

## MEMORANDUM

PRINCIPALS

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**DATE:** October 19, 2018

**TO:** Eleanor W. Antonietti  
Zoning Administrator/Land Use Specialist  
Nantucket Planning Office  
2 Fairgrounds Road  
Nantucket, MA 02554

**FROM:** Robert J. Michaud, P.E. – Managing Principal  
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**RE: Response to BETA Traffic Impact and Access Study**  
Proposed Surfside Crossing Residential Development  
Nantucket, Massachusetts

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MDM Transportation Consultants, Inc. (MDM) has reviewed the September 2018 Traffic Impact and Access Study (TIAS) prepared by BETA Group (BETA) for the Surfside Crossing 40B project prepared for the Town of Nantucket. This memorandum identifies several clarifying points regarding the BETA analysis methodology that result in differing results from MDM's July 2018 TIAS for Surfside Crossing and supplemental technical analyses presented in the MDM September 2018 memorandum. MDM concludes that findings of our July 2018 TIAS remain valid and that under a potential reduced-build scenario (100 units) that incremental traffic impacts are further reduced. Under either development scenario, mitigative actions on public way are not independently warranted based on modest traffic impacts of the Surfside Crossing 40B development beyond those identified in the July 2018 TIAS.

Specific points are as follows:

1. **Expanded Study Area:** While the expanded study area considered in the BETA study is beneficial for Town planning purposes that are beyond the scope of the Surfside Crossing project, MDM contends that analysis of the expanded area beyond Surfside Road/South Shore Road/Fairgrounds Road is not warranted for the project. We reference our response to TetraTech as documented in the MDM September 2018 response memorandum which also addresses study area and which is incorporated herein by reference. We conclude that the selected study area presented in the July 2018 TIAS is valid on the following basis:

- *Industry Recommended Practice.* Absent specific local guidance or policy on traffic study area, the Institute of Transportation Engineers (ITE) provides guidance on selection of an appropriate study area for traffic impact analyses in the ITE *Transportation Planning Handbook, 4th Edition* and the ITE *Transportation Impact Analyses for Site Development (2010)*. ITE recommended practice in the case of Surfside Crossing 40B (for either the full build 156 units or the potential 100-unit reduced build scenario) limits the area to site access and major intersections located within 1,000 feet from Site access.
  - *MassDOT Traffic Study Guidelines.* Another reference to consider in selecting a study area is MassDOT's Traffic Study Guidelines. MDM emphasizes that MassDOT jurisdiction does not apply in this case; however, application of these guidelines would include only those locations that sustain traffic increases of 100 vehicles or more than a 5 percent increase in volume. The relative traffic increases for a 156-unit project at intersections beyond Surfside Road/South Shore Road/Fairgrounds Road represent fewer than 65 vehicles and less than a 5 percent change in traffic over No Build conditions. The reduced build scenario (100 units) represents less than a 3 percent change in traffic over No Build conditions beyond the Surfside Road/South Shore Road/Fairgrounds Road.
  - *Modest Relative Traffic Increases.* Project traffic increases at all locations fall within observed day-to-day fluctuation in area traffic during summertime conditions. Comparison of summertime traffic data as documented in the July 2018 TIAS and the BETA study for the months of June and August 2018 (June 28, August 2 and August 16) indicate that peak hour traffic along Surfside Road alone can vary by over 100 vehicles per hour during peak hours from one day to the next. MDM further notes a similar trend on Fairgrounds Road, which MassDOT provides hourly counts for August 2017. These data indicate hourly traffic volume variation of up to 86 vehicles during peak hours from one day to the next (see **Attachments**). Additional intersection locations beyond those included in the July 2018 TIAS would not sustain a material impact from the Project and represent locations that have already been the subject of study and mitigation by the Town independent of the Project.
2. **Study Horizon Year:** BETA selects a 7-year horizon for analysis versus the 5-year horizon used in the July 2018 TIAS. Use of the 5-year horizon is appropriate in this case and is consistent with industry practices for projects subject to local jurisdiction and review. TetraTech, the Town peer reviewer, concurs and specifically cites in their August 17, 2018 letter that “...*the five-year planning horizon used in the TIA is consistent with industry-standard guidelines published by the Institute of Transportation Engineers in Transportation Planning Handbook, 4th Edition. Since the study area intersection is under local (Town) jurisdiction, a five-year planning horizon is appropriate.*”

3. **Peak Season Volumes.** BETA utilizes the highest documented summertime volume conditions in its analysis (August 2, 2018). Industry practice is to use volume conditions that are reasonably representative of typical or average conditions (whether these conditions occur during a peak season or during average month conditions). Accordingly, collected traffic data should avoid days or periods that are likely to have skewed or atypical conditions (such as Mondays or Fridays) or that in this case rely on a single peak season/peak day condition that is known to significantly vary throughout the season. Accordingly, the July 2018 TIAS analysis and subsequent MDM technical response memorandum of September 2018 are based on peak summertime conditions as averaged among all available data collected during the summertime period including June 28, August 2 and August 16 2018. This methodology best represents average summertime design conditions at the study intersections rather than a single summer day condition that is known to be among the single highest activity days of the entire year on Nantucket. The averaged peak summertime volumes used in the July 2018 TIAS and September 2018 response memorandum therefore properly account for average peak season conditions that accounts for known day-to-day variability in volume during summertime that occur on Nantucket.
  
4. **Capacity Analysis Assumptions.** The BETA TIAS assumes the use of individual intersection approach peak hour factors (PHFs) rather than an observed single intersection peak hour factor. The July 2018 TIAS and September 2018 response memorandum analyses use peak hour factors for the entire intersection (rather than for individual approached) that conforms with the Highway Capacity Manual (HCM) procedures. As outlined in the HCM 2010 Edition,

“The use of a single peak hour factor for the entire intersection is intended to avoid the likelihood of creating demand scenarios with conflicting volumes that are disproportionate to the actual volumes during the 15-min analysis period. If peak hour factors for each individual approach or movement are used, they are likely to generate demand volumes from one 15-min period that are in apparent conflict with demand volumes from another 15-min period, whereas in reality these peak volumes do not occur at the same time.”

The use of individual approach PHFs result in design-hour volumes in the BETA TIAS capacity analysis that are significantly inflated relative to actual observed peak hourly volumes – by as much as 16 percent (i.e., by a factor nearly *twice* that of Surfside Crossing traffic increases for a 156-unit development scenario). This assumption and the resulting inflated (and unrealistic) volume conditions are inconsistent with recommended HCM procedures.

5. **Background Growth Assumptions.** Annualized growth factors applied in the July 2018 TIAS were confirmed with Nantucket Planning as reasonable and account for peripheral trip activity associated with other area background projects. In addition to annualized growth, the BETA TIAS assumes additional trip activity from the Richmond Great Point development and the Ticcoma Green 40B development (a project that is under appeal and for which no traffic study is available). The assignment of these trips to the Surfside Road/South Shore Road/Fairgrounds Road (particularly for Richmond Great Point) in the opinion of MDM highly conservative. Specifically, BETA assumes that all of the 15 percent of Richmond Great Point trips assigned to Fairgrounds Road per the traffic study for that project travel exclusively through Surfside Road/South Shore Road/Fairgrounds Road. This not only “double counts” the likely trip increases from background projects already accounted for in the annualized growth factor, it ignores the likelihood that alternative and more direct routes are used for likely destinations (such as downtown or surfside beaches). The resulting trip paths associated with Richmond Great Point are not entirely supported by simply applying “overall distribution of traffic in the area”.
  
