TRAFFIC IMPACT AND ACCESS STUDY

PROPOSED USC HOSPITALITY AND OLLI FACILITY
POPE AVENUE AT OFFICE PARK ROAD
HILTON HEAD ISLAND, SOUTH CAROLINA

Prepared for:

Wood & Partners, Inc.
Hilton Head Island, SC

Submitted
September, 2014

SOUTH CAROLINA
REGISTERED PROFESSIONAL ENGINEER
No. 21977
MICHAEL R. RIDGELY

9-4-14

Prepared by:

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September 4, 2014

Ms. Kyle Theodore
Wood & Partners, Inc.
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RE: Traffic Study
USC Hospitality & OLLI Facility
Pope Avenue at Office Park Road
Town of Hilton Head Island, SC

Dear Kyle:

As requested, SRS Engineering, LLC (SRS) has completed an assessment of the traffic impacts associated with the development of a new educational facility to be located just east of Pope Avenue along Office Park Road. The new facility will include two users; first a University of South Carolina (USC) Hospitality Education facility and secondly the Osher Lifelong Learning Institute (OLLI). The following provides a summary of this study's findings.

PROJECT DESCRIPTION

The project site is located in the south west quadrant of the Pope Avenue at Office Park Road/New Orleans Road intersection in the Town of Hilton Head Island, SC. The project site consists of multiple parcels totaling slightly less than nine-acres. Currently development has occurred on a total of 6.8-acres; the Time Warner Office, Carolina/Sapelo Office and the Kiawah Office Buildings. These existing businesses/facilities, which total 56,965 square-feet (sf), will be razed as part of the planned development.

The two new planned facilities will be comprised of a new USC Hospitality education facility which will provide an emphasis in the hotel and hospitality business sector. It is planned that during the future 2017 Build conditions, this facility will serve approximately 200-students within a 38,299 sf foot-print. Also planned, the OLLI facility will be orientated towards adult education; and at any one time will also have a maximum of 200-students on-site; located within a 6,784 sf facility. At the 2017 Build conditions, combined total on-site is planned at 45,083 sf with a maximum of 400 on-site students. Both of these facilities will resemble a community college, therefore no dormitories, or residential uses are planned as part of the development. As scheduled, this project is planned to be constructed and operational within a three-year period (2017). **Figure 1** depicts the site location in relation to the regional roadway system.

Access for this new educational facility is planned to/from Office Park Road via three drives which in turn provide access to the signalized intersection with Pope Avenue and New Orleans Road. **Figure 2** depicts the preliminary development plan proposal.

EXISTING CONDITIONS

A comprehensive field inventory of the project study area was conducted in February 2014. The field inventory included a collection of geometric data, traffic volumes and traffic control within the study area. The following sections detail the current traffic conditions and include a description of intersections serving the site and traffic flow in close proximity to the project.

Study Area Intersections

As identified by Town staff, three intersections were required to be analyzed in order to determine project impact on the surrounding roadway network; Sea Pines Circle (intersection of William Hilton Parkway (US 278B), US 278 (Palmetto Bay Road), Pope Avenue and Greenwood Drive), Pope Avenue at Office Park Road/New Orleans Road and Greenwood Drive at Office Park Road. **Figure 3** illustrates the existing geometrics and traffic control for the study area intersections and roadways.

Traffic Volumes

In order to determine the existing traffic volume flow patterns within the study area, traffic volume data was obtained from Town staff for the signalized intersection of Pope Avenue at Office Park Road which reflects traffic volume data for the 45th highest traffic flow day of the year which is required under the Town guidelines. No traffic data was available for the Greenwood intersection so manual turning movement counts were performed. Weekday morning (7:00-9:00 AM) and evening (4:00-6:00 PM) peak period turning movement specific counts were conducted at the Greenwood Drive at Office Park Road intersection on Thursday February 20, 2014. The data for this intersection was then upwardly adjusted in order to account for the seasonally 45th highest day of the year. Based on information provided by Town staff, a seasonal adjustment factor of 1.16 was developed for this intersection and approved for use in this report.

Traffic volume data for the Sea Pines Circle was provided by the Town and reflects 2010 turning movements. This information had to be upwardly adjusted in order to reflect 2013 traffic volumes. In order to accomplish this, information for adjacent signalized intersections to the Sea Pines Traffic Circle were provided by Town staff so that an adjustment factor(s) could be developed which will be used to adjust the 2010 Sea Pines Traffic Circle data to 2013 conditions. Adjustments were developed for each approach to the traffic circle and provided to Town staff for their approval for use in this report.

As directed by the Town's Land Management Ordnances (LMO), the Greenwood Drive at Office Park Road and Pope Avenue at Office Park Road/New Orleans Road intersections have been studied for the AM and PM peak hours. The Sea Pines Traffic Circle has been analyzed for the AM, NOON and PM peak-hour time periods as directed by the LMO.

Summarized count sheets for the study area intersections are included in the Appendix of this report. **Figure 4A**, graphically depicts the Existing AM and PM peak-hour traffic volumes at the study area intersections. **Figure 4B** depicts the NOON peak hour traffic volumes for the Sea Pines Traffic Circle.

Development Vacancies

Existing offices located along Office Park Road are not fully occupied which will have a bearing on traffic volumes within the study area. The following present development square-footages and occupancies of these existing offices as based on current occupancy rates:

1. Time Warner Building- Corner of Pope Avenue and Office Park Road: Facility has a total of 5,799 sf and is currently 100% occupied.
2. Kiawah Building- Southside of Office Park Road: Facility has a total of 18,566 sf of which 9,283 sf is occupied resulting in 9,283 sf currently vacant.
3. Carolina/Sapelo Building- Southside of Office Park Road: Facility is a total of 32,600 sf of which 15,469 sf is occupied resulting in 17,131 sf currently vacant.

These existing office buildings provide a total 56,965 sf with a total vacant square-footage of 26,414 sf (9,283 sf+17,131 sf) or approximately 46.4-percent vacancy. Traffic expected to be generated by this vacant space is presented in **Table 1**.

Table 1
TRIP-GENERATION SUMMARY[1]
VACANT OFFICE USES

Time Period	Existing Land-Uses 56,965 sf Office Space	46.4% of Existing Office Space Currently Vacant
Weekday Daily	870	400
AM Peak-Hour		
Enter	105	49
Exit	15	7
Total	120	56
PM Peak-Hour		
Enter	24	11
Exit	119	55
Total	143	66

[1] ITE *Trip Generation* manual, 9th Ed., LUC 710.

Traffic that can be expected to be generated by the current vacant office space (second column) has been added to the study area network based on existing traffic patterns at the study area intersections; specifically both entering and exiting Office Park Road from Greenwood Drive, Pope Avenue and New Orleans Road. These Existing Traffic plus fully occupied Office AM and PM peak-hour volumes are shown in **Figure 4C**. **Figure 4D** depicts the Noon peak-hour for the Sea Pines Traffic Circle.

FUTURE CONDITIONS

The USC Hospitality/OLLI facility is anticipated to be built-out and fully occupied over a four-year period resulting in full occupancy in 2017. As such, 2017 has been used for the future year analysis for purposes of this report.

Future No-Build Traffic Conditions

Planned Roadway Improvements

Based on discussions with Town staff, there are currently no planned/funded roadway improvement projects that will be completed within the study area by the time this development is operational. However, as part of this project, roadway improvements/mitigation are being suggested in order to

support both existing and future traffic volumes associated with this development which will be described later in this report.

Background Development

Based on discussions with Town staff, there are no new approved development project(s) in the immediate vicinity of the site that would affect traffic growth.

Annual Growth Rate

Based on the projection year of 2017, a 2.4-percent annual growth rate has been utilized to project future conditions based on historical traffic volume data. The anticipated 2017 No-Build AM and PM peak-hour traffic volumes, which reflect the annual 2.4-percent growth rate, are shown in **Figure 5A** and **Figure 5B** for the Noon peak-hour for the traffic circle. It should be noted that these No-Build traffic volumes reflect three years of growth for the Greenwood Drive at Office Park Road since it was counted in 2014, and four years of growth for the Sea Pines Circle and Pope Avenue at Office Park Road/New Orleans Road intersection since these two intersection reflect year 2013 Existing conditions.

Site-Generated Traffic

Traffic volumes expected to be generated by the proposed project were forecasted using the Ninth Edition of the ITE *Trip Generation* manual, as published by the Institute of Transportation Engineers. Land-Use Code #540 (Community College) has been used to estimate the specific site-generated traffic.

Traffic generation calculations for this particular type of land-use can be completed via gross floor area or expected student count variables. While the floor area will be a fixed number once finalized, student count may vary year-by-year or at different times through the same year. Since student counts may vary, it was decided (and approved by Town staff) that an average of trips generated by the student variable and the square-foot variable would be used for purposes of estimating traffic generated by this facility. **Table 2** depicts the anticipated site-generated traffic using this methodology.

Table 2
PROJECT TRIP-GENERATION SUMMARY[1]
USC Hospitality & OLLI Facility

Time Period	USC Hopsitality/OLLI Facility 400 Students, 45,083 sf
Weekday Daily	980
AM Peak-Hour	
Enter	119
Exit	34
Total	153
PM Peak-Hour	
Enter	105
Exit	67
Total	172

[1] ITE *Trip Generation* manual, 9th Ed., LUC 540.

As shown, the proposed development is expected to generate a total of 980 trips on a daily basis of which 153 trips (119 entering, 34 exiting) are expected during the AM peak-hour. During the PM peak-hour, a total of 172 trips (105 entering, 67 exiting) are expected. Noon peak-hour trips for the site are estimated at a total of 163 trips (112 entering, 51 exiting). It should be noted that the remaining daily trips are expected to occur during off-peak time periods.

Distribution Pattern

The directional distribution of site-generated traffic on the study area roadways has been based on an evaluation of existing travel patterns in the area. The anticipated pattern is shown in **Table 3**. This distribution pattern has been applied to the site-generated traffic volumes from Table 2 to develop the site-generated specific volumes for the study area intersections illustrated in **Figures 6A** and **6B**.

Table 3
TRIP DISTRIBUTION PATTERN
USC Hospitality & OLLI Facility

Roadways		Percent Enter	Percent Exit
Pope Avenue	North	30	45
	South	20	20
New Orleans Road	East	20	20
Greenwood Drive	East	25	10
	West	5	5
	Total	**100**	**100**

Future Build Traffic Conditions

In order to develop the future 2017 Build traffic volumes, a multi-stage process has occurred. First, the site-generated traffic, as depicted in Figures 6A and 6B has been added to the respective 2017 No-Build traffic volumes shown in Figures 5A and 5B. This would normally result in the Build peak-hour traffic volumes. However, because the four existing office building on-site will be removed as part of this development, traffic expected by the total 56,965 sf (as shown in Table 1 column 1) has been removed. After these volumes have been "credited" against the peak-hour traffic volumes, the results are Build traffic volumes, which are graphically depicted in **Figures 7A** and **7B**. These volumes were used as the basis to determine potential improvement measures necessary to mitigate traffic impacts caused by the project.

Current Zoning Potential Development

The current planned development of the USC Hospitality and OLLI facility will total 45,083 sf. Under the current zoning, the site could potentially be developed to contain a much larger facility. Up to 89,800 sf of office development could potentially be developed on the subject site.

In order to present a comparison of traffic of possible development under existing zoning regulations, trip generation estimates have been completed for the 89,800 sf office scenarios. **Table 4** presents the expected trip-generation for this scenario. It should be noted that these volumes are being presented for comparison uses only. No detailed analyses presented in this report have been conducted using the existing zoning scenario.

Table 4
TRIP-GENERATION SUMMARY[1]
ALTERNATIVE LAND-USE

Time Period	Current Zoning 89,800 sf Office Space
Weekday Daily	1,230
AM Peak-Hour	
Enter	151
Exit	21
Total	172
PM Peak-Hour	
Enter	30
Exit	149
Total	179

[1] ITE *Trip Generation* manual, 9th Ed., LUC 710.

As shown by Table 4, the allowed development potential under existing zoning could generate up to 1,230 daily trips with a total of 172 trips during the AM peak-hour and 179 trips during the PM peak-hour. Comparing these numbers to the expected traffic to be generated by the USC Hospitality and OLLI facility (Table 2) indicates that for all time periods, daily, AM peak and PM peak, the allowable zoning development would generate more traffic than what is being currently planned (980 daily trips hospitality/OLLI vs. 1,230 daily trips exiting zoning; AM peak-hour: 153 vs. 172 trips and PM peak-hour: 172 vs. 179 trips.)

Square-footage differences are significant between the USC Hospitality/OLLI facility being 45,083 sf and the allowable under existing zoning being 89,800 sf. The planned development of the USC Hospitality/OLLI facility is 44,717 sf less than what could be developed under the existing zoning.

TRAFFIC OPERATIONS

Analysis Methodology

A primary result of capacity analysis is the assignment of Level-of-Service (LOS) and/or delay to traffic facilities under various traffic flow conditions. These concepts are defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.

Six Levels-of-Service are defined for each type of facility (signalized and unsignalized intersections). They are given letter designations from A to F, with LOS A representing the best operating conditions and LOS F the worst. Round-a-bouts or traffic circles have been defined by using the Town's LMO which states that any approach to a round-a-bout or traffic circle must be less than 150.0 seconds. Using this standard, acceptable is measured at less than 150-seconds, failing is measured at greater than 150-seconds.

Analysis Results

As part of this Traffic Study, capacity analyses have been performed at the study area intersections under Existing, Existing plus Vacant Office, Future No-Build (included on-site offices) and Build (removed on-site offices) conditions. It should be noted the analyses for the signalized intersection of Pope Avenue at Office Park Road/New Orleans Drive accounts for the Town's signal coordination system by implementing the current timings which include cycle lengths, all-reds, lost-time and green time splits. The results of these analyses are summarized in **Table 5**.

Table 5
LEVEL-OF-SERVICE SUMMARY[1]
USC Hospitality & OLLI Facility

		EXISTING			EXISTING + Occupancy of Office Buildings On-Site[5]			2017 NO-BUILD			2017 BUILD (Removes Existing Office Buildings On-Site)[6]		
Signalized Intersection	**Time Period**	**Delay[2]**	**V/C[3]**	**LOS[4]**	**Delay**	**V/C**	**LOS**	**Delay**	**V/C**	**LOS**	**Delay**	**V/C**	**LOS**
Pope Avenue at Office Park Road/New Orleans Road	AM	20.1	0.37	C	20.6	0.39	C	21.6	0.43	C	24.8	0.46	C
	PM	31.5	0.60	C	32.1	0.60	C	34.6	0.68	C	36.0	0.70	D
Unsignalized Intersection													
Greenwood Drive at Office Park Road	AM	31.4	-	D	**39.5**	**-**	**E**	**61.3**	**-**	**F**	**53.3**	**-**	**F**
	PM	**>500.0**	**-**	**F**	**>500.0**	**-**	**F**	**>500.0**	**-**	**F**	**>500.0**	**-**	**F**
Sea Pines Traffic Circle													
Greenwood Drive Approach	AM	9.2	-	-	9.2	-	-	11.9	-	-	12.4	-	-
	NOON	17.2	-	-	18.1	-	-	32.5	-	-	31.9	-	-
	PM	13.5	-	-	14.5	-	-	23.0	-	-	21.1	-	-
Pope Avenue Approach	AM	7.5	-	-	7.5	-	-	9.4	-	-	9.6	-	-
	NOON	12.8	-	-	13.2	-	-	21.3	-	-	22.0	-	-
	PM	30.4	-	-	32.6	-	-	69.3	-	-	69.2	-	-
William Hilton Parkway/US 278 Business Approach	AM	10.2	-	-	10.6	-	-	14.5	-	-	14.8	-	-
	NOON	55.9	-	-	59.8	-	-	115.8	-	-	120.5	-	-
	PM	37.9	-	-	39.1	-	-	87.2	-	-	94.2	-	-
US 278/Palmetto Bay Road Approach	AM	28.6	-	-	32.0	-	-	66.5	-	-	72.4	-	-
	NOON	28.8	-	-	30.6	-	-	67.0	-	-	77.6	-	-
	PM	29.4	-	-	29.9	-	-	63.7	-	-	90.0	-	-

1. Calculations completed using the 2000 HCM methodology.
2. Delay in seconds-per-vehicle.
3. V/C = Volume-to-capacity ratio.
4. LOS = Level-of-Service.
5. Assumed occupancy of vacant office space on-site.
6. Removes all existing office traffic (Time Warner, Carolina/Sapalo & Kiawah and includes site-generated traffic.

