389	643	887	0			
Direction, Lane #	EB 1	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	37	65	819	819	451	256	0
Volume Left	18	65	0	0	0	0	0
Volume Right	19	0	0	0	0	30	0
cSH	488	887	1700	1700	1700	1700	1700
Volume to Capacity	0.08	0.07	0.48	0.48	0.27	0.15	0.00
Queue Length 95th (ft)	6	6	0	0	0	0	0
Control Delay (s)	13.0	9.4	0.0	0.0	0.0	0.0	0.0
Lane LOS	B	A					
Approach Delay (s)	13.0	0.4	0.0				
Approach LOS	B						
<b>Intersection Summary</b>							
Average Delay	0.4						
Intersection Capacity Utilization	57.9%			ICU Level of Service			B
Analysis Period (min)	15						

# HCM Signalized Intersection Capacity Analysis

## 3: Osgood Rd & Blacow Rd

09/04/2019



Movement	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Configurations							
Traffic Volume (vph)	19	15	22	1472	23	599	34
Future Volume (vph)	19	15	22	1472	23	599	34
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.6	4.6	4.5	5.5	4.5	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	0.95	1.00	0.95	1.00
Frt	1.00	0.85	1.00	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3539	1770	3539	1583
Flt Permitted	0.95	1.00	0.95	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	1583	1770	3539	1770	3539	1583
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	21	17	25	1654	26	673	38
RTOR Reduction (vph)	0	15	0	0	0	0	15
Lane Group Flow (vph)	21	2	25	1654	26	673	23
Turn Type	Perm	Perm	Prot	NA	Prot	NA	Perm
Protected Phases			5	2	1	6	
Permitted Phases	8	8					6
Actuated Green, G (s)	8.8	8.8	3.2	42.9	2.8	42.5	42.5
Effective Green, g (s)	8.8	8.8	3.2	42.9	2.8	42.5	42.5
Actuated g/C Ratio	0.13	0.13	0.05	0.62	0.04	0.62	0.62
Clearance Time (s)	4.6	4.6	4.5	5.5	4.5	5.5	5.5
Vehicle Extension (s)	2.0	2.0	1.0	4.0	1.0	4.0	4.0
Lane Grp Cap (vph)	225	201	81	2197	71	2176	973
v/s Ratio Prot			0.01	c0.47	c0.01	0.19	
v/s Ratio Perm	c0.01	0.00					0.01
v/c Ratio	0.09	0.01	0.31	0.75	0.37	0.31	0.02
Uniform Delay, d1	26.6	26.3	31.9	9.3	32.3	6.3	5.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.0	0.8	2.4	1.2	0.4	0.0
Delay (s)	26.7	26.4	32.7	11.8	33.5	6.7	5.2
Level of Service	C	C	C	B	C	A	A
Approach Delay (s)	26.5			12.1		7.6	
Approach LOS	C			B		A	

### Intersection Summary

HCM 2000 Control Delay	10.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	69.1	Sum of lost time (s)	14.6
Intersection Capacity Utilization	55.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Queues

3: Osgood Rd & Blacow Rd

09/04/2019



Lane Group	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Group Flow (vph)	20	6	18	291	36	1496	13
v/c Ratio	0.07	0.02	0.09	0.11	0.20	0.53	0.01
Control Delay	20.4	10.7	28.5	8.1	31.5	12.2	8.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.4	10.7	28.5	8.1	31.5	12.2	8.7
Queue Length 50th (ft)	8	0	7	0	14	0	0
Queue Length 95th (ft)	17	6	24	81	40	#612	13
Internal Link Dist (ft)	418			931		1039	
Turn Bay Length (ft)			250		170		170
Base Capacity (vph)	717	645	217	2728	192	2835	1270
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.01	0.08	0.11	0.19	0.53	0.01

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Queues

3: Osgood Rd & Blacow Rd

09/04/2019



Lane Group	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Group Flow (vph)	21	17	25	1654	37	673	38
v/c Ratio	0.07	0.06	0.12	0.65	0.21	0.27	0.03
Control Delay	20.5	9.0	29.0	15.5	31.6	9.6	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.5	9.0	29.0	15.5	31.6	9.6	6.1
Queue Length 50th (ft)	8	0	10	137	15	36	0
Queue Length 95th (ft)	17	11	30	#667	40	188	20
Internal Link Dist (ft)	418			1236		1039	
Turn Bay Length (ft)			250		170		170
Base Capacity (vph)	717	651	217	2542	192	2521	1139
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.03	0.12	0.65	0.19	0.27	0.03

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Queues

3: Osgood Rd & Blacow Rd

09/04/2019



Lane Group	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Group Flow (vph)	20	6	18	291	6	1496	13
v/c Ratio	0.07	0.02	0.09	0.10	0.03	0.53	0.01
Control Delay	20.4	10.7	28.5	7.0	28.7	12.2	8.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.4	10.7	28.5	7.0	28.7	12.2	8.7
Queue Length 50th (ft)	8	0	7	0	2	0	0
Queue Length 95th (ft)	17	6	24	81	13	#612	13
Internal Link Dist (ft)	418			931		1039	
Turn Bay Length (ft)			250		170		170
Base Capacity (vph)	717	645	217	2845	192	2835	1270
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.01	0.08	0.10	0.03	0.53	0.01

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Queues

3: Osgood Rd & Blacow Rd

09/04/2019



Lane Group	EBL	EBR	NBL	NBT	SBU	SBT	SBR
Lane Group Flow (vph)	21	17	25	1654	26	673	38
v/c Ratio	0.07	0.06	0.12	0.65	0.15	0.27	0.03
Control Delay	20.5	9.0	29.0	15.5	30.4	9.6	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.5	9.0	29.0	15.5	30.4	9.6	6.1
Queue Length 50th (ft)	8	0	10	137	10	36	0
Queue Length 95th (ft)	17	11	30	#667	31	188	20
Internal Link Dist (ft)	418			1236		1039	
Turn Bay Length (ft)			250		170		170
Base Capacity (vph)	717	651	217	2542	192	2521	1139
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.03	0.12	0.65	0.14	0.27	0.03

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.