6. **Inflated Capacity Analysis Results.** As documented in the MDM September 2018 memorandum, relative traffic impacts of Surfside Crossing (whether at 156 full-build or 100-unit reduced build scenarios) at even the most impacted intersection of Surfside Road/South Shore Road/Fairgrounds Road are modest and do not result in a material degradation of level-of-service relative to No-Build conditions. As documented in the MDM September 2018 memorandum, delay increases at this intersection under averaged peak summertime conditions range from 1 to 6 seconds for any intersection approach.

Conversely, traffic assumptions employed in the BETA TIAS unreasonably inflate volume conditions at study intersections; inflated volume conditions that grossly misrepresent impacts from even the modest traffic increases of Surfside Crossing. These assumptions include seasonal volumes from a single highest summer day count, use of a 7-year horizon, inclusion of additional background projects already accounted for in annualized growth assumptions, and use of peak hour factors that result in conflicting intersection volumes that are disproportionate to the actual volumes during the 15-min analysis period at the intersection. The BETA TIAS capacity analysis results do not reasonably represent the likely impact of adding less than two additional vehicles at the intersection per minute. Specifically, the BETA TIAS estimates delay increases of 20 to 69 seconds at Surfside Road/South Shore Road/Fairgrounds Road – a doubling of delay for certain approaches relative to “No Build” conditions. The BETA highly conservative analytical assumptions conflate to produce unreasonable volumes at study intersections with capacity results that do not reasonably reflect likely project impacts.

7. **Sensitivity Analysis.** A sensitivity analysis has been prepared by MDM that serves as an additional point of reference for quantifying relative trip impacts of the Surfside Crossing project under highly conservative volume conditions. The analysis assumes the following:

- BETA count data for August 2, 2018 to reflect a worst-case analysis scenario
- A 5-year horizon for future year conditions
- Background growth to include Ticcoma Green and Richmond Great Point
- A single intersection peak hour factor, consistent with HCM procedures

Traffic volume networks for the Baseline, No-Build, Reduced Build (100 units), and Full Build (156 units) are provided in the **Attachments** for the weekday morning and weekday evening peak hours. Level-of-Service (LOS) and vehicle queue analyses were conducted for the 2018 Baseline, 2023 No-Build, 2023 Reduced Build (100 units), and 2023 Full Build (156 units) conditions for the study intersection of Surfside Crossing at Surfside Road/Fairgrounds Road/South Shore Road. The results of the intersection capacity are summarized below in **Table 1**. Detailed analysis results are presented in the **Attachments**.

As summarized in **Table 1**, even under highly conservative peak-day/peak season conditions the relative impact of the Surfside Crossing development results in modest relative delay and vehicle queue increases that do not independently warrant mitigative action:

- *Capacity Analysis Results – Peak Weekday/Peak Season.* Under future conditions, capacity analyses indicate that the Surfside Road intersection with Fairgrounds Road and South Shore Road will operate with long delays during weekday evening peak hour under peak weekday/peak season conditions, specifically, for the eastbound Surfside Road and southbound Fairgrounds Road approaches to the intersection. The incremental traffic associated with the proposed development (1 to 2 additional trips per minute through the adjacent all-way STOP intersection of Surfside Road at Fairgrounds Road/South Shore Road during the peak commute hours) is not expected to materially impact operating conditions at the intersection compared to No-Build conditions.
- *Vehicle Queue Results.* The 95<sup>th</sup> percentile vehicle queues at the study intersections will generally be contained within available storage lanes during peak hours. During peak hours under peak summer conditions the eastbound Surfside Road approach and southbound Fairgrounds Road approach will have No-Build queues that are manageable which extend between one and two hundred feet from the intersection. The project will not significantly change queue lengths compared to No-Build conditions and will generally result in an increase of 2 vehicles or less on all approaches.

**TABLE 1**  
**INTERSECTION CAPACITY ANALYSIS RESULTS – PEAK WEEKDAY/PEAK SEASON SENSITIVITY ANALYSIS**  
**SURFSIDE ROAD AT FAIRGOUND ROAD/SOUTH SHORE ROAD**

Period	Approach	2018 BETA Existing				2023 No-Build				2023 Reduced Build (100 Units)				2023 Full Build (156 Units)			
		v/c <sup>1</sup>	Delay <sup>2</sup>	LOS <sup>3</sup>	95 <sup>th</sup> % Q <sup>5</sup>	v/c	Delay	LOS	95 <sup>th</sup> % Q	v/c	Delay	LOS	95 <sup>th</sup> % Q	v/c	Delay	LOS	95 <sup>th</sup> % Q
<i>Weekday</i>	Surfside EB	0.71	22	C	6	0.79	30	D	8	0.86	39	E	9	0.89	45	E	10
<i>Morning Peak</i>	Surfside WB	0.40	13	B	2	0.46	15	B	2	0.49	17	C	3	0.52	18	C	3
<i>Hour</i>	South Shore	0.29	12	B	1	0.32	14	B	1	0.44	16	C	2	0.51	18	C	3
	Fairgrounds	0.53	16	C	3	0.64	20	C	5	0.69	24	C	5	0.72	26	D	6
<i>Weekday</i>	Surfside EB	0.78	28	D	7	0.92	50	F	11	>1.0	>50	F	13	>1.0	>50	F	13
<i>Evening Peak</i>	Surfside WB	0.68	22	C	5	0.81	33	D	8	0.86	43	E	9	0.89	47	E	10
<i>Hour</i>	South Shore	0.24	13	B	1	0.29	15	C	1	0.40	18	C	2	0.42	19	C	2
	Fairgrounds	0.68	22	C	5	0.82	35	E	8	0.89	48	E	10	0.93	>50	F	11

<sup>1</sup>Volume-to-capacity ratio

<sup>2</sup>Average control delay per vehicle (in seconds)