GENERAL NOTES:

1. For unsignalized intersections, Delay is representative of critical movement/lane group/approach.
2. For signalized intersections, Delay is representative of over-all average of all approaches.
3. For round-a-bout, Delay is representative of each approach. No LOS is given, LMO indicates acceptable at a delay less than 150.0, unacceptable if delay greater than 150.0.

As shown in Table 5, under Existing traffic volume conditions, analysis for the signalized study area intersection of Pope Avenue at Office Park Road indicates over-all acceptable service levels during both peak hours (LOS C). Further detailed review of the analysis indicates that while the over-all LOS is acceptable, both the eastbound and westbound approaches (Office Park Road and New Orleans Drive respectively) operate at a LOS E during these same peak times. The main reasoning for this is the green-time splits between the main street movements (northbound and southbound on Pope Avenue) and the side streets. These splits logically favor the major street movements which results in some increased delays on the minor street approaches. In addition, the operations of this intersection for the minor streets are "split phased" which means that the eastbound approach (Office Park Road) operates under separate green-time from the westbound approach (New Orleans Road). This split phasing is due to the slight off-set of these two minor street approaches as well as lane geometry for the New Orleans Road approach.

The unsignalized intersection of Greenwood Drive at Office Park Road operates at a LOS F during the PM peak-hour and at a LOS D during the AM peak-hour. Delays at this intersection are due to the high volume of existing through traffic on Greenwood Drive as well as the minor street left-turn movement from Office Park Road to eastbound Greenwood Drive towards Sea Pines entry gates.

The operations of the Sea Pines Circle are as expected, with the greatest delays being during the Noon peak-hour followed by the PM peak-hour and the least delay during the AM peak-hour. Specifically, during the Noon time period, the approach is US 278 Business (William Hilton Parkway) presents the greatest delay (calculated delay of 55.9-seconds) however this delay is less that the maximum delay of 150-seconds for any approach of the traffic circle. In review of the over all operations of the Sea Pines circle under Existing conditions, all approaches during the respective AM, Noon and PM peak hours are less than the 150-second delay.

The Existing plus Office is basically the same as the prior described Existing conditions. The signalized intersection of Pope Avenue at Office Park Road/New Orleans Road operates at over-all LOS C during both peak-hours. Each approach to the Sea Pines Circle presents delays less than the 150-second maximum during each peak-hour studied and the unsignalized intersection of Greenwood Drive at Office Park Road now operates at a LOS E during the AM peak-hour (LOS D under AM Existing conditions) and will continue at the LOS F just as it had under Existing conditions.

Under future 2017 No-Build traffic volume conditions, which account for the addition of a normal annual growth (2.4% per-year), operations will basically remain the same as compared to Existing conditions. The signalized intersection of Pope Avenue at Office Park Road/New Orleans Road continues to operate at a LOS C during both peak hours. Each approach to the Sea Pines Circle presents delays less than the 150-second maximum and the unsignalized intersection of Greenwood Drive at Office Park Road will continue to operate at a LOS F during the PM peak-hour and will now decrease in service level to a LOS F during the AM peak-hour.

Under 2017 Build conditions, which include the subtraction of the existing office building traffic and addition of traffic related to the proposed new USC Hospitality and OLLI facilities, the signalized study area intersection of Pope Avenue at Office Park Road is expected to operate at an overall LOS C during the AM peak-hour and a LOS D during the PM peak-hour. For this intersection, project traffic causes an increase in both delay and volume-to-capacity (V/C) ratio as well as a change in service level during the PM peak-hour.

The Sea Pines Circle will continue to operate with approach delays less than 150-seconds. The greatest delay calculated is the US 278 Business approach during the NOON peak hour with a calculated delay of 120.5 seconds.

The unsignalized intersection of Greenwood Drive at Office Park Road will continue to operate at a LOS F during both peak hours just as it had under the No-Build scenario. A very slight decrease in delay is expected (AM peak-hour) due to the removal of the existing office traffic (Time Warner, Kiawah & Carolina/Sapelo buildings) however, the intersection will continue to operate at a LOS F during both the AM and PM peak-hours.

MITIGATION

The final phase of the analysis process is to identify mitigating measures which may either minimize the impact of the project on the transportation system or alleviate poor service levels not caused by the project. The following describes measures necessary to mitigate the project's impact.

Proposed Site Access Drives

The project proposes three access drives to/from Office Park Road west of Pope Avenue. Within the site, connectivity will be provided between these access drives as well as the parking areas/facilities on-site. The following provides the detailed lane geometrics and traffic control requirements as well as separation between access drives and adjacent intersections:

Western Site Access Drive

This access is to be located approximately 1,030-feet west of the signalized intersection of Pope Avenue (approx. 550-feet west of below referenced eastern site access) along Office Park Road. This drive will provide access to the main parking area on-site orientated towards the USC Hospitality facility. The following describes the suggested geometry for this proposed access:

- ***Northbound (Site Access) Approach:*** Construct site drive to provide a three-lane cross-section with one lane entering the site and two lanes exiting the site designated as a separate left-turn lane and a separate right-turn lane;

- ***Eastbound (Office Park Road) Approach:*** In accordance with Figure 15.5A of the SCDOT Design Manual, a separate right-turn lane at the site access is NOT warranted;

- ***Westbound (Office Park Road) Approach:*** In accordance with Figure 15.5F of the SCDOT Design Manual, a separate left-turn lane at the site access is NOT warranted; and

- ***Traffic Control:*** Place intersection under STOP sign control where vehicles exiting the site will be required to stop.

Central Site Access Drive

This access is to be located approximately 425-feet west of the signalized intersection of Pope Avenue (550-feet east of western site access) and 220-feet west of the Office Way intersection (existing three legged intersection). This drive will provide access to the drop-off/visitors parking area on-site. The following describes the suggested geometry for this proposed access:

- ***Northbound (Site Access) Approach:*** Construct site drive to provide a two-lane cross-section with one lane entering the site and one lane exiting the site designated as a shared left and right-turn lane;

- ***Eastbound (Office Park Road) Approach:*** In accordance with Figure 15.5A of the SCDOT Design Manual, a separate right-turn lane at the site access is NOT warranted;

- ***Westbound (Office Park Road) Approach:*** In accordance with Figure 15.5G of the SCDOT Design Manual, a separate left-turn lane at the site access is NOT warranted; and

- ***Traffic Control:*** Place intersection under STOP sign control where vehicles exiting the site will be required to stop.

Eastern Site Access Drive

This access is to be located approximately 250-feet west of the signalized intersection of Pope Avenue (800-feet east of Central Site Access) opposite the existing access of CVS (western CVS access). This drive will provide access to the parking area east of the proposed hospitality facility. The following describes the suggested geometry for this proposed access:

- ***Northbound (Site Access) Approach:*** Construct site drive to provide a two-lane cross-section with one lane entering the site and one lane exiting the site designated as a shared left and right-turn lane;

- ***Eastbound (Office Park Road) Approach:*** In accordance with Figure 15.5A of the SCDOT Design Manual, a separate right-turn lane at the site access is NOT warranted;

- ***Westbound (Office Park Road) Approach:*** In accordance with Figure 15.5G of the SCDOT Design Manual, a separate left-turn lane at the site access is NOT warranted; and

- ***Traffic Control:*** Place intersection under STOP sign control where vehicles exiting the site will be required to stop

It should be noted that the development of the site as planned would result in a net reduction of three curb-cuts along the site's frontage with Office Park Road. Currently six access drives exist which will be reduced to three access drives given the current development plan.

Sight Distance Considerations

All previously-cited access drive intersections should be designed/constructed to meet current applicable Town/SCDOT standards and/or guidelines in terms of sight distance. It is assumed that this will be the responsibility of the project's civil engineer and will be depicted by the site plan/submittal information.

<u>Off-Site Study Area Intersections</u>

As shown in Table 5, the expected traffic to be generated by the project results in a slight impact on the adjacent off-site intersection of Greenwood Drive at Office Park Road. Project impacts at the signalized intersection of Pope Avenue at Office Park Road/New Orleans Road are expected to be significant as this intersection. It is anticipated to serve the greatest volume of site-generated traffic being that the facility is orientating its "front door" towards this intersection. Based on this, the following mitigation is suggested in order to reduce impacts caused by the planned development.

Pope Avenue at Office Park Road/New Orleans Drive

Besides the high volumes of traffic that utilize this intersection, one of the capacity challenges that this intersection currently has is the split phase operations. This is due to the existing lane geometry of New Orleans Drive (left, shared left/through) as well as the off-set alignment of New Orleans Drive with Office Park Road. If these capacity constraints could be remedied, operations at this intersection could be drastically improved for the side street/minor approaches.

The existing intersection currently operates optimally given the traffic conditions (high volumes, signal phasing, geometry, etc.) that it serves. To enhance operations, geometric conditions must be changed. One improvement would be to relocate/align the eastbound and westbound approaches such that split phasing of the minor approaches would no longer be needed. This would require that either Office Park

Road be shifted to the north towards the CVS Pharmacy or New Orleans Drive be shifted to the south towards the Compass Rose Park (Town of Hilton Head Island Park), or a combination of the two.

Shifting Office Park Road to the north is unlikely due to the existing CVS location being in the northwest corner of the intersection. Shifting New Orleans Road to the south may be possible being that the Town owns the property in the southeast quadrant of this intersection.

Further review of the feasibility to enhance this intersection should be investigated but if possible, the following improvements should be competed for this intersection:

1. **Westbound Approach (New Orleans Drive)**: Re-align roadway approach to Pope Avenue to the south to align with the opposing approach of Office Park Road. Cross-section of New Orleans Road should provide a 5-lane cross-section with one lane departing the intersection, and four lanes approaching Pope Avenue designated as two separate left-turn lanes, a through lane and a separate right-turn lane. Given that the separation between Pope Avenue and the knuckle curve in New Orleans Road is approximately 270-feet, it is suggested that the 5-lane cross-section be maximized along this length/section of New Orleans Road.

2. **Eastbound Approach (Office Park Road)**: Align roadway approach with the suggested alignment of the New Orleans Drive approach; left-turn lane(s) as well as through lanes must align. Suggested cross-section for Office Park Road includes a single lane departing the intersection (must align with the through lane from New Orleans Drive), a median and then separate left-turn lane (left-turn lane must align with #2 left-turn lane from New Orleans Drive approach in order to avoid "split signal phasing"), a through lane (aligned with New Orleans Drive departing through lane) and a separate right-turn lane. Suggested storage length for the left-turn lane is 100-feet. Taper will depend on the method chosen to widen Office Park Road whether it is symmetrical or a-symmetrical. The separate right-turn lane should provide a storage length of 150-feet with a 120-foot taper.

3. **Southbound Approach (Pope Avenue)**: The existing left-turn pocket has a length of approximately 120-feet. This length is short and does not meet current standards. If possible, lengthen the storage length of this lane to 200-feet (grassed/treed median will be impacted). If feasible, construct a separate right-turn lane along the frontage of the CVS. Due to the CVS right-in/right-out access (130-feet to the north), this lane and taper would be shorter than standard. Suggest 100-foot lane and maximize taper length. This right-turn lane must continue to accommodate the multi-use bike/pedestrian path that parallels Pope Avenue.

4. **Northbound Approach (Pope Avenue):** Existing geometry, cross-section and left-turn lane storage lengths are all adequate, no improvements are suggested at this time.

5. **Traffic Control**: Maintain the signal coordination for this intersection and enhance operations by removing the split phasing for the eastbound and westbound approaches. Protected only phasing will be required for the westbound dual left-turn lanes which when aligned properly, can operate concurrently with the eastbound left-turn lane (potential protected/permissive phasing). Operate with right-turn over-lap phases where appropriate.

Implementation of these improvements indicates that service levels will be improved to an over-all LOS B (delay=18.8 sec., V/C=0.41) during the AM peak-hour and a LOS C (delay=25.5 sec., V/C=0.67) during the PM peak-hour. One of the biggest enhancements that is anticipated with these improvements are that the two minor street approaches (Office Park Road and New Orleans Drive) no longer have an

approach or lane group, that operates at a LOS E as with current conditions; they are now anticipated at a LOS D or better.

Greenwood Drive at Office Park Road

This unsignalized intersection is located approximately 1,000-feet east of the Sea Pines Circle. Greenwood Drive serves as the main access to/from Sea Pines PUD (420-feet to the west) and as well as provides access to the commercial uses located on both the north and south sides of Greenwood Drive. As indicated previously, traffic entering Sea Pines Circle to the east and traffic entering Sea Pines PUD to the west can cause queue constraints across this intersection causing increments of gridlock conditions.

This intersection currently provides a four-lane divided cross-section (two through lanes in each direction separated by a 18-ft grassed median) as well as separate turning lanes on all approaches for traffic both entering and exiting Office Park Road. Opportunities for improvements at this intersection are limited due to multiple full-movement access drives located along Greenwood Drive as well as the proximities of both the Sea Pines PUD main gate and the Sea Pines Circle.

In order to improve operations at this intersection, geometric modifications are recommended which will aid in vehicular circulation as well as improve storage lanes for vehicles entering and exiting Office Park Road. The following improvements are suggested for this intersection (See Appendix for concept.):

1. **Northbound Approach (Office Park Road):** Reconstruct and extend the existing raised delta median that separates the left-turn movement from the right-turn movement approximately 8-feet. This will allow the STOP bar to be moved ahead towards Greenwood Drive (also by approximately 8-feet). Place right-turn movements from Office Park Road to eastbound Greenwood Drive under STOP sign control.

2. **Landscaped Median with Greenwood Drive:** Modify median noses as needed in order to provide/sufficient adequate vehicular turning radius.

3. **Office Park Road Median Cross-Over:** Provide a stripped median within the median break/cross-over of this intersection so that left-turn movements entering Office Park Road from eastbound Greenwood Drive and northbound left-turns from Office Park Road to eastbound Greenwood Drive are provided separate/channelized storage lanes/areas. This will result in an eastbound left-turn storage lane (eastbound Greenwood Drive to southbound Office Park Road) of approximately 100-feet and an eastbound acceleration lane for minor street left-turns (northbound Office Park Road to eastbound Greenwood Drive) of approximately 120-feet.

4. **Eastbound Approach (Greenwood Drive):** Install RIGHT-TURN ONLY signage and striping for the separate right-turn lane entering Office Park Road. Suggest adding the pavement marking ONLY to the existing right-turn lane arrow.

It should be noted that operations at the Greenwood Drive at Office Park Road intersection are currently failing under Existing conditions and are expected to remain at a LOS F under all scenarios studied. The proposed USC/OLLI facility is not the causes of the poor operations at this intersection but as identified, it is the volume of through traffic on Greenwood Drive which is impacting the left-turn movements entering and exiting Office Park Road. The above recommended improvements for this intersection are not expected to improve service levels, but will enhance vehicular circulation and turning movements entering and exiting Office Park Road and Greenwood drive by enhancing driver direction, storage lanes and traffic control.

SUMMARY

SRS has completed an analysis of the proposed development of a new USC Hospitality and OLLI Education facility to be located on the south side of Office Park Road just west of Pope Avenue on Hilton Head Island, SC. As proposed, these two facilities will provide a total of 45,083 sf with a student count of 400-students between the two facilities in 2017. The location of these two educational facilities will be on six land parcels of which four are currently developed as the Time Warner Office, Carolina/Sapelo Office and the Kiawah Office Buildings which total 56,965 sf of office space. These existing office buildings will be razed as part of this planned development. Development of the new USC and OLLI facilities are expected to occur over an 18-month period with completion expected in 2017.