<sup>3</sup>Level of service

<sup>4</sup>n/a = not applicable

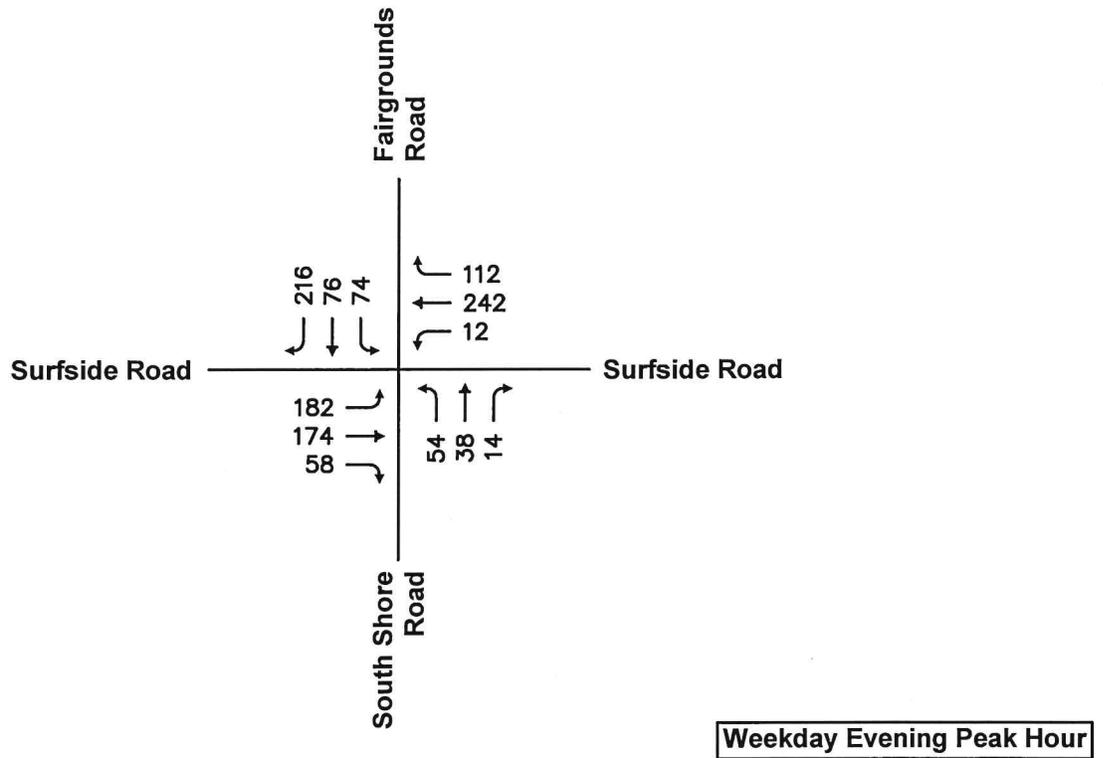
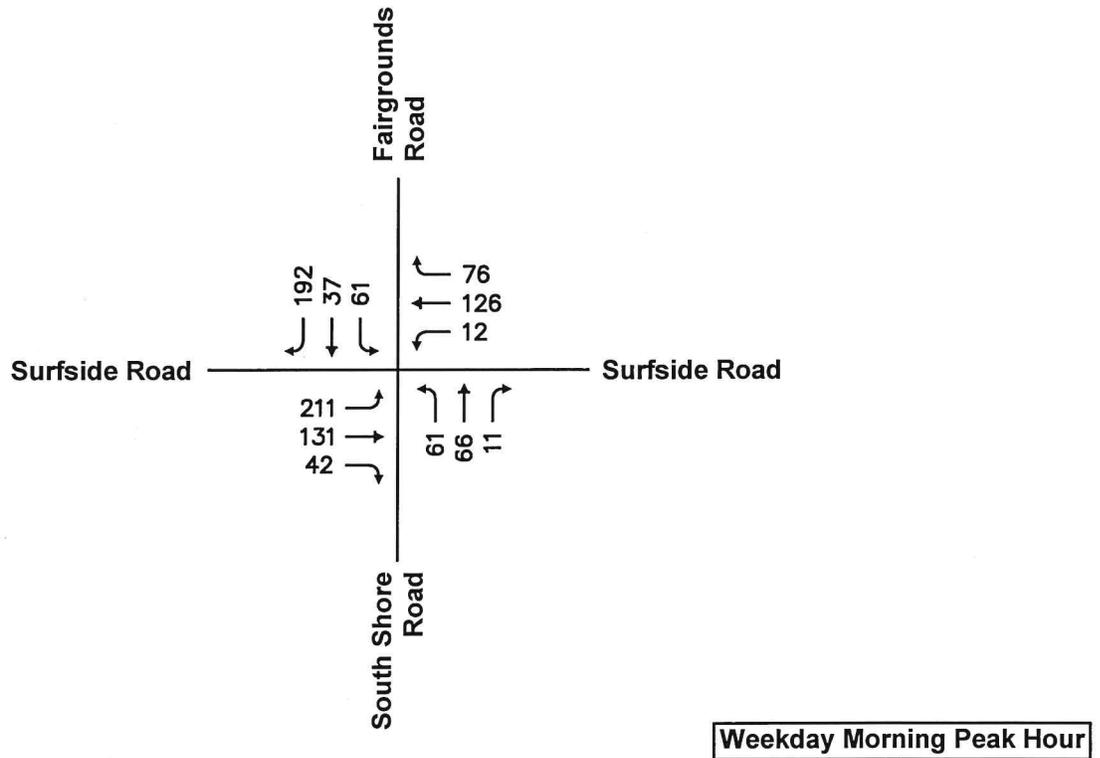
<sup>5</sup>95<sup>th</sup> Percentile Vehicle Queue (in vehicles)

In conclusion, MDM finds that the proposed Surfside Crossing 40B development, whether developed at 156 units or 100 units, represents a modest traffic generator that has immaterial impacts to study intersections. Sensitivity analysis as presented herein, which relies on highly conservative summertime volume conditions per the BETA counts conducted on August 2, 2018, results in the same finding and conclusions. Project traffic impacts do not independently warrant the need for mitigative actions at study intersections beyond those identified in the July 2018 TIAS.

## **ATTACHMENTS**

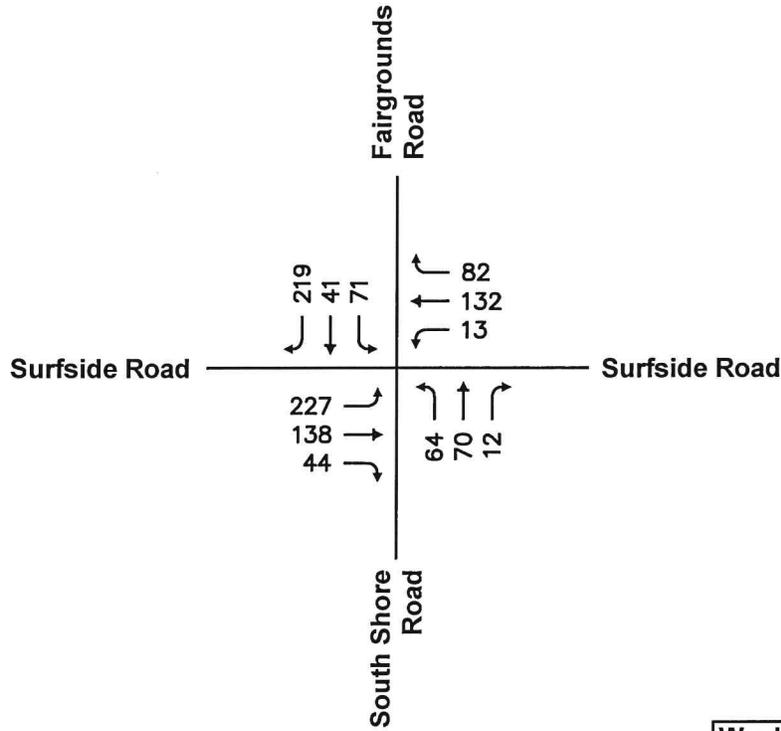
- Traffic Volume Networks (Sensitivity Analysis)
- Capacity Worksheets (Sensitivity Analysis)
- MassDOT Count Data – Fairgrounds Road (2017)
- Intersection Trip Increases (Peak Season/Peak Day)

- Traffic Volume Networks (Sensitivity Analysis)

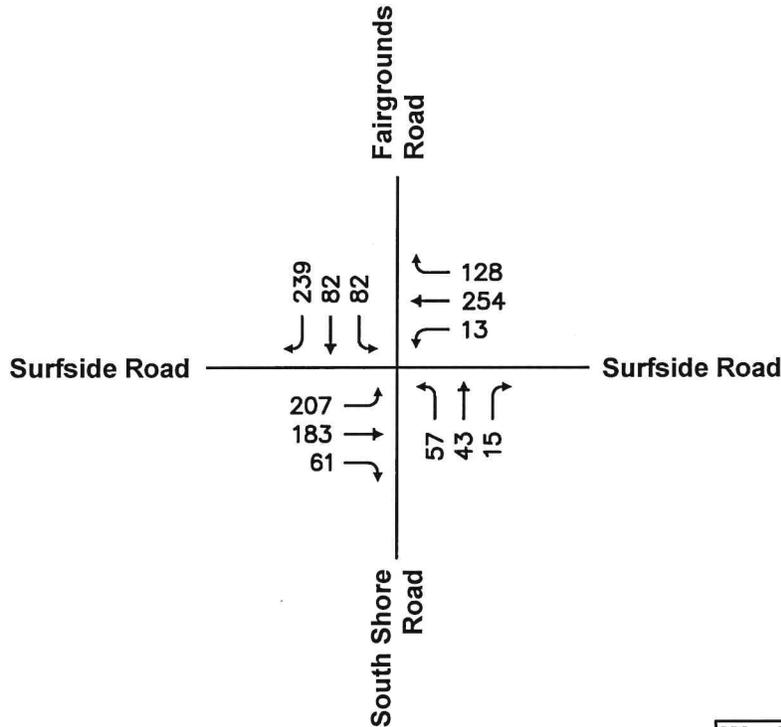


North

Scale: Not to Scale



**Weekday Morning Peak Hour**

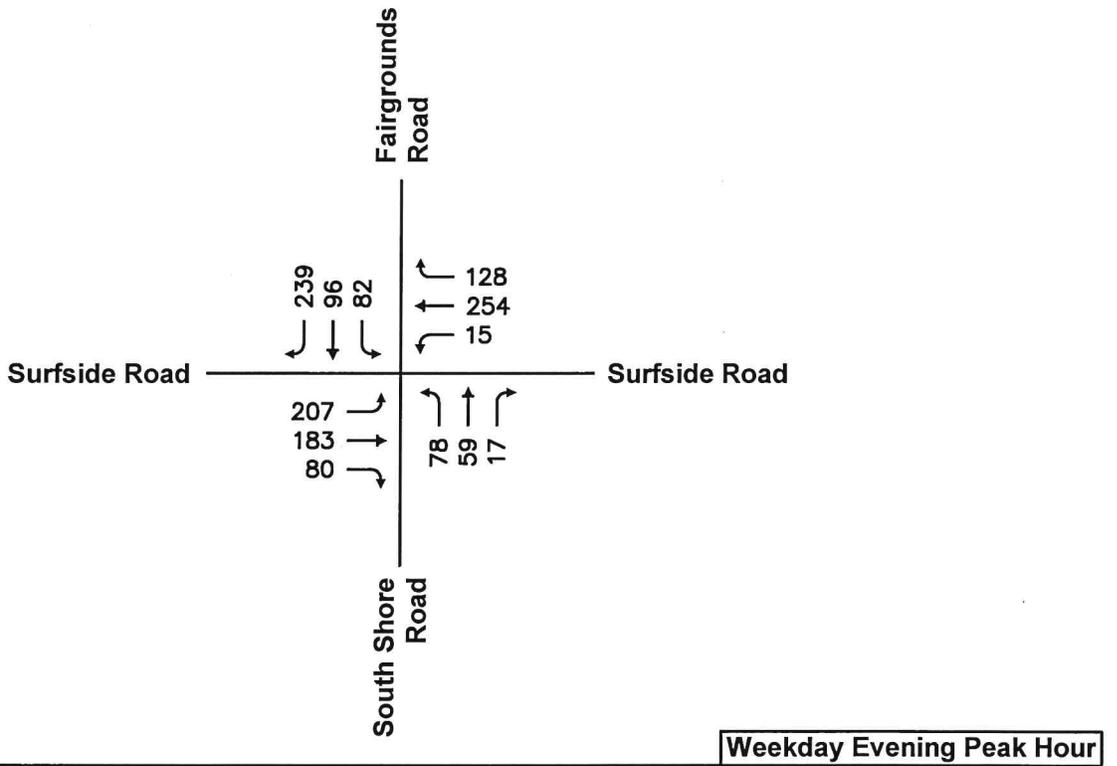
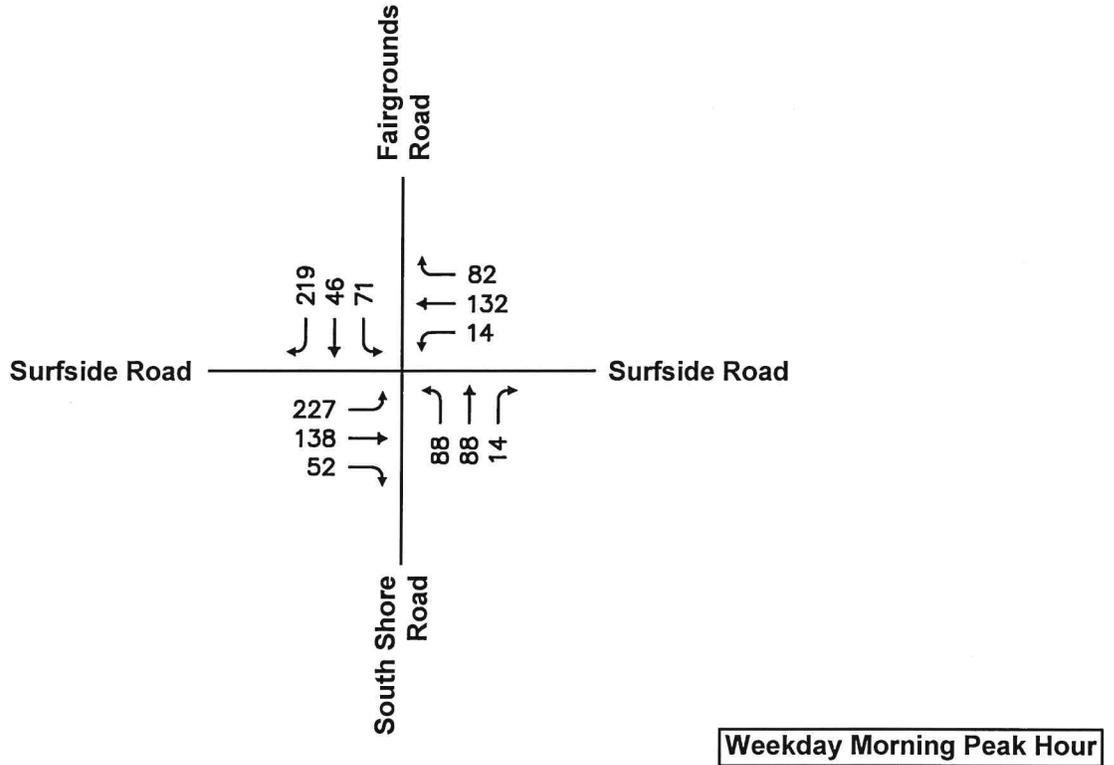