The planned development of the USC Hospitality and OLLI facilities will replace the existing development on-site (56,965 sf) as well as the potential of up to 89,800-sf of development which is allowed under existing zoning. When comparing the expected traffic generation for the USC Hospitality and OLLI facility to the existing zoning potential there is a significant difference in development square-footage (USC Hospitality and OLLI facility is 44,717 sf less) and there is a measurable difference in traffic generation: 250 less daily trips, 19 and 7 less for respective AM and PM peak-hour trips.

Recommendations have been made regarding the front door intersection of Pope Avenue at Office Park Road/New Orleans Road which will enhance operations at this intersection. These improvements will require the re-location of New Orleans Road to align opposite Office Park Road as well as widening of both the westbound of New Orleans Road, the eastbound Office Park Road and if possible the southbound Pope Avenue approaches. With these improvements, a significant increase in capacity is expected at this intersection, which will improve operations for the two minor street approaches. These improvements will more than off-set any impact caused by the planned facility at this intersection.

Enhancements recommendations for the Greenwood Drive at Office Park Road intersection have also been made which will aid in vehicular circulation, driver direction and traffic control. While operations at this intersection will continue to be poor, these operations are not caused by the planned project but are rather the result of existing traffic along Greenwood Drive and Office Park Road.

Recommendations for the three access drives along Office Park Road have been made which will provide access to both the USC Hospitality and OLLI facilities. This planning will resulted in the net reduction of three access drives along the southerly curb-face of Office Park Road.

If you have any questions or comments regarding any information contained within this report, please contact me at (803) 361 3265.

Regards,

Todd E. Salvagin

SRS ENGINEERING, LLC
Todd E. Salvagin
Principal

Attachments

N

NOT TO SCALE

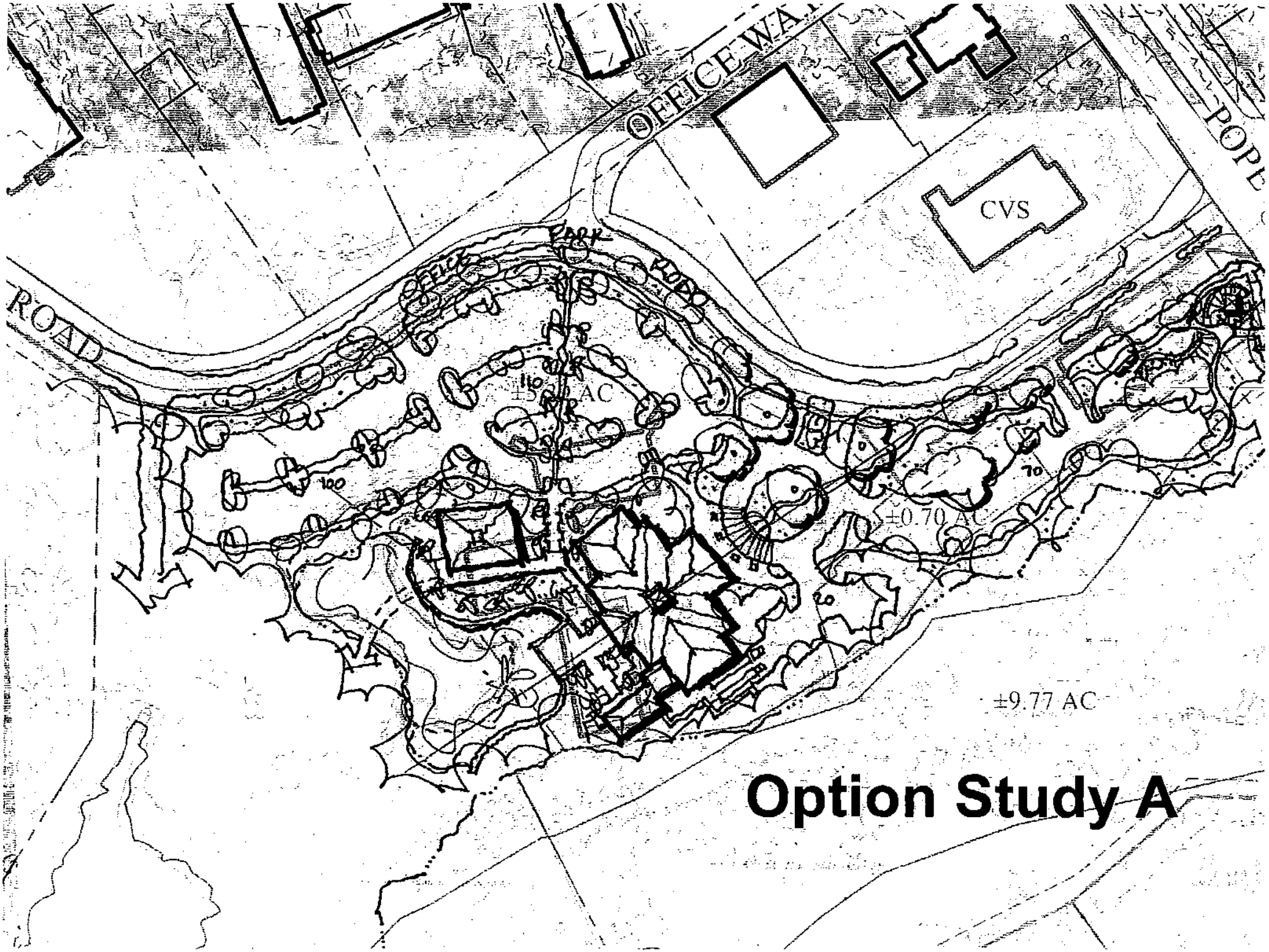
Figure 1

SITE LOCATION MAP

USC Hospitality& OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING

Traffic, Transportation, & Parking Consultants



Option Study A

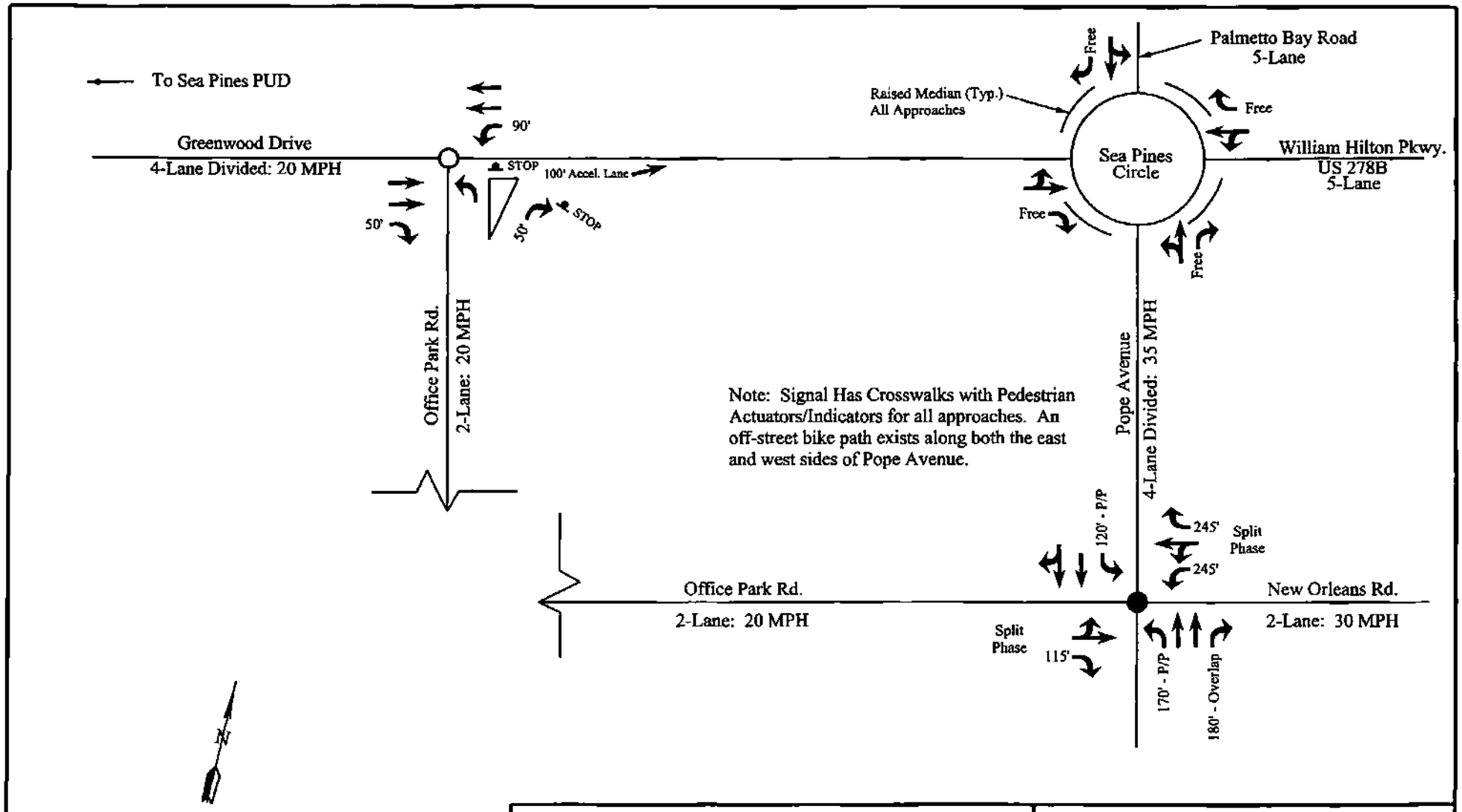


Figure 3

EXISTING GEOMETRY & TRAFFIC CONTROL

Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants

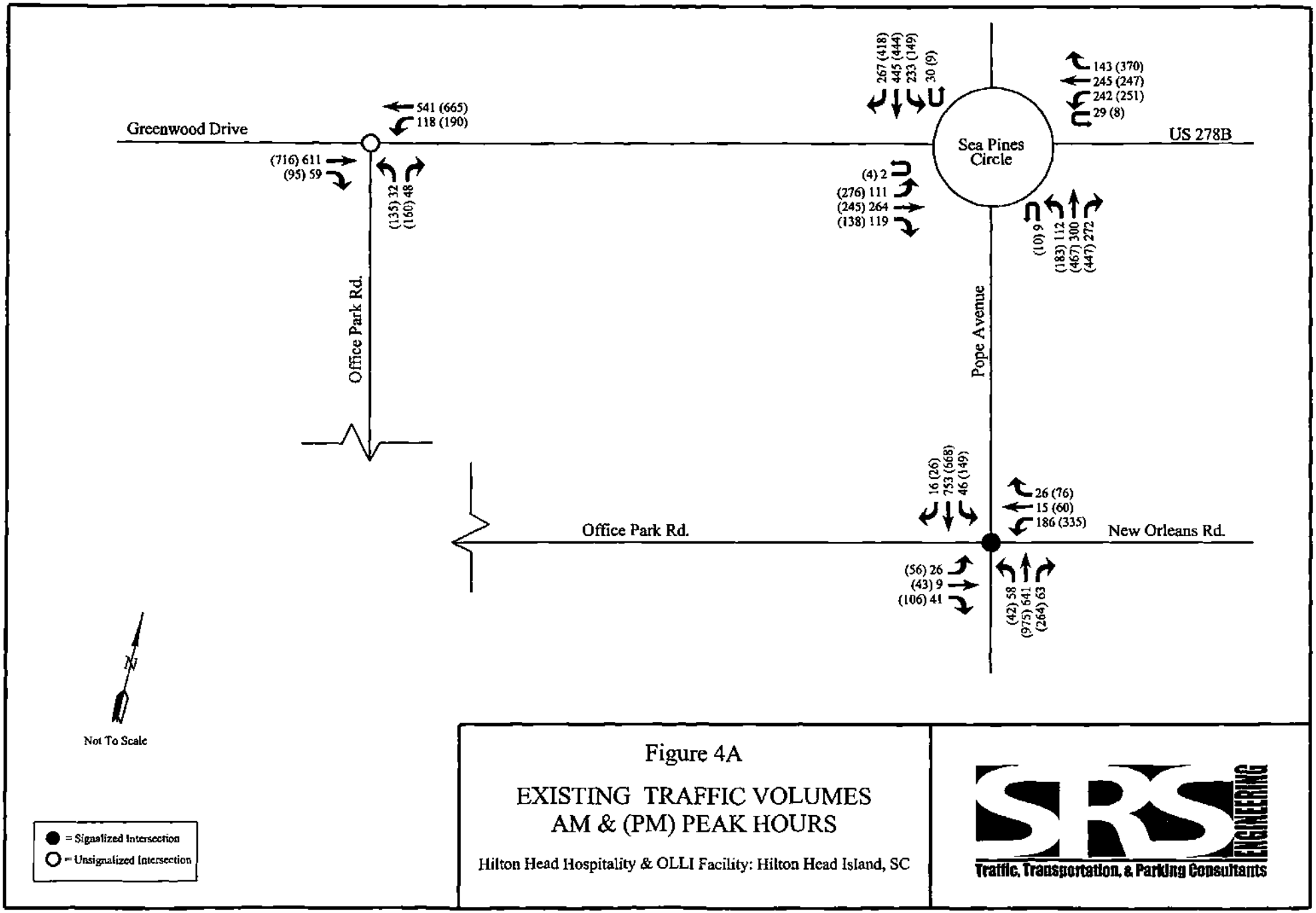
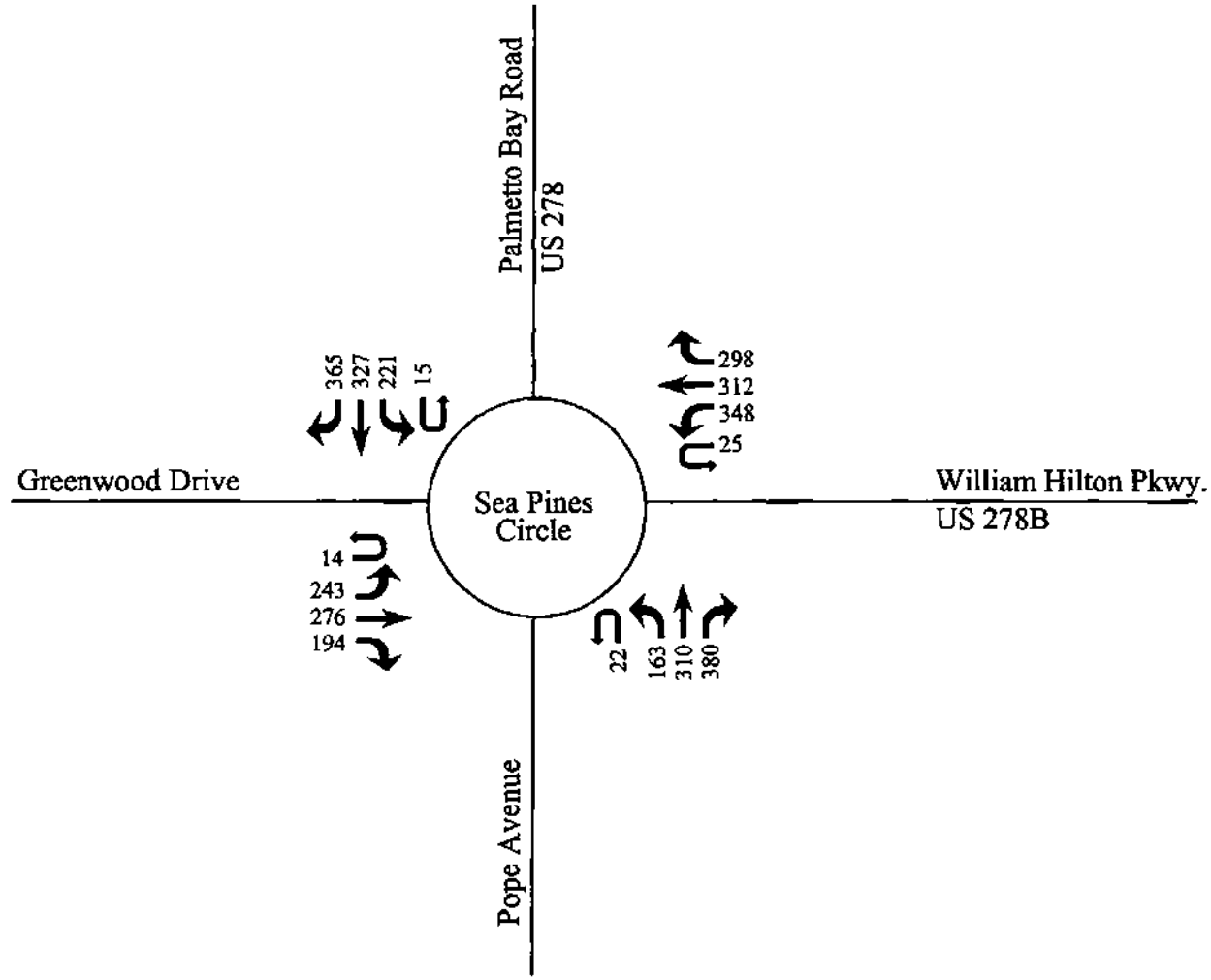