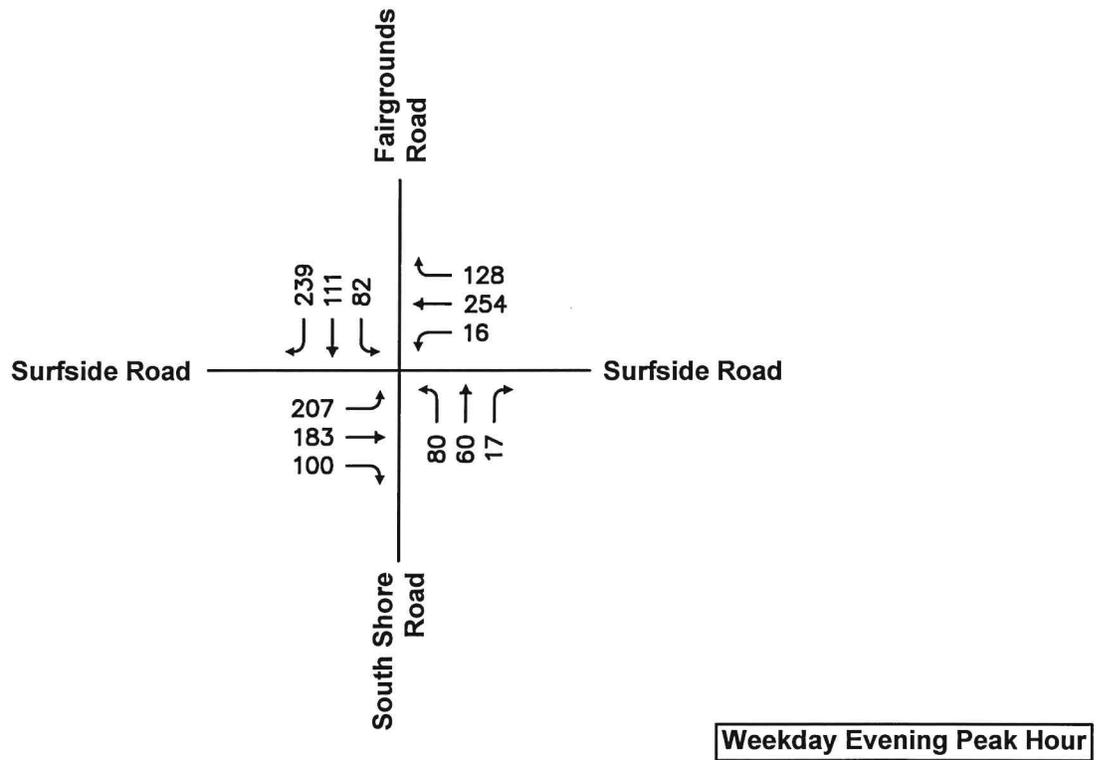
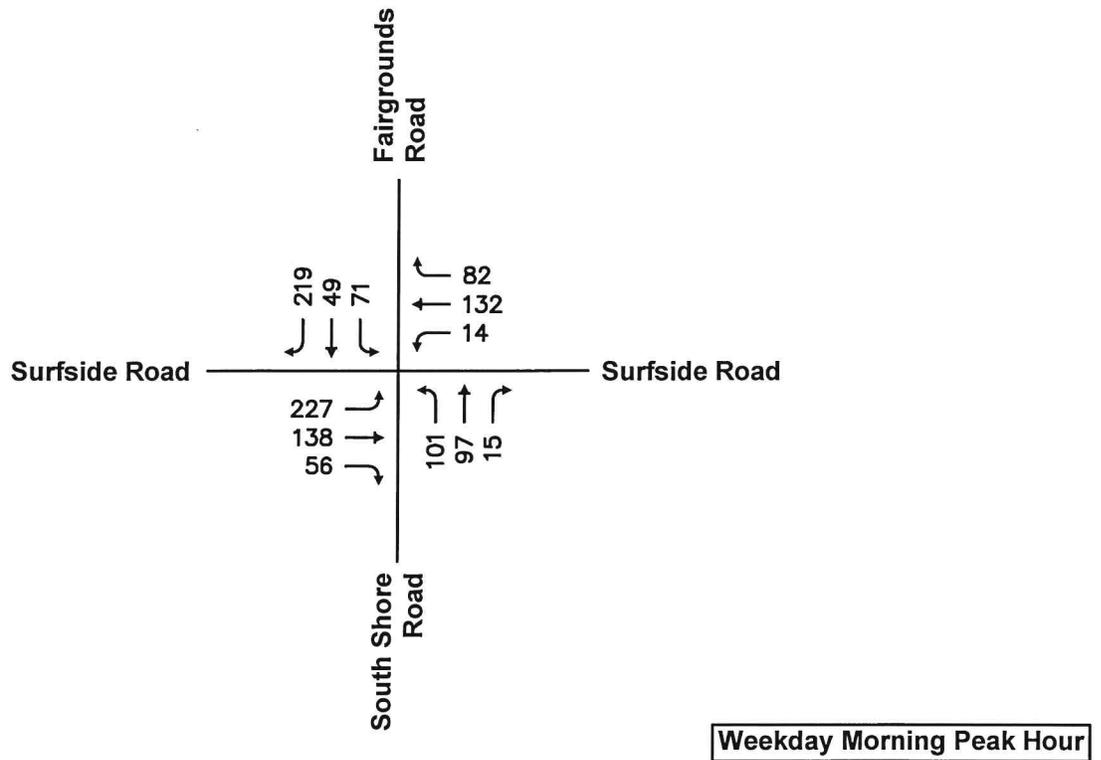
**Weekday Evening Peak Hour**



North

Scale: Not to Scale





North

Scale: Not to Scale

□ Capacity Worksheets (Sensitivity Analysis)

□ Capacity Analysis

Intersection

Intersection Delay, s/veh	17.1											
Intersection LOS	C											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	211	131	42	0	12	126	76	0	61	66	11
Peak Hour Factor	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	1	1	0	2	0	2	0	2	0	0	0
Mvmt Flow	0	234	146	47	0	13	140	84	0	68	73	12
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	22	13.2	12.4
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	44%	55%	6%	21%
Vol Thru, %	48%	34%	59%	13%
Vol Right, %	8%	11%	36%	66%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	138	384	214	290
LT Vol	61	211	12	61
Through Vol	66	131	126	37
RT Vol	11	42	76	192
Lane Flow Rate	153	427	238	322
Geometry Grp	1	1	1	1
Degree of Util (X)	0.285	0.705	0.402	0.533
Departure Headway (Hd)	6.7	5.951	6.079	5.95
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	535	606	590	606
Service Time	4.762	3.998	4.133	3.998
HCM Lane V/C Ratio	0.286	0.705	0.403	0.531
HCM Control Delay	12.4	22	13.2	15.6
HCM Lane LOS	B	C	B	C
HCM 95th-tile Q	1.2	5.7	1.9	3.1