Figure 4A

EXISTING TRAFFIC VOLUMES
AM & (PM) PEAK HOURS

Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants



Not To Scale

● = Signalized Intersection
○ = Unsignalized Intersection

Figure 4B

EXISTING TRAFFIC VOLUMES
NOON PEAK HOUR

Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants

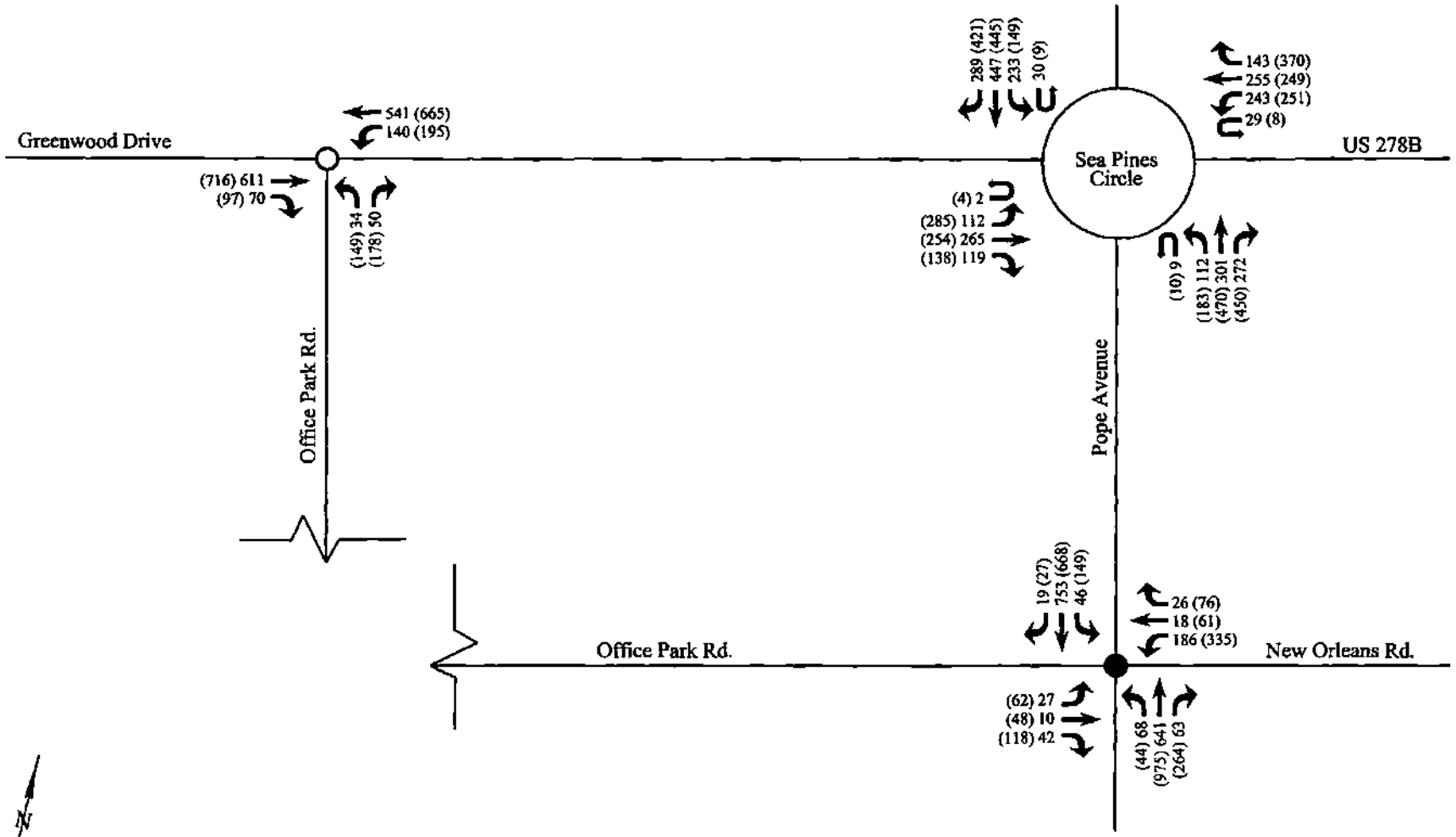
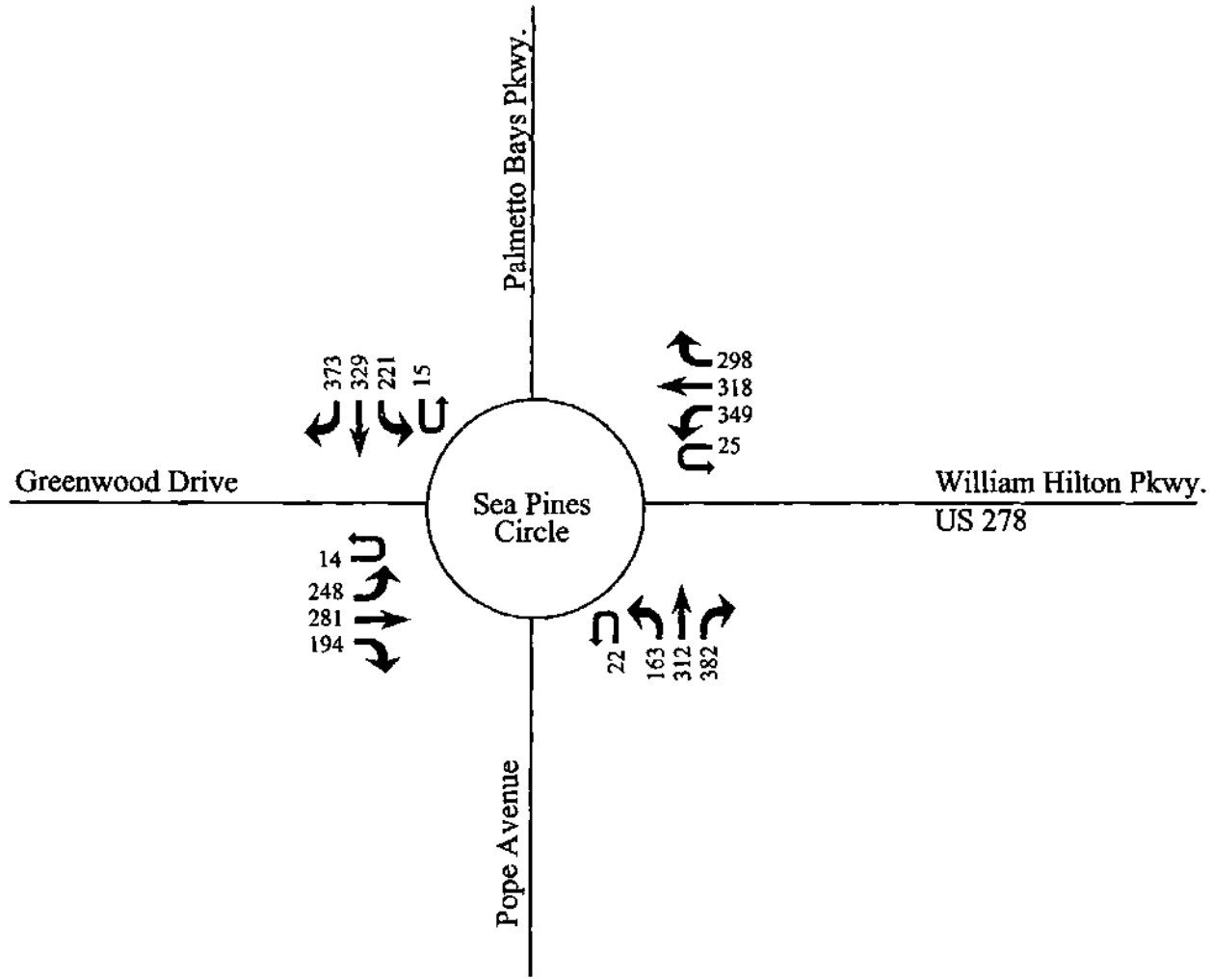


Figure 4C
EXISTING TRAFFIC VOLUMES
PLUS OFFICE VACANCIES
AM & (PM) PEAK HOURS

Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants



Not To Scale

● = Signalized Intersection
○ = Unsignalized Intersection

Figure 4D
EXISTING TRAFFIC VOLUMES
PLUS OFFICE VACANCIES
NOON PEAK HOUR
Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants

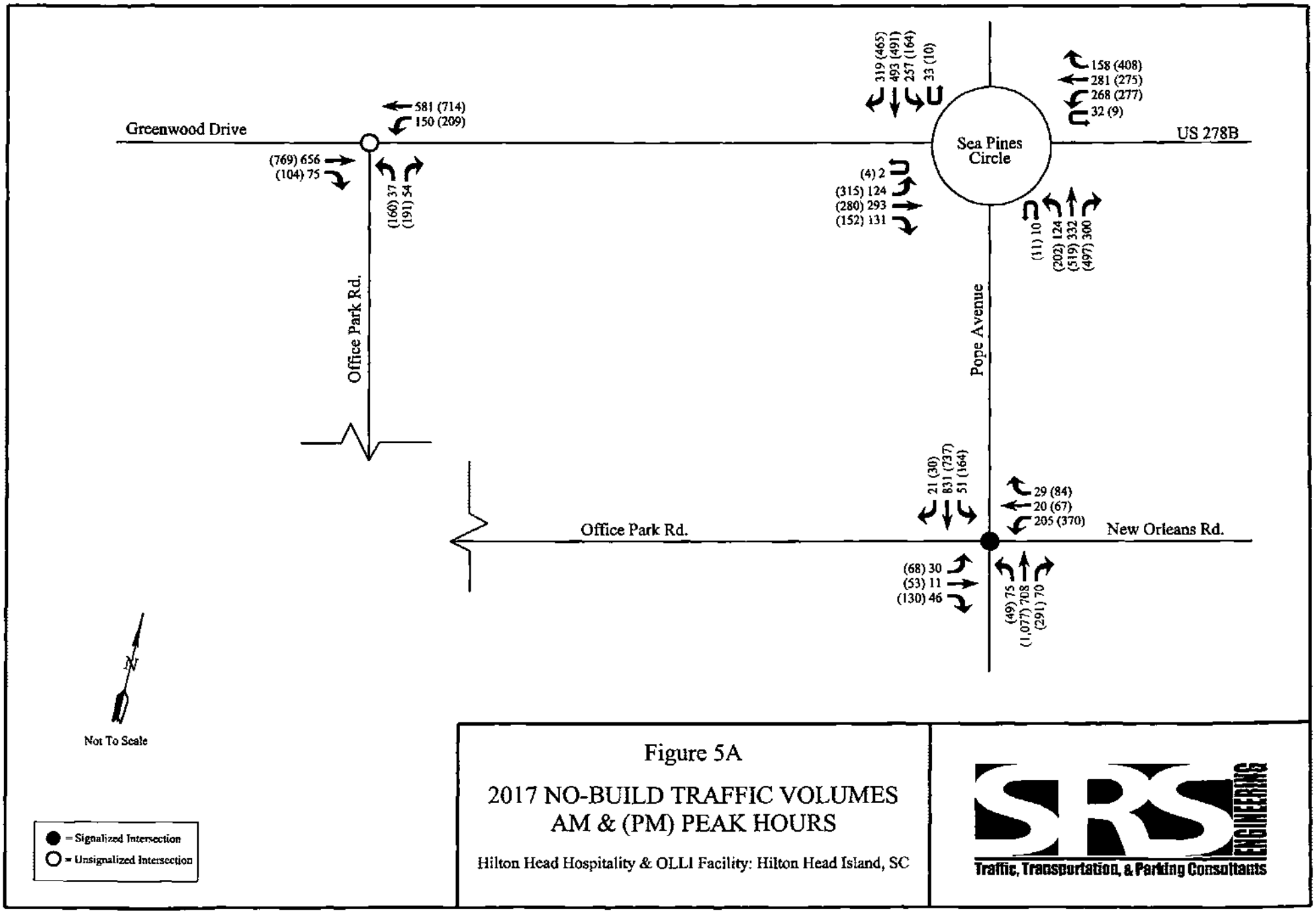
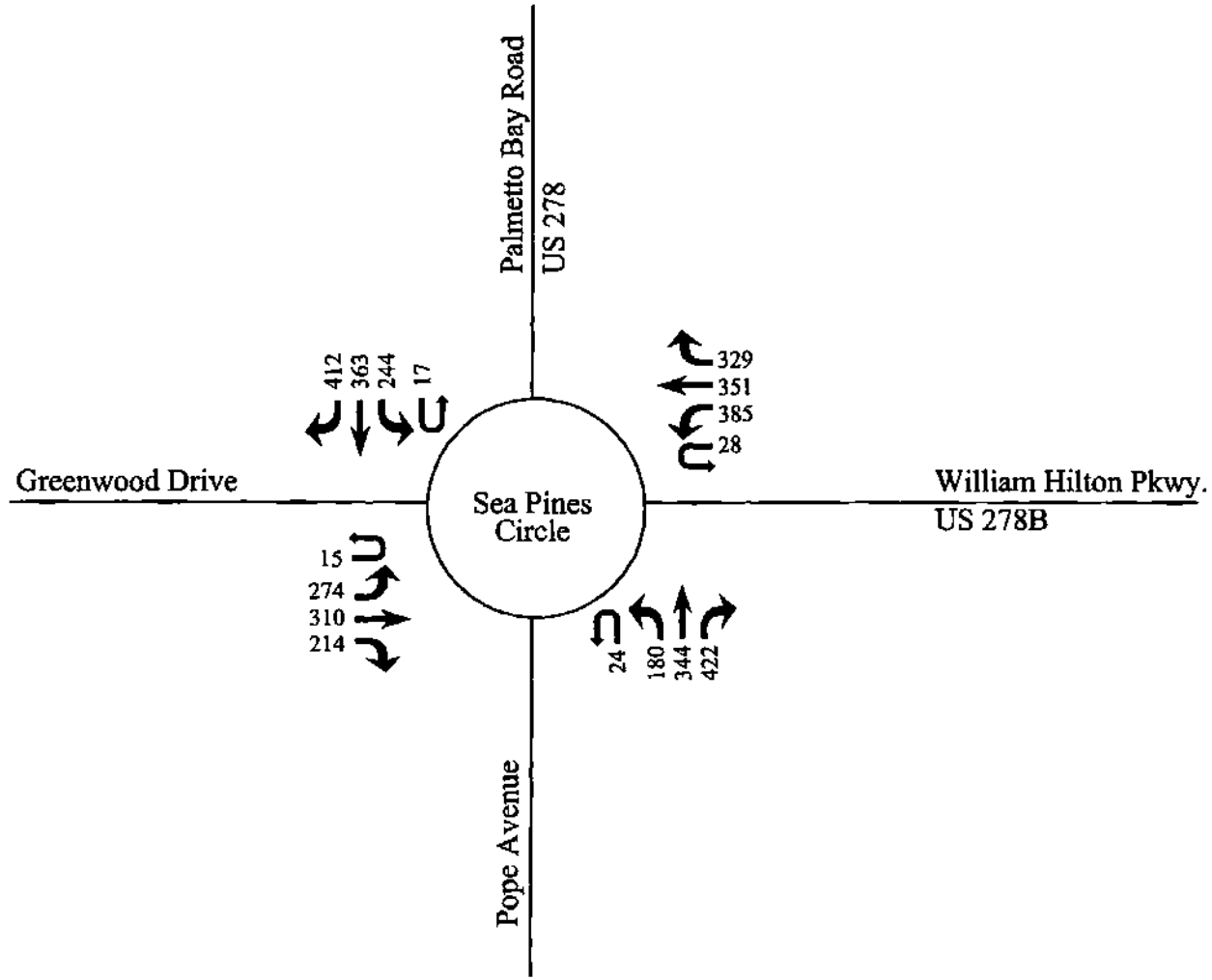