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Intersection

Intersection Delay, s/veh

Intersection LOS

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Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	61	37	192
Peak Hour Factor	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	2	0	2
Mvmt Flow	0	68	41	213
Number of Lanes	0	0	1	0

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Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	15.6
HCM LOS	C

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Lane

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HCM 2010 AWSC  
 1: South Shore Road/Fairgrounds Road & Surfside Road

2018 BETA Existing  
 Weekday Evening Peak Hour

Intersection

Intersection Delay, s/veh	23.3											
Intersection LOS	C											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	182	174	58	0	12	242	112	0	54	38	14
Peak Hour Factor	0.92	0.96	0.96	0.96	0.92	0.96	0.96	0.96	0.92	0.96	0.96	0.96
Heavy Vehicles, %	2	0	0	0	2	0	0	1	2	0	0	0
Mvmt Flow	0	190	181	60	0	13	252	117	0	56	40	15
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	28.1	21.9	13.1
HCM LOS	D	C	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	51%	44%	3%	20%
Vol Thru, %	36%	42%	66%	21%
Vol Right, %	13%	14%	31%	59%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	106	414	366	366
LT Vol	54	182	12	74
Through Vol	38	174	242	76
RT Vol	14	58	112	216
Lane Flow Rate	110	431	381	381
Geometry Grp	1	1	1	1
Degree of Util (X)	0.237	0.77	0.675	0.68
Departure Headway (Hd)	7.73	6.43	6.373	6.422
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	467	556	560	557
Service Time	5.73	4.527	4.473	4.516
HCM Lane V/C Ratio	0.236	0.775	0.68	0.684
HCM Control Delay	13.1	28.1	21.9	22.2
HCM Lane LOS	B	D	C	C
HCM 95th-tile Q	0.9	7	5.1	5.2

Intersection

Intersection Delay, s/veh  
 Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	74	76	216
Peak Hour Factor	0.92	0.96	0.96	0.96
Heavy Vehicles, %	2	0	0	0
Mvmt Flow	0	77	79	225
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	22.2
HCM LOS	C

Lane

Intersection

Intersection Delay, s/veh	21.6											
Intersection LOS	C											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	227	138	44	0	13	132	82	0	64	70	12
Peak Hour Factor	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	1	1	0	2	0	2	0	2	0	0	0
Mvmt Flow	0	252	153	49	0	14	147	91	0	71	78	13
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	29.5	15	13.6
HCM LOS	D	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	44%	56%	6%	21%
Vol Thru, %	48%	34%	58%	12%
Vol Right, %	8%	11%	36%	66%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	146	409	227	331
LT Vol	64	227	13	71
Through Vol	70	138	132	41
RT Vol	12	44	82	219
Lane Flow Rate	162	454	252	368
Geometry Grp	1	1	1	1
Degree of Util (X)	0.322	0.794	0.455	0.638
Departure Headway (Hd)	7.139	6.29	6.489	6.249
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	500	573	550	574
Service Time	5.238	4.364	4.579	4.325
HCM Lane V/C Ratio	0.324	0.792	0.458	0.641
HCM Control Delay	13.6	29.5	15	19.8
HCM Lane LOS	B	D	B	C
HCM 95th-tile Q	1.4	7.6	2.4	4.5

Intersection

Intersection Delay, s/veh

Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	71	41	219
Peak Hour Factor	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	2	0	2
Mvmt Flow	0	79	46	243
Number of Lanes	0	0	1	0

Approach

SB

Opposing Approach

NB

Opposing Lanes

1

Conflicting Approach Left

WB

Conflicting Lanes Left

1

Conflicting Approach Right

EB

Conflicting Lanes Right

1

HCM Control Delay

19.8

HCM LOS

C

Lane

Intersection

Intersection Delay, s/veh	37.6											
Intersection LOS	E											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	207	183	61	0	13	254	128	0	57	43	15
Peak Hour Factor	0.92	0.96	0.96	0.96	0.92	0.96	0.96	0.96	0.92	0.96	0.96	0.96
Heavy Vehicles, %	2	0	0	0	2	0	0	1	2	0	0	0
Mvmt Flow	0	216	191	64	0	14	265	133	0	59	45	16
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	49.7	33.3	15.1
HCM LOS	E	D	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	50%	46%	3%	20%
Vol Thru, %	37%	41%	64%	20%
Vol Right, %	13%	14%	32%	59%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	115	451	395	403
LT Vol	57	207	13	82
Through Vol	43	183	254	82
RT Vol	15	61	128	239
Lane Flow Rate	120	470	411	420
Geometry Grp	1	1	1	1
Degree of Util (X)	0.288	0.921	0.804	0.818
Departure Headway (Hd)	8.668	7.061	7.033	7.015
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	417	512	510	512
Service Time	6.668	5.155	5.131	5.105
HCM Lane V/C Ratio	0.288	0.918	0.806	0.82
HCM Control Delay	15.1	49.7	33.3	34.7
HCM Lane LOS	C	E	D	D
HCM 95th-tile Q	1.2	10.9	7.6	8

Intersection

Intersection Delay, s/veh

Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	82	82	239
Peak Hour Factor	0.92	0.96	0.96	0.96
Heavy Vehicles, %	2	0	0	0
Mvmt Flow	0	85	85	249
Number of Lanes	0	0	1	0

Approach SB

Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	34.7
HCM LOS	D

Lane

HCM 2010 AWSC 2023 Reduced Build Condition (1% Over 5 Years + Background Projects)  
 1: South Shore Road/Fairgrounds Road & Surfside Road Weekday Morning Peak Hour

Intersection

Intersection Delay, s/veh	26.6											
Intersection LOS	D											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	227	138	52	0	14	132	82	0	88	88	14
Peak Hour Factor	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	1	1	0	2	0	2	0	2	0	0	0
Mvmt Flow	0	252	153	58	0	16	147	91	0	98	98	16
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	38.8	16.9	16.4
HCM LOS	E	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	46%	54%	6%	21%
Vol Thru, %	46%	33%	58%	14%
Vol Right, %	7%	12%	36%	65%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	190	417	228	336
LT Vol	88	227	14	71
Through Vol	88	138	132	46
RT Vol	14	52	82	219
Lane Flow Rate	211	463	253	373
Geometry Grp	1	1	1	1
Degree of Util (X)	0.441	0.863	0.495	0.694
Departure Headway (Hd)	7.516	6.709	7.031	6.69
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	477	537	512	538
Service Time	5.59	4.768	5.103	4.752
HCM Lane V/C Ratio	0.442	0.862	0.494	0.693
HCM Control Delay	16.4	38.8	16.9	23.7
HCM Lane LOS	C	E	C	C
HCM 95th-tile Q	2.2	9.3	2.7	5.4