Figure 5A

2017 NO-BUILD TRAFFIC VOLUMES
AM & (PM) PEAK HOURS

Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants



Not To Scale

● = Signalized Intersection
○ = Unsignalized Intersection

Figure 5B

2017 NO-BUILD TRAFFIC VOLUMES
NOON PEAK HOUR

Hilton Head Hospitality & OLLI Facility; Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants

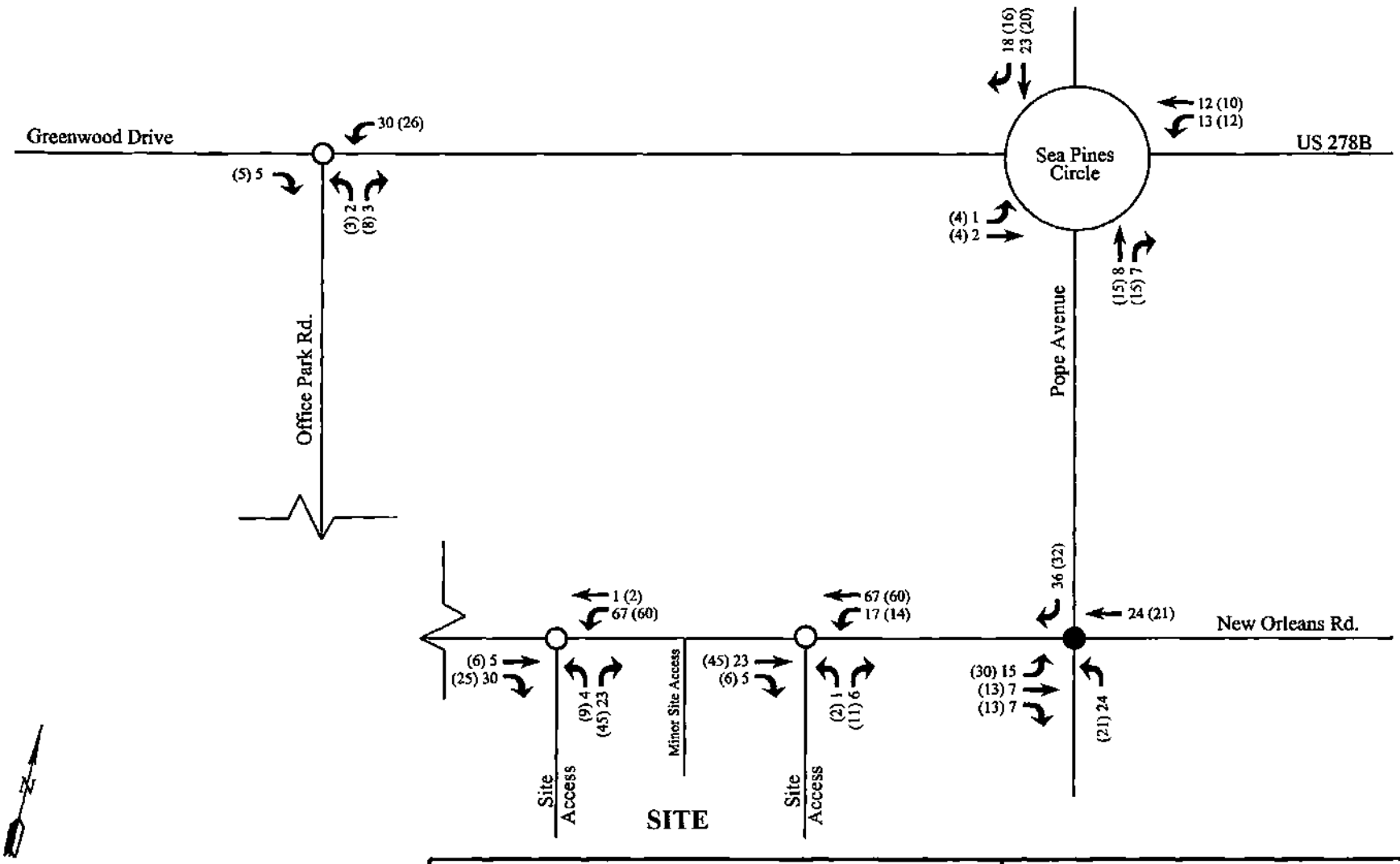
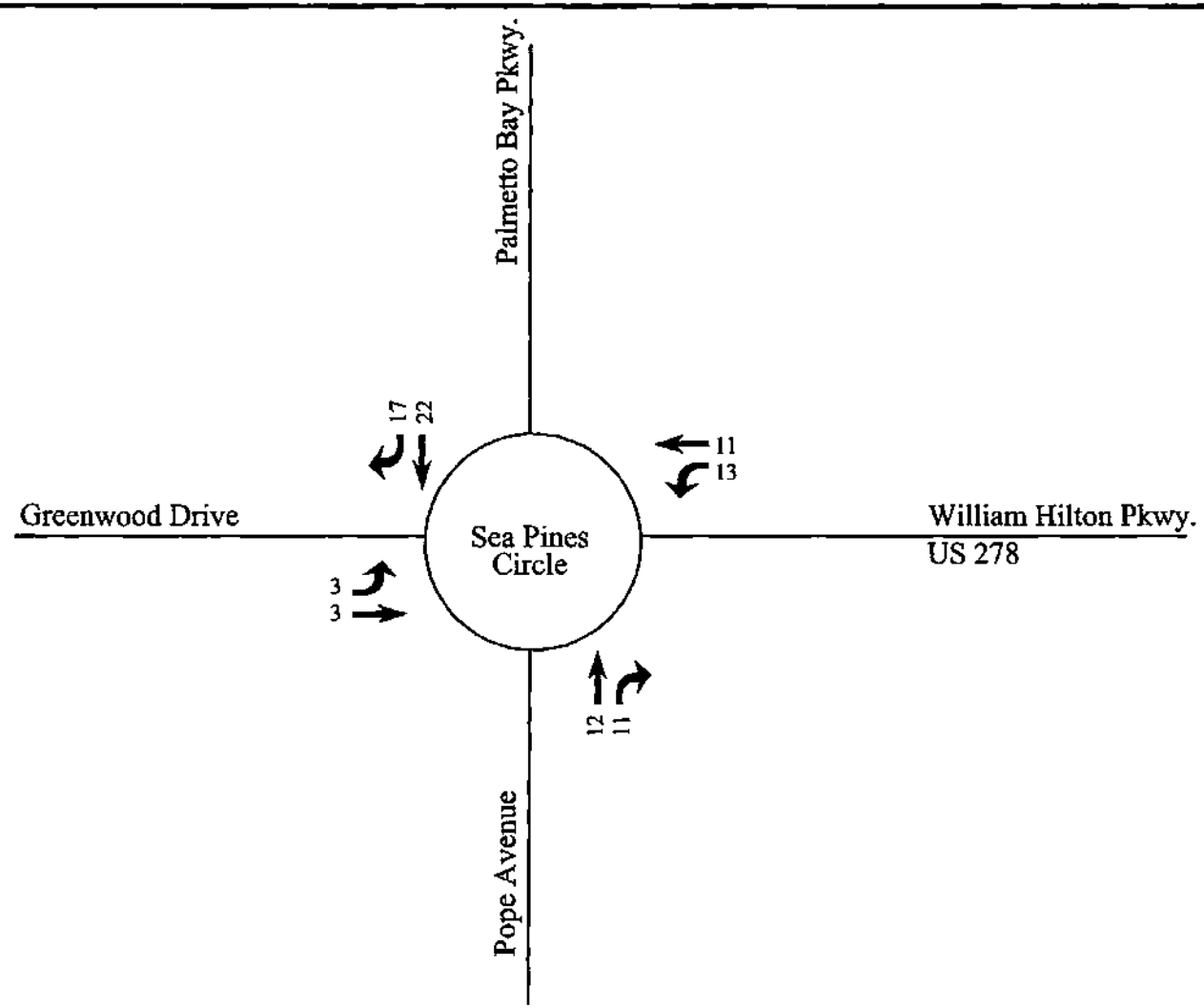


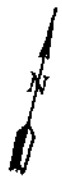
Figure 6A

SITE-GENERATED TRAFFIC VOLUMES
AM & (PM) PEAK HOURS

Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants





Not To Scale

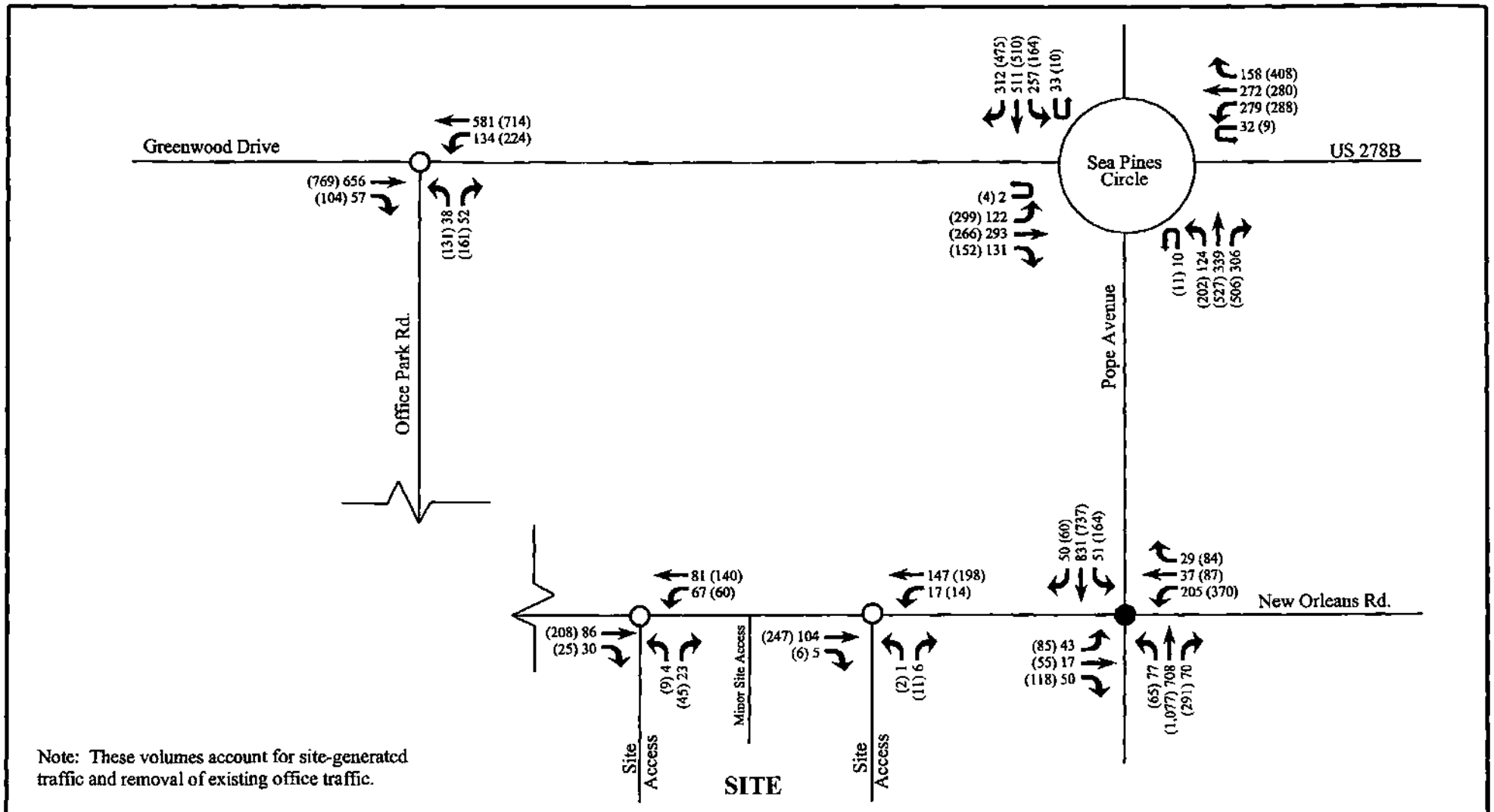
● = Signalized Intersection
○ = Unsignalized Intersection

Figure 6B

SITE-GENERATED TRAFFIC VOLUMES
NOON PEAK HOUR

Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants



Note: These volumes account for site-generated traffic and removal of existing office traffic.

● = Signalized Intersection
○ = Unsignalized Intersection

N

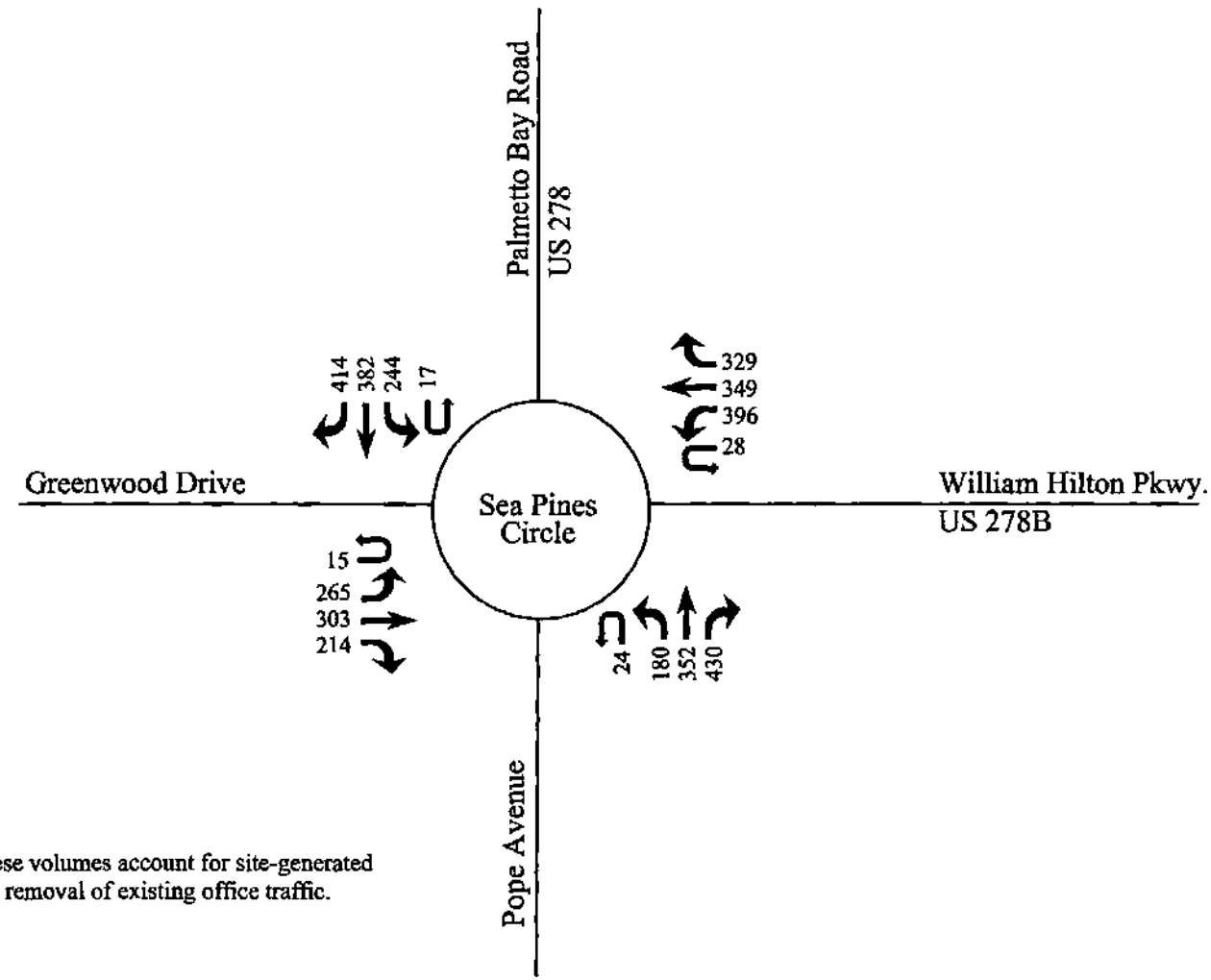
Not To Scale

Figure 7A

2017 BUILD TRAFFIC VOLUMES
AM & (PM) PEAK HOURS

Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants



Note: These volumes account for site-generated traffic and removal of existing office traffic.

Not To Scale

● = Signalized Intersection
○ = Unsignalized Intersection

Figure 7B

2017 BUILD TRAFFIC VOLUMES
NOON PEAK HOUR

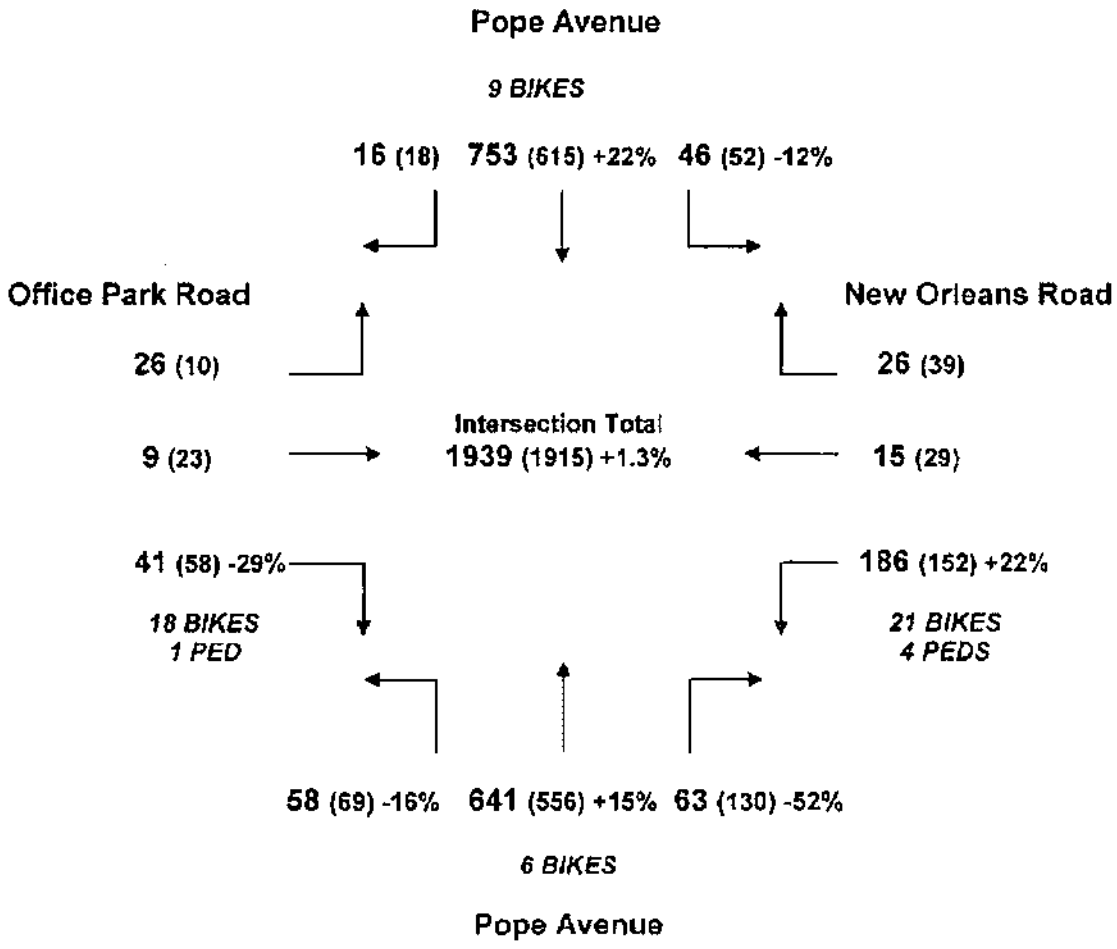
Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants

TRAFFIC VOLUME DATA

Pope Avenue with New Orleans Road and Office Park Road

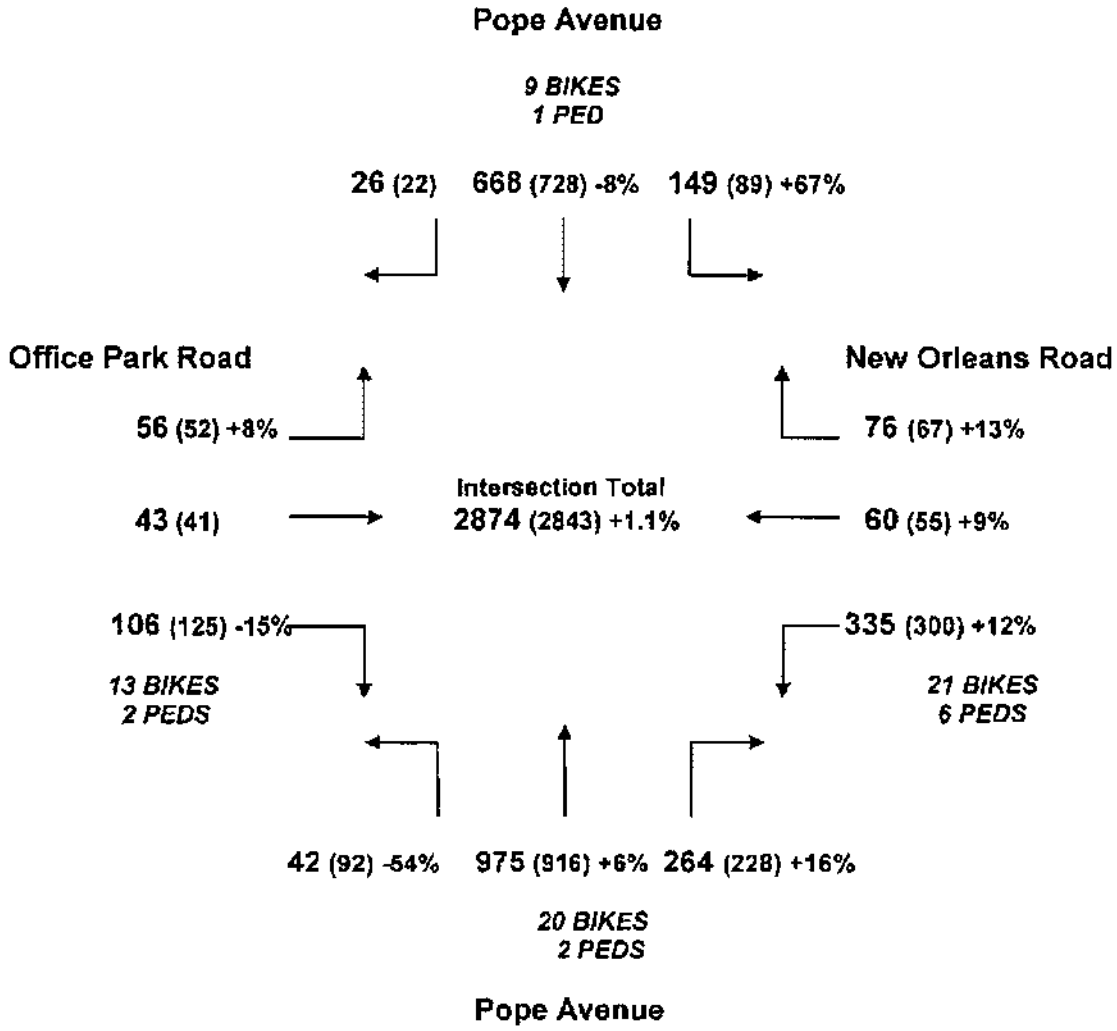
A.M. PEAK HOUR - (7:30 to 8:30 a.m. – Thu. 6/6/13)



2013 (2012) %chg

Pope Avenue with New Orleans Road and Office Park Road

P.M. PEAK HOUR - (4:15 to 5:15 p.m. – Thu. 6/6/13)



2013 (2012) %chg

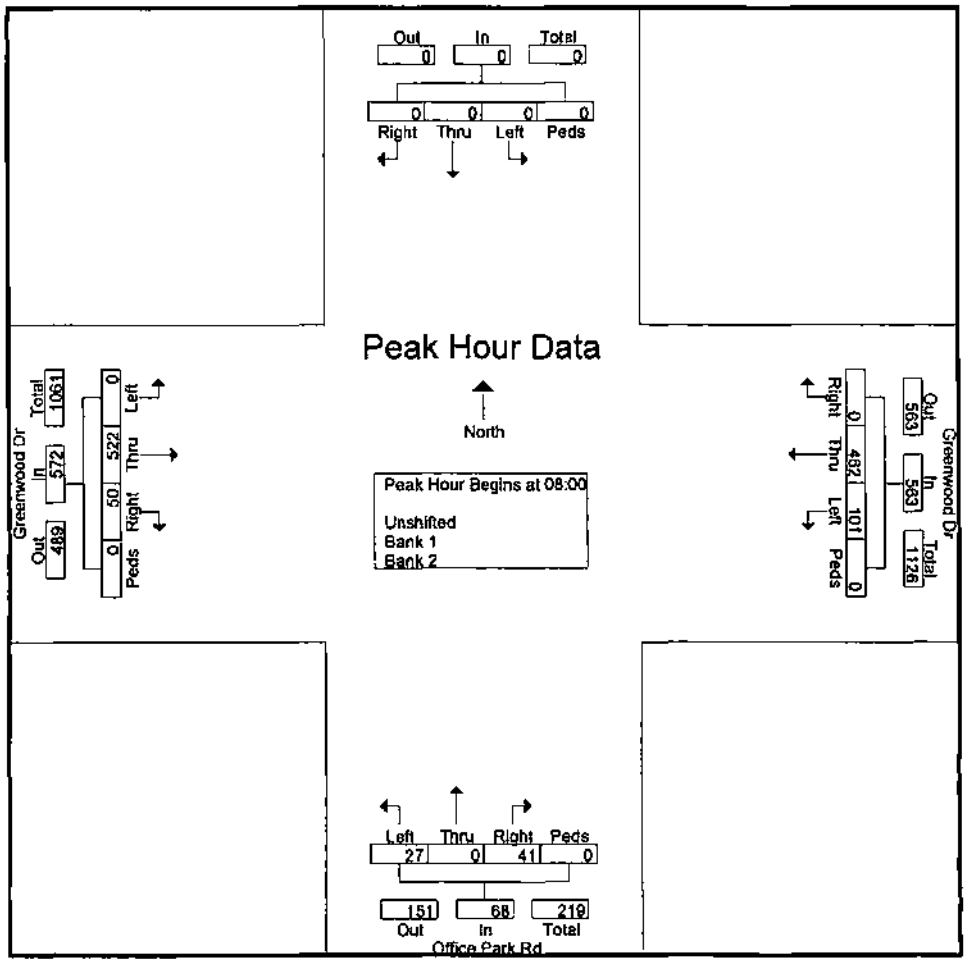
Short Counts

735 Maryland St
Columbia, SC 29201
You can Count on us!

Default Comments
Change These in The Preferences Window
Select File/Preference in the Main Scree
Then Click the Comments Tab

File Name : Greenwood Dr @ Office Park Dr
Site Code : 00022014
Start Date : 2/20/2014
Page No : 3

	Southbound					Greenwood Dr Westbound					Office Park Rd Northbound					Greenwood Dr Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 08:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00																					
08:00	0	0	0	0	0	19	106	0	0	125	6	0	11	0	17	0	118	11	0	129	271
08:15	0	0	0	0	0	17	93	0	0	110	6	0	6	0	12	0	114	12	0	126	248
08:30	0	0	0	0	0	32	125	0	0	157	5	0	11	0	16	0	129	6	0	135	308
08:45	0	0	0	0	0	33	138	0	0	171	10	0	13	0	23	0	161	21	0	182	376
Total Volume	0	0	0	0	0	101	462	0	0	563	27	0	41	0	68	0	522	50	0	572	1203
% App. Total	0	0	0	0		17.9	82.1	0	0		39.7	0	60.3	0		0	91.3	8.7	0		
PHF	.000	.000	.000	.000	.000	.765	.837	.000	.000	.823	.675	.000	.788	.000	.739	.000	.811	.595	.000	.786	.800



Short Counts

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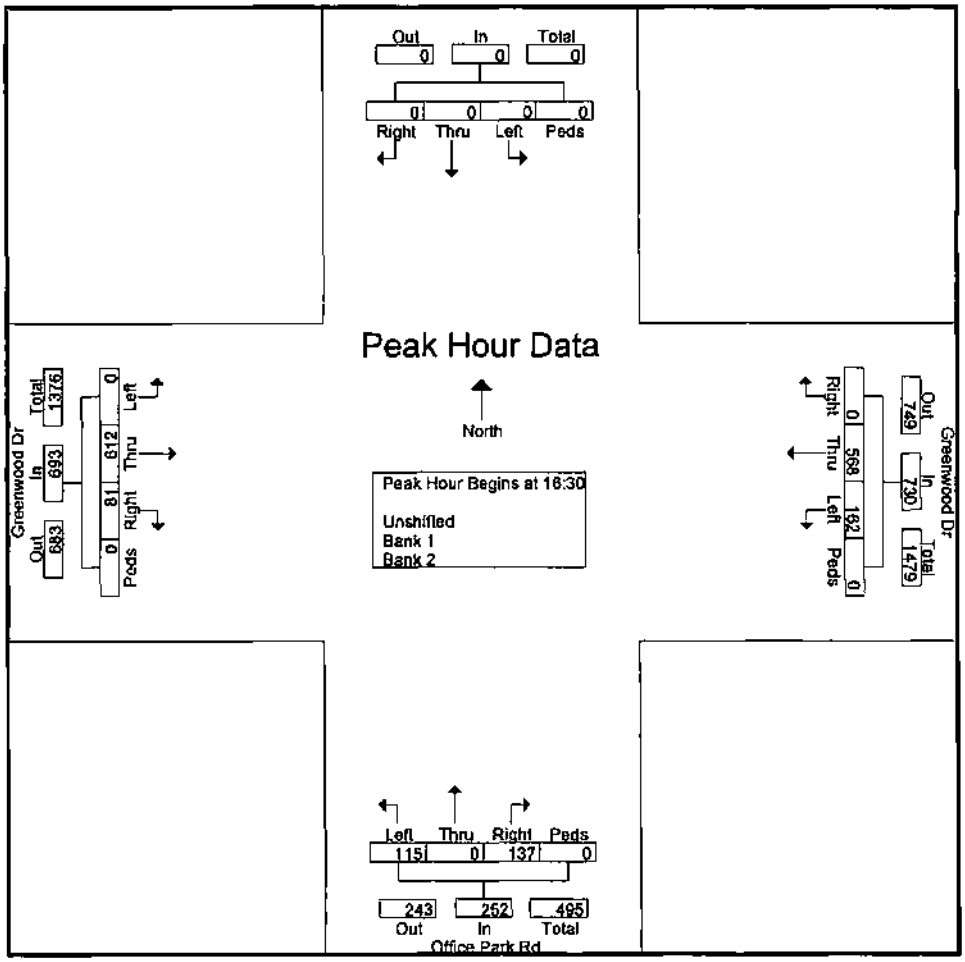
Default Comments
Change These in The Preferences Window
Select File/Preference in the Main Scree
Then Click the Comments Tab