HCM 2010 AWSC 2023 Reduced Build Condition (1% Over 5 Years + Background Projects)  
 1: South Shore Road/Fairgrounds Road & Surfside Road Weekday Morning Peak Hour

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Intersection

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Intersection Delay, s/veh

Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	71	46	219
Peak Hour Factor	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	2	0	2
Mvmt Flow	0	79	51	243
Number of Lanes	0	0	1	0

Approach

SB

Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	23.7
HCM LOS	C

Lane

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HCM 2010 AWSC 2023 Reduced Build Condition (1% Over 5 Years + Background Projects)

1: South Shore Road/Fairgrounds Road & Surfside Road

Weekday Evening Peak Hour

Intersection

Intersection Delay, s/veh	50.4											
Intersection LOS	F											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	207	183	80	0	15	254	128	0	78	59	17
Peak Hour Factor	0.92	0.96	0.96	0.96	0.92	0.96	0.96	0.96	0.92	0.96	0.96	0.96
Heavy Vehicles, %	2	0	0	0	2	0	0	1	2	0	0	0
Mvmt Flow	0	216	191	83	0	16	265	133	0	81	61	18
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	69.6	43.3	18
HCM LOS	F	E	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	51%	44%	4%	20%
Vol Thru, %	38%	39%	64%	23%
Vol Right, %	11%	17%	32%	57%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	154	470	397	417
LT Vol	78	207	15	82
Through Vol	59	183	254	96
RT Vol	17	80	128	239
Lane Flow Rate	160	490	414	434
Geometry Grp	1	1	1	1
Degree of Util (X)	0.401	1	0.87	0.9
Departure Headway (Hd)	8.992	7.629	7.575	7.462
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	399	475	480	487
Service Time	7.06	5.705	5.625	5.509
HCM Lane V/C Ratio	0.401	1.032	0.863	0.891
HCM Control Delay	18	69.6	43.3	47.6
HCM Lane LOS	C	F	E	E
HCM 95th-tile Q	1.9	13.2	9.2	10.1

HCM 2010 AWSC 2023 Reduced Build Condition (1% Over 5 Years + Background Projects)  
 1: South Shore Road/Fairgrounds Road & Surfside Road Weekday Evening Peak Hour

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Intersection

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Intersection Delay, s/veh

Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	82	96	239
Peak Hour Factor	0.92	0.96	0.96	0.96
Heavy Vehicles, %	2	0	0	0
Mvmt Flow	0	85	100	249
Number of Lanes	0	0	1	0

Approach

SB

Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	47.6
HCM LOS	E

Lane

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Intersection

Intersection Delay, s/veh	29.7											
Intersection LOS	D											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	227	138	56	0	14	132	82	0	101	97	15
Peak Hour Factor	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	1	1	0	2	0	2	0	2	0	0	0
Mvmt Flow	0	252	153	62	0	16	147	91	0	112	108	17
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	44.7	17.9	18.4
HCM LOS	E	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	47%	54%	6%	21%
Vol Thru, %	46%	33%	58%	14%
Vol Right, %	7%	13%	36%	65%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	213	421	228	339
LT Vol	101	227	14	71
Through Vol	97	138	132	49
RT Vol	15	56	82	219
Lane Flow Rate	237	468	253	377
Geometry Grp	1	1	1	1
Degree of Util (X)	0.504	0.897	0.513	0.722
Departure Headway (Hd)	7.67	6.904	7.289	6.897
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	466	524	491	524
Service Time	5.764	4.978	5.381	4.976
HCM Lane V/C Ratio	0.509	0.893	0.515	0.719
HCM Control Delay	18.4	44.7	17.9	26
HCM Lane LOS	C	E	C	D
HCM 95th-tile Q	2.8	10.3	2.9	5.9

Intersection

Intersection Delay, s/veh

Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	71	49	219
Peak Hour Factor	0.92	0.90	0.90	0.90
Heavy Vehicles, %	2	2	0	2
Mvmt Flow	0	79	54	243
Number of Lanes	0	0	1	0

Approach SB

Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	26
HCM LOS	D

Lane

Intersection

Intersection Delay, s/veh	54.1											
Intersection LOS	F											
Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	207	183	100	0	16	254	128	0	80	60	17
Peak Hour Factor	0.92	0.96	0.96	0.96	0.92	0.96	0.96	0.96	0.92	0.96	0.96	0.96
Heavy Vehicles, %	2	0	0	0	2	0	0	1	2	0	0	0
Mvmt Flow	0	216	191	104	0	17	265	133	0	83	63	18
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	70.3	46.5	18.6
HCM LOS	F	E	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	51%	42%	4%	19%
Vol Thru, %	38%	37%	64%	26%
Vol Right, %	11%	20%	32%	55%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	157	490	398	432
LT Vol	80	207	16	82
Through Vol	60	183	254	111
RT Vol	17	100	128	239
Lane Flow Rate	164	510	415	450
Geometry Grp	1	1	1	1
Degree of Util (X)	0.415	1	0.887	0.942
Departure Headway (Hd)	9.13	7.759	7.704	7.534
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	394	464	468	482
Service Time	7.207	5.846	5.764	5.584
HCM Lane V/C Ratio	0.416	1.099	0.887	0.934
HCM Control Delay	18.6	70.3	46.5	55.7
HCM Lane LOS	C	F	E	F
HCM 95th-tile Q	2	13.1	9.6	11.3

Intersection

Intersection Delay, s/veh

Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	82	111	239
Peak Hour Factor	0.92	0.96	0.96	0.96
Heavy Vehicles, %	2	0	0	0
Mvmt Flow	0	85	116	249
Number of Lanes	0	0	1	0

Approach

SB

Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	55.7
HCM LOS	F

Lane

□ MassDOT Count Data – Fairgrounds Road (2017)

Location Info	
Location ID	253514
Type	I-SECTION
Functional Class	7
Located On	FAIRGROUNDS ROAD
Between	AND
Direction	2-WAY
Community	Nantucket
MPO_ID	
HPMS ID	
Agency	Massachusetts Highway Department

Count Data Info	
Start Date	8/1/2017
End Date	8/2/2017
Start Time	10:00 AM
End Time	10:00 AM
Direction	
Notes	
Count Source	253514
File Name	253514.txt
Weather	
Study	
Owner	rpa13

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Interval: 15 mins					
Time	15 Min				Hourly Count
	1st	2nd	3rd	4th	
00:00 - 01:00	19	24	10	9	62
01:00 - 02:00	6	13	9	8	36
02:00 - 03:00	5	5	5	5	20
03:00 - 04:00	4	5	1	1	11
04:00 - 05:00	2	4	0	6	12
05:00 - 06:00	4	5	6	14	29
06:00 - 07:00	20	27	71	84	202
07:00 - 08:00	111	115	174	175	575
08:00 - 09:00	201	178	164	177	720
09:00 - 10:00	192	170	146	169	677
10:00 - 11:00	12	157	160	141	470
11:00 - 12:00	167	166	176	178	687
12:00 - 13:00	159	177	179	169	684
13:00 - 14:00	171	179	153	126	629
14:00 - 15:00	167	148	150	157	622
15:00 - 16:00	168	170	148	174	660
16:00 - 17:00	154	165	197	192	708
17:00 - 18:00	214	208	196	176	794
18:00 - 19:00	171	160	139	125	595
19:00 - 20:00	113	122	120	106	461
20:00 - 21:00	88	99	82	55	324
21:00 - 22:00	50	79	55	62	246
22:00 - 23:00	58	46	52	41	197
23:00 - 24:00	34	29	21	11	95
TOTAL					9516



Location Info	
Location ID	253514
Type	I-SECTION
Functional Class	7
Located On	FAIRGROUNDS ROAD
Between	AND
Direction	2-WAY
Community	Nantucket
MPO_ID	
HPMS ID	
Agency	Massachusetts Highway Department

Count Data Info	
Start Date	8/2/2017
End Date	8/3/2017
Start Time	10:00 AM
End Time	10:00 AM
Direction	
Notes	
Count Source	253514
File Name	253514.txt
Weather	
Study	
Owner	rpa13

Interval: 15 mins					
Time	15 Min				Hourly Count
	1st	2nd	3rd	4th	
00:00 - 01:00	20	18	9	21	68
01:00 - 02:00	10	14	12	8	44
02:00 - 03:00	5	3	5	6	19
03:00 - 04:00	3	6	2	4	15
04:00 - 05:00	5	3	2	4	14
05:00 - 06:00	9	11	14	13	47
06:00 - 07:00	25	39	65	86	215
07:00 - 08:00	100	105	191	169	565
08:00 - 09:00	195	157	165	180	697
09:00 - 10:00	203	155	156	164	678
10:00 - 11:00	165	165	144	158	632
11:00 - 12:00	176	181	169	157	683
12:00 - 13:00	191	203	169	174	737
13:00 - 14:00	186	192	171	180	729
14:00 - 15:00	161	136	154	162	613
15:00 - 16:00	170	184	162	185	701
16:00 - 17:00	171	192	164	181	708
17:00 - 18:00	177	200	208	181	766
18:00 - 19:00	185	146	160	140	631
19:00 - 20:00	111	139	94	82	426
20:00 - 21:00	109	101	67	88	365
21:00 - 22:00	60	60	76	81	277
22:00 - 23:00	38	52	53	39	182
23:00 - 24:00	32	25	25	32	114
TOTAL					9926



Location Info	
Location ID	253514
Type	I-SECTION
Functional Class	7
Located On	FAIRGROUNDS ROAD
Between	AND
Direction	2-WAY
Community	Nantucket
MPO_ID	
HPMS ID	
Agency	Massachusetts Highway Department

Count Data Info	
Start Date	8/3/2017
End Date	8/4/2017
Start Time	10:00 AM
End Time	10:00 AM
Direction	
Notes	
Count Source	253514
File Name	253514.txt
Weather	
Study	
Owner	rpa13

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Interval: 15 mins					
Time	15 Min				Hourly Count
	1st	2nd	3rd	4th	
00:00 - 01:00	14	15	15	13	57
01:00 - 02:00	13	8	8	19	48
02:00 - 03:00	4	9	3	3	19
03:00 - 04:00	7	6	5	1	19
04:00 - 05:00	5	1	3	5	14
05:00 - 06:00	5	6	15	13	39
06:00 - 07:00	13	32	52	65	162
07:00 - 08:00	102	132	168	180	582
08:00 - 09:00	173	163	171	151	658
09:00 - 10:00	192	142	164	167	665
10:00 - 11:00	160	139	129	133	561
11:00 - 12:00	145	139	146	150	580
12:00 - 13:00	195	178	180	190	743
13:00 - 14:00	195	172	184	146	697
14:00 - 15:00	169	157	138	161	625
15:00 - 16:00	172	183	172	174	701
16:00 - 17:00	187	199	201	196	783
17:00 - 18:00	177	191	163	177	708
18:00 - 19:00	196	144	176	167	683
19:00 - 20:00	135	118	125	106	484
20:00 - 21:00	85	88	94	99	366
21:00 - 22:00	67	67	67	72	273
22:00 - 23:00	54	47	53	47	201
23:00 - 24:00	39	35	25	23	122
TOTAL					9790



Location Info	
Location ID	253514
Type	I-SECTION
Functional Class	7
Located On	FAIRGROUNDS ROAD
Between	AND
Direction	2-WAY
Community	Nantucket
MPO_ID	
HPMS ID	
Agency	Massachusetts Highway Department

Count Data Info	
Start Date	8/4/2017
End Date	8/5/2017
Start Time	10:00 AM
End Time	10:00 AM
Direction	
Notes	
Count Source	253514
File Name	253514.txt
Weather	
Study	
Owner	rpa13

Interval: 15 mins					
Time	15 Min				Hourly Count
	1st	2nd	3rd	4th	
00:00 - 01:00	14	22	17	18	71
01:00 - 02:00	20	12	21	18	71
02:00 - 03:00	13	24	8	3	48
03:00 - 04:00	8	5	4	3	20
04:00 - 05:00	5	5	3	9	22
05:00 - 06:00	5	4	7	12	28
06:00 - 07:00	18	20	32	58	128
07:00 - 08:00	64	65	83	104	316
08:00 - 09:00	104	87	108	122	421
09:00 - 10:00	143	143	148	155	589
10:00 - 11:00	156	147	157	148	608
11:00 - 12:00	161	156	164	174	655
12:00 - 13:00	165	207	178	166	716
13:00 - 14:00	184	201	166	159	710
14:00 - 15:00	147	154	162	130	593
15:00 - 16:00	172	164	165	182	683
16:00 - 17:00	162	195	187	188	732
17:00 - 18:00	184	203	172	179	738 *
18:00 - 19:00	174	172	152	149	647
19:00 - 20:00	126	110	105	111	452
20:00 - 21:00	99	99	100	69	367
21:00 - 22:00	72	78	73	52	275
22:00 - 23:00	57	63	50	41	211
23:00 - 24:00	37	22	26	33	118
TOTAL					9219

□ Intersection Trip Increases

- Intersection Trip Increases (Peak Season/Peak Day)

**TRIP INCREASE CALCULATIONS  
 PEAK WEEKDAY/PEAK SEASON  
 SURFSIDE ROAD/SOUTH SHORE ROAD/FAIRGROUNDS ROAD**

<b>Period</b>	<b>No-Build<sup>1</sup></b>	<b>Reduced Build<sup>2</sup></b>	<b>Full Build<sup>3</sup></b>
<i>Weekday Morning Peak Hour:</i>	1,113	+5.2% (58)	+7.9% (88)
<i>Weekday Evening Peak Hour:</i>	1,364	+5.4% (74)	+8.3% (113)

<sup>1</sup>Based on Traffic Counts conducted by BETA Group, Inc on August 2, 2018. (1% background Growth over 5 years + Background trips associated with Ticcoma Green and Richmond Development)

<sup>2</sup>Based on ITE LUC 210 Single-Family Detached Housing trip rates applied to 40 units; and ITE LUC 220 Multifamily Housing (Low-Rise) trip rates applied to 60 units.

<sup>3</sup>Based on ITE LUC 210 Single-Family Detached Housing trip rates applied to 60 units; and ITE LUC 220 Multifamily Housing (Low-Rise) trip rates applied to 96 units.