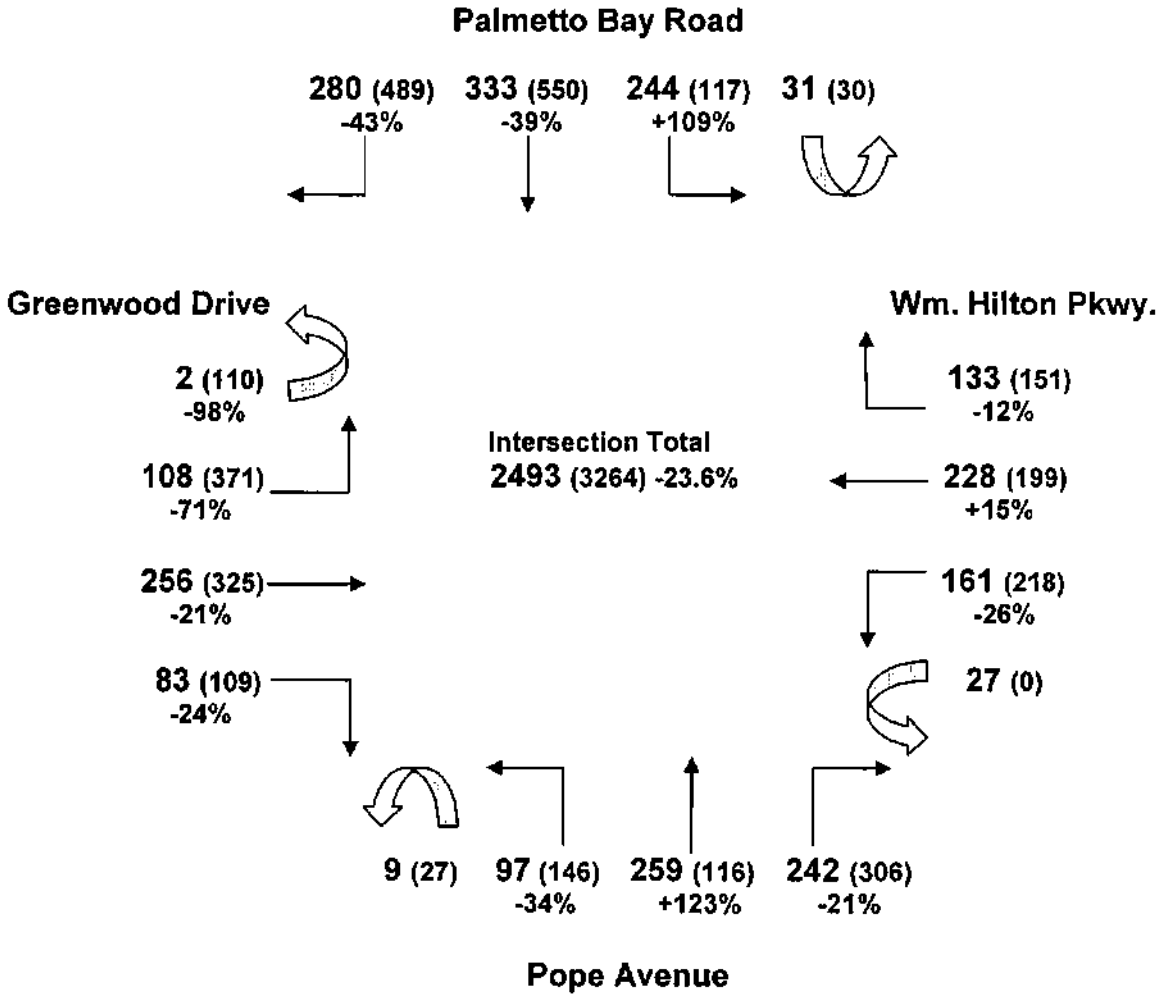
File Name : Greenwood Dr @ Office Park Dr
Site Code : 00022014
Start Date : 2/20/2014
Page No : 4

	Southbound					Greenwood Dr Westbound					Office Park Rd Northbound					Greenwood Dr Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 16:00 to 17:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:30																					
16:30	0	0	0	0	0	31	143	0	0	174	27	0	33	0	60	0	138	20	0	158	392
16:45	0	0	0	0	0	39	150	0	0	189	26	0	30	0	56	0	161	19	0	180	425
17:00	0	0	0	0	0	46	139	0	0	185	31	0	39	0	70	0	144	16	0	160	415
17:15	0	0	0	0	0	46	136	0	0	182	31	0	35	0	66	0	169	26	0	195	443
Total Volume	0	0	0	0	0	162	568	0	0	730	115	0	137	0	252	0	612	81	0	693	1675
% App. Total	0	0	0	0		22.2	77.8	0	0		45.6	0	54.4	0		0	88.3	11.7	0		
PHF	.000	.000	.000	.000	.000	.880	.947	.000	.000	.966	.927	.000	.878	.000	.900	.000	.905	.779	.000	.888	.945



Sea Pines Circle

A.M. PEAK HOUR (8:00 to 9:00 a.m. – Thu. 6/10/10)

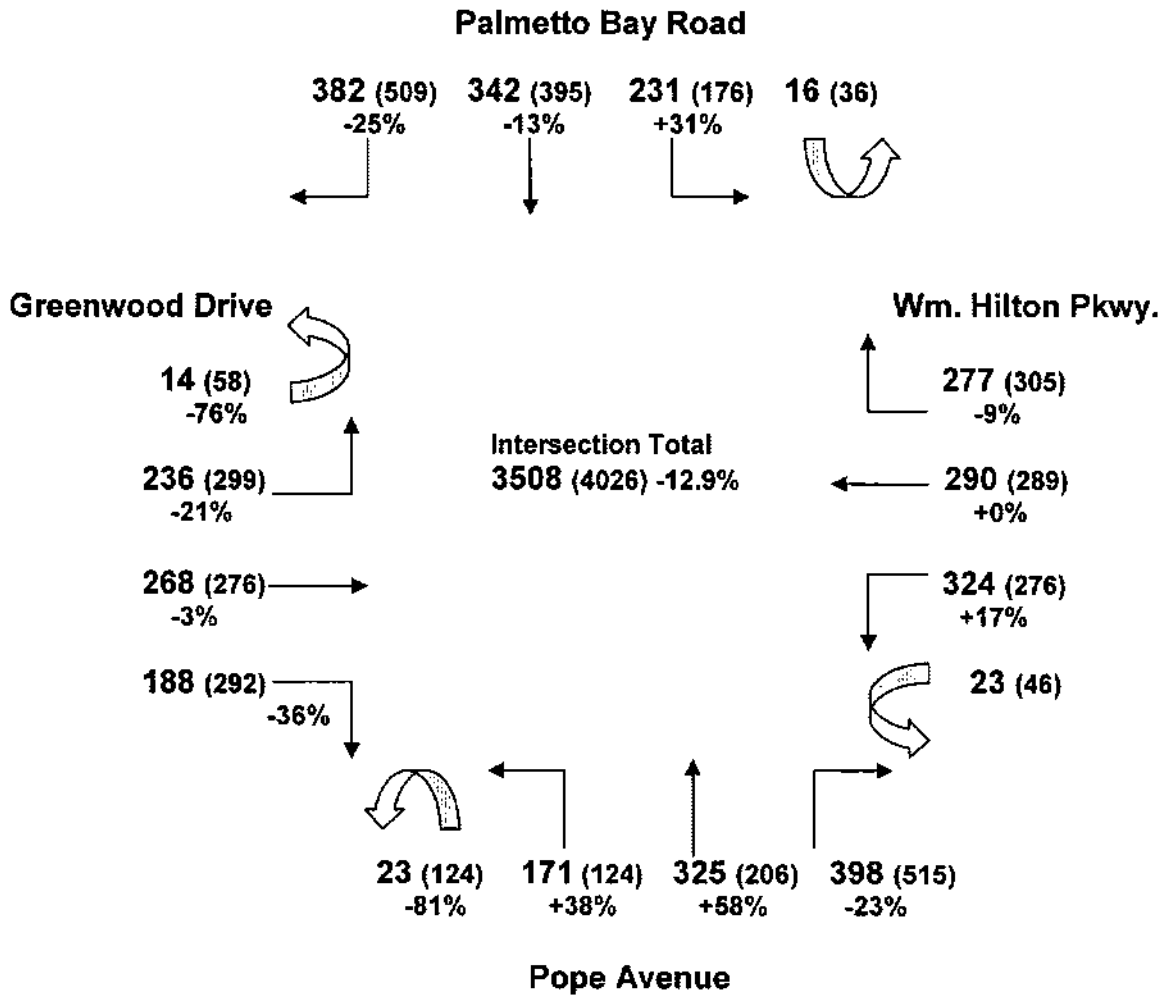


NO PEDS RECORDED

2010 (2005) 5-year %chg

Sea Pines Circle

MIDDAY PEAK HOUR (11:30 a.m. to 12:30 p.m. – Thu. 6/10/10)

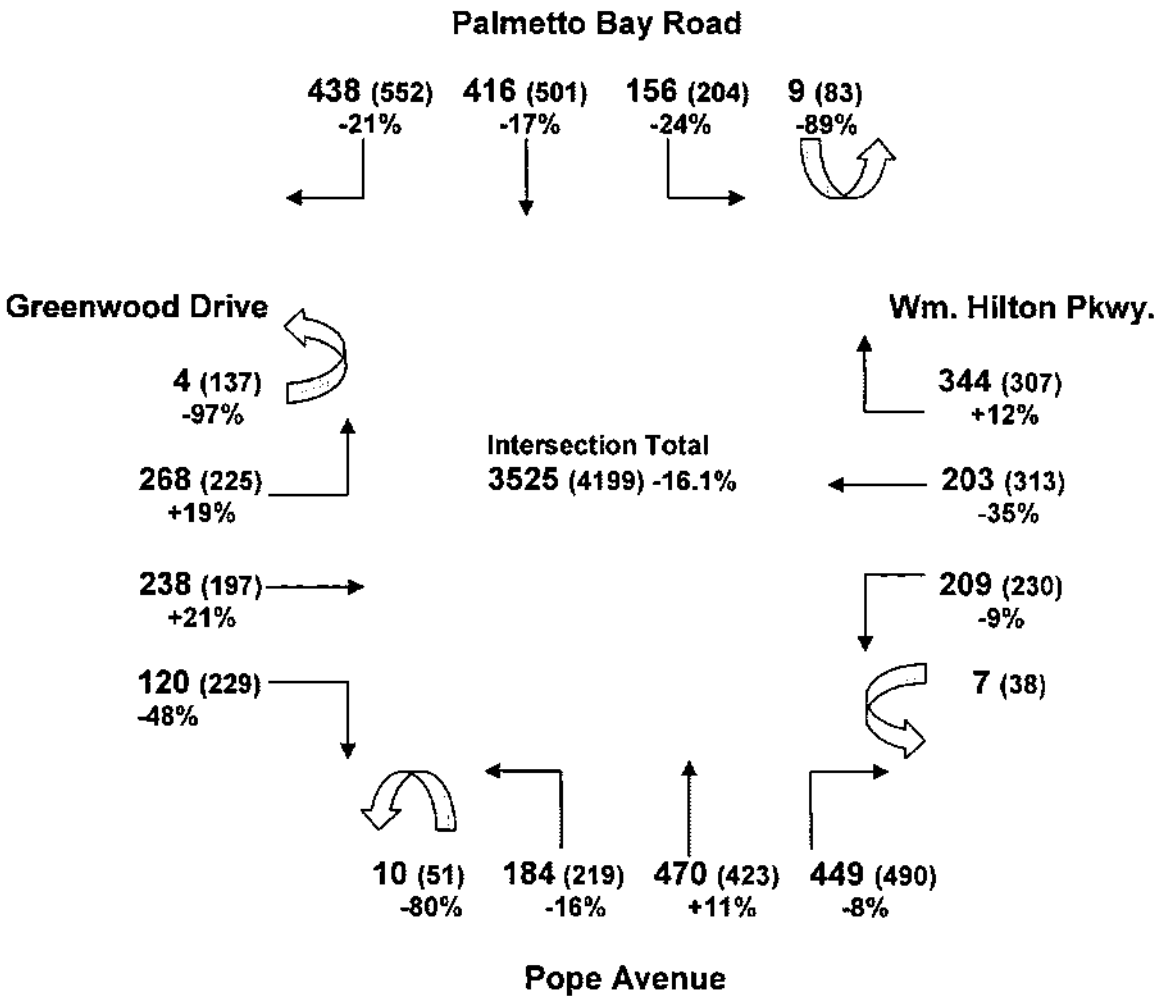


NO PEDS RECORDED

2010 (2005) 5-year %chg

Sea Pines Circle

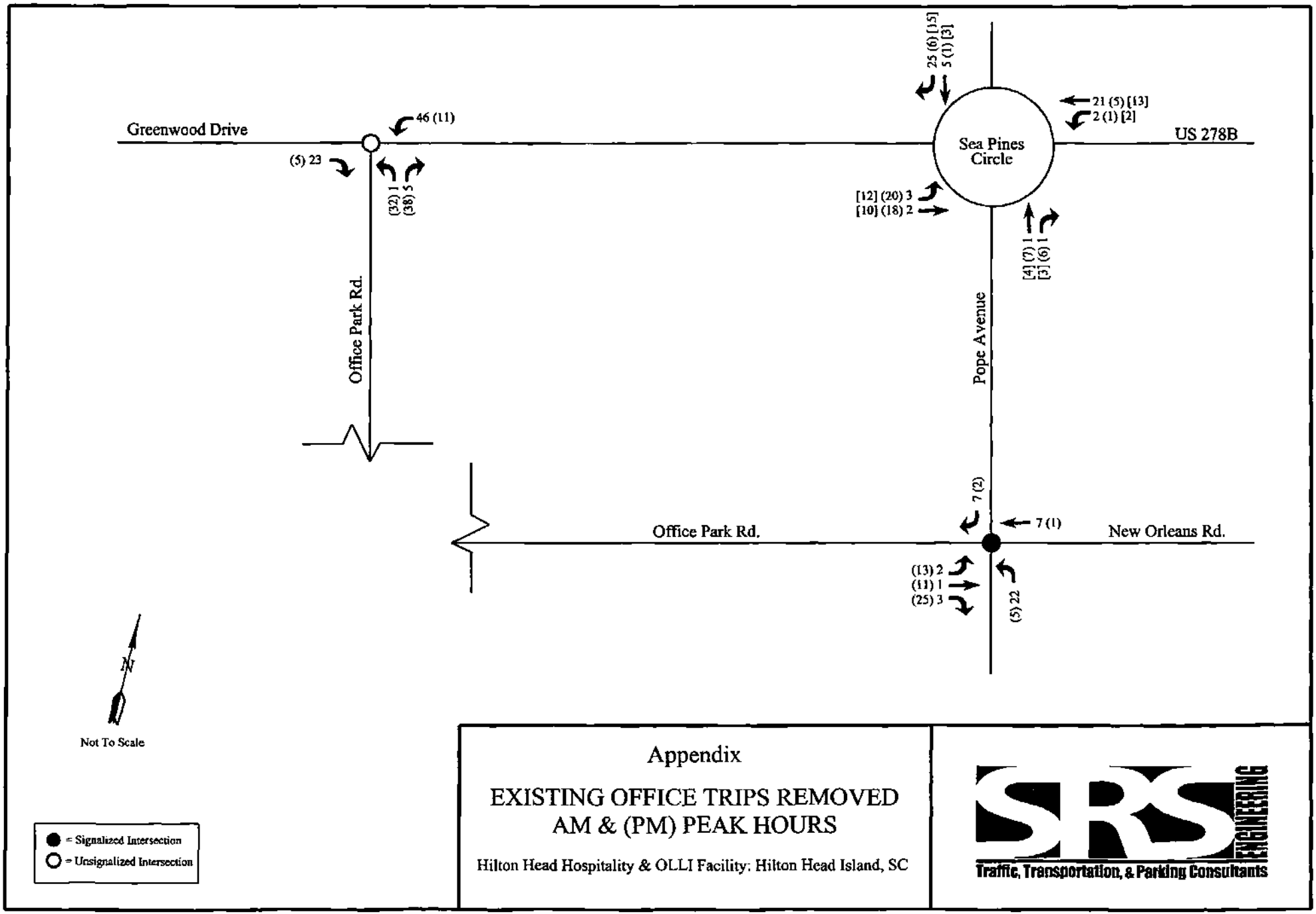
P.M. PEAK HOUR (4:30 p.m. to 5:30 p.m. – Thu. 6/10/10)



NO PEDS RECORDED

2010 (2005) 5-year %chg

EXISTING OFFICE TRAFFIC PEAK-HOUR VOLUMES



Appendix

EXISTING OFFICE TRIPS REMOVED
AM & (PM) PEAK HOURS

Hilton Head Hospitality & OLLI Facility: Hilton Head Island, SC

SRS ENGINEERING
Traffic, Transportation, & Parking Consultants

CAPACITY ANALYSIS

- **Existing**
- **2017 No-Build**
- **2017 Build**

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	26	9	41	186	15	26	58	641	63	46	753	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1797	1531	1681	1697	1538	1770	3539	1543	1770	3526	
Flt Permitted		0.96	1.00	0.95	0.96	1.00	0.29	1.00	1.00	0.35	1.00	
Satd. Flow (perm)		1797	1531	1681	1697	1538	542	3539	1543	652	3526	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	28	10	45	202	16	28	63	697	68	50	818	17
RTOR Reduction (vph)	0	0	42	0	0	25	0	0	15	0	1	0
Lane Group Flow (vph)	0	38	3	109	109	3	63	697	53	50	834	0
Confl. Peds. (#/hr)			1									
Confl. Bikes (#/hr)			6			9			21			18
Turn Type	Split		Perm	Split		Perm	pm+pt		pm+ov	pm+pt		
Protected Phases	8	8		4	4		1	6	4	5	2	
Permitted Phases			8			4	6		6	2		
Actuated Green, G (s)		7.7	7.7	15.2	15.2	15.2	101.1	95.1	110.3	100.5	94.8	
Effective Green, g (s)		10.7	10.7	18.2	18.2	18.2	105.1	97.4	116.3	104.5	97.1	
Actuated g/C Ratio		0.07	0.07	0.12	0.12	0.12	0.70	0.65	0.78	0.70	0.65	
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	6.0	6.3	7.0	6.0	6.3	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		128	109	204	206	187	445	2298	1196	512	2282	
v/s Ratio Prot		c0.02		c0.06	0.06		c0.01	0.20	0.01	0.01	c0.24	
v/s Ratio Perm			0.00			0.00	0.09		0.03	0.06		
v/c Ratio		0.30	0.03	0.53	0.53	0.02	0.14	0.30	0.04	0.10	0.37	
Uniform Delay, d1		66.1	64.8	61.9	61.9	58.0	7.6	11.5	3.9	7.4	12.2	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.3	0.1	2.7	2.4	0.0	0.1	0.3	0.0	0.1	0.5	
Delay (s)		67.4	64.9	64.6	64.3	58.1	7.8	11.8	3.9	7.5	12.7	
Level of Service		E	E	E	E	E	A	B	A	A	B	
Approach Delay (s)		66.1			63.7			10.9			12.4	
Approach LOS		E			E			B			B	

Intersection Summary

HCM Average Control Delay	20.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	48.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	56	43	106	335	60	76	42	975	264	149	668	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	0.94	1.00	1.00	0.97	1.00	1.00	0.96	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00	0.95	0.97	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1812	1493	1681	1710	1543	1770	3539	1516	1770	3515	
Flt Permitted		0.97	1.00	0.95	0.97	1.00	0.32	1.00	1.00	0.16	1.00	
Satd. Flow (perm)		1812	1493	1681	1710	1543	588	3539	1516	293	3515	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	61	47	115	364	65	83	46	1060	287	162	726	28
RTOR Reduction (vph)	0	0	102	0	0	67	0	0	86	0	1	0
Lane Group Flow (vph)	0	108	13	215	214	16	46	1060	201	162	753	0
Confl. Peds. (#/hr)			2			1			6			2
Confl. Bikes (#/hr)			20			9			21			13
Turn Type	Split		Perm	Split		Perm	pm+pt		pm+ov	pm+pt		
Protected Phases	8	8		4	4		1	6	4	5	2	
Permitted Phases			8			4	6		6	2		
Actuated Green, G (s)		13.7	13.7	25.2	25.2	25.2	79.6	73.6	98.8	90.0	78.8	
Effective Green, g (s)		16.7	16.7	28.2	28.2	28.2	83.6	75.9	104.8	92.8	81.1	
Actuated g/C Ratio		0.11	0.11	0.19	0.19	0.19	0.56	0.51	0.70	0.62	0.54	
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	6.0	6.3	7.0	6.0	6.3	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		202	166	316	321	290	391	1791	1059	311	1900	
v/s Ratio Prot		c0.06		c0.13	0.13		0.01	c0.30	0.04	c0.05	0.21	
v/s Ratio Perm			0.01			0.01	0.06		0.10	0.28		
v/c Ratio		0.53	0.08	0.68	0.67	0.05	0.12	0.59	0.19	0.52	0.40	
Uniform Delay, d1		63.0	59.7	56.7	56.5	50.0	15.5	26.1	7.8	17.5	20.1	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		2.7	0.2	5.9	5.2	0.1	0.1	1.4	0.1	1.6	0.6	
Delay (s)		65.7	59.9	62.6	61.7	50.0	15.6	27.6	7.9	19.0	20.8	
Level of Service		E	E	E	E	D	B	C	A	B	C	
Approach Delay (s)		62.7			60.2			23.1			20.5	
Approach LOS		E			E			C			C	

Intersection Summary

HCM Average Control Delay	31.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	62.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Volume (veh/h)	611	59	118	541	32	48
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	764	74	148	676	40	60
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						1
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			848		1407	392
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			848		1407	392
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			81		62	90
cM capacity (veh/h)			779		104	602

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	382	382	74	148	338	338	100
Volume Left	0	0	0	148	0	0	40
Volume Right	0	0	74	0	0	0	60
cSH	1700	1700	1700	779	1700	1700	234
Volume to Capacity	0.22	0.22	0.04	0.19	0.20	0.20	0.43
Queue Length 95th (ft)	0	0	0	17	0	0	50
Control Delay (s)	0.0	0.0	0.0	10.7	0.0	0.0	31.4
Lane LOS				B			D
Approach Delay (s)	0.0			1.9			31.4
Approach LOS							D

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	36.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Volume (veh/h)	716	95	190	665	135	160
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	754	100	200	700	142	168
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						1
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			864		1514	387
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			864		1514	387
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			74		0	72
cM capacity (veh/h)			768		81	606

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	377	377	100	200	350	350	311
Volume Left	0	0	0	200	0	0	142
Volume Right	0	0	100	0	0	0	168
cSH	1700	1700	1700	768	1700	1700	154
Volume to Capacity	0.22	0.22	0.06	0.26	0.21	0.21	2.02
Queue Length 95th (ft)	0	0	0	26	0	0	609
Control Delay (s)	0.0	0.0	0.0	11.3	0.0	0.0	527.9
Lane LOS				B			F
Approach Delay (s)	0.0			2.5			527.9
Approach LOS							F

Intersection Summary			
Average Delay	80.5		
Intersection Capacity Utilization	47.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	10	42	186	18	26	68	641	63	46	753	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.97	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1798	1531	1681	1700	1539	1770	3539	1543	1770	3523	
Flt Permitted		0.97	1.00	0.95	0.96	1.00	0.28	1.00	1.00	0.36	1.00	
Satd. Flow (perm)		1798	1531	1681	1700	1539	526	3539	1543	662	3523	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	11	46	202	20	28	74	697	68	50	818	21
RTOR Reduction (vph)	0	0	43	0	0	25	0	0	15	0	1	0
Lane Group Flow (vph)	0	40	3	111	111	3	74	697	53	50	838	0
Confl. Peds. (#/hr)			1									
Confl. Bikes (#/hr)			6			9			21			18
Turn Type	Split		Perm	Split		Perm	pm+pt		pm+ov	pm+pt		
Protected Phases	8	8		4	4		1	6	4	5	2	
Permitted Phases			8			4	6		6	2		
Actuated Green, G (s)		7.7	7.7	15.4	15.4	15.4	102.4	94.9	110.3	98.8	93.1	
Effective Green, g (s)		10.7	10.7	18.4	18.4	18.4	106.4	97.2	116.3	102.8	95.4	
Actuated g/C Ratio		0.07	0.07	0.12	0.12	0.12	0.71	0.65	0.78	0.69	0.64	
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	6.0	6.3	7.0	6.0	6.3	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		128	109	206	209	189	452	2293	1196	511	2241	
v/s Ratio Prot		c0.02		c0.07	0.07		c0.01	0.20	0.01	0.01	c0.24	
v/s Ratio Perm			0.00			0.00	0.11		0.03	0.06		
v/c Ratio		0.31	0.03	0.54	0.53	0.02	0.16	0.30	0.04	0.10	0.37	
Uniform Delay, d1		66.2	64.8	61.8	61.8	57.9	7.5	11.6	3.9	7.9	13.0	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.4	0.1	2.7	2.6	0.0	0.2	0.3	0.0	0.1	0.5	
Delay (s)		67.6	64.9	64.5	64.3	57.9	7.7	11.9	3.9	7.9	13.5	
Level of Service		E	E	E	E	E	A	B	A	A	B	
Approach Delay (s)		66.2			63.7			10.9			13.2	
Approach LOS		E			E			B			B	

Intersection Summary

HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	48.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	62	48	118	335	61	76	44	975	264	149	668	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	0.94	1.00	1.00	0.97	1.00	1.00	0.96	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00	0.95	0.97	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1812	1495	1681	1710	1543	1770	3539	1516	1770	3514	
Flt Permitted		0.97	1.00	0.95	0.97	1.00	0.31	1.00	1.00	0.16	1.00	
Satd. Flow (perm)		1812	1495	1681	1710	1543	585	3539	1516	289	3514	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	67	52	128	364	66	83	48	1060	287	162	726	29
RTOR Reduction (vph)	0	0	113	0	0	67	0	0	88	0	2	0
Lane Group Flow (vph)	0	119	15	215	215	16	48	1060	199	162	753	0
Confl. Peds. (#/hr)			2			1			6			2
Confl. Bikes (#/hr)			20			9			21			13
Turn Type	Split		Perm	Split		Perm	pm+pt		pm+ov	pm+pt		
Protected Phases	8	8		4	4		1	6	4	5	2	
Permitted Phases			8			4	6		6	2		
Actuated Green, G (s)		14.3	14.3	25.2	25.2	25.2	79.0	72.9	98.1	89.4	78.1	
Effective Green, g (s)		17.3	17.3	28.2	28.2	28.2	83.0	75.2	104.1	92.2	80.4	
Actuated g/C Ratio		0.12	0.12	0.19	0.19	0.19	0.55	0.50	0.69	0.61	0.54	
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	6.0	6.3	7.0	6.0	6.3	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		209	172	316	321	290	388	1774	1052	309	1884	
v/s Ratio Prot		c0.07		c0.13	0.13		0.01	c0.30	0.04	c0.05	0.21	
v/s Ratio Perm			0.01			0.01	0.06		0.10	0.28		
v/c Ratio		0.57	0.09	0.68	0.67	0.05	0.12	0.60	0.19	0.52	0.40	
Uniform Delay, d1		62.8	59.3	56.7	56.6	50.0	15.8	26.6	8.1	17.8	20.6	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		3.5	0.2	5.9	5.2	0.1	0.1	1.5	0.1	1.6	0.6	
Delay (s)		66.4	59.5	62.6	61.8	50.0	15.9	28.1	8.2	19.4	21.2	
Level of Service		E	E	E	E	D	B	C	A	B	C	
Approach Delay (s)		62.8			60.2			23.6			20.9	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM Average Control Delay	32.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Volume (veh/h)	611	70	140	541	34	50
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	764	88	175	676	42	62
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						1
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			861		1462	392
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			861		1462	392
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			77		54	90
cM capacity (veh/h)			770		92	602

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	382	382	88	175	338	338	105
Volume Left	0	0	0	175	0	0	42
Volume Right	0	0	88	0	0	0	62
cSH	1700	1700	1700	770	1700	1700	206
Volume to Capacity	0.22	0.22	0.05	0.23	0.20	0.20	0.51
Queue Length 95th (ft)	0	0	0	22	0	0	65
Control Delay (s)	0.0	0.0	0.0	11.0	0.0	0.0	39.5
Lane LOS				B			E
Approach Delay (s)	0.0			2.3			39.5
Approach LOS							E

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	38.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Volume (veh/h)	716	97	195	665	149	178
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	754	102	205	700	157	187
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						1
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			866		1524	387
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			866		1524	387
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			73		0	69
cM capacity (veh/h)			767		79	606

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	377	377	102	205	350	350	344
Volume Left	0	0	0	205	0	0	157
Volume Right	0	0	102	0	0	0	187
cSH	1700	1700	1700	767	1700	1700	151
Volume to Capacity	0.22	0.22	0.06	0.27	0.21	0.21	2.28
Queue Length 95th (ft)	0	0	0	27	0	0	717
Control Delay (s)	0.0	0.0	0.0	11.4	0.0	0.0	645.7
Lane LOS				B			F
Approach Delay (s)	0.0			2.6			645.7
Approach LOS							F

Intersection Summary				
Average Delay	106.7			
Intersection Capacity Utilization	48.9%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	30	11	46	205	20	29	75	708	70	51	831	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00	0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1797	1531	1681	1700	1540	1770	3539	1544	1770	3523	
Flt Permitted		0.96	1.00	0.95	0.96	1.00	0.25	1.00	1.00	0.32	1.00	
Satd. Flow (perm)		1797	1531	1681	1700	1540	461	3539	1544	599	3523	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	12	50	223	22	32	82	770	76	55	903	23
RTOR Reduction (vph)	0	0	46	0	0	28	0	0	17	0	1	0
Lane Group Flow (vph)	0	45	4	123	122	4	82	770	59	55	925	0
Confl. Peds. (#/hr)			1									
Confl. Bikes (#/hr)			6			9			21			18
Turn Type	Split		Perm	Split		Perm	pm+pt		pm+ov	pm+pt		
Protected Phases	8	8		4	4		1	6	4	5	2	
Permitted Phases			8			4	6		6	2		
Actuated Green, G (s)		8.0	8.0	16.5	16.5	16.5	101.1	93.3	109.8	97.3	91.4	
Effective Green, g (s)		11.0	11.0	19.5	19.5	19.5	105.1	95.6	115.8	101.3	93.7	
Actuated g/C Ratio		0.07	0.07	0.13	0.13	0.13	0.70	0.64	0.77	0.68	0.62	
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	6.0	6.3	7.0	6.0	6.3	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		132	112	219	221	200	409	2256	1192	466	2201	
v/s Ratio Prot		c0.03		c0.07	0.07		c0.01	0.22	0.01	0.01	c0.26	
v/s Ratio Perm			0.00			0.00	0.13		0.03	0.07		
v/c Ratio		0.34	0.03	0.56	0.55	0.02	0.20	0.34	0.05	0.12	0.42	
Uniform Delay, d1		66.1	64.6	61.2	61.2	56.9	8.4	12.6	4.1	8.5	14.3	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.5	0.1	3.3	3.0	0.0	0.2	0.4	0.0	0.1	0.6	
Delay (s)		67.6	64.7	64.5	64.1	57.0	8.7	13.0	4.1	8.6	14.9	
Level of Service		E	E	E	E	E	A	B	A	A	B	
Approach Delay (s)		66.1			63.5			11.9			14.6	
Approach LOS		E			E			B			B	

Intersection Summary

HCM Average Control Delay	21.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	51.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	68	53	130	370	67	84	49	1077	291	164	737	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	0.95	1.00	1.00	0.98	1.00	1.00	0.96	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00	0.95	0.97	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1812	1497	1681	1710	1544	1770	3539	1517	1770	3513	
Flt Permitted		0.97	1.00	0.95	0.97	1.00	0.28	1.00	1.00	0.11	1.00	
Satd. Flow (perm)		1812	1497	1681	1710	1544	513	3539	1517	214	3513	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	74	58	141	402	73	91	53	1171	316	178	801	33
RTOR Reduction (vph)	0	0	124	0	0	73	0	0	91	0	2	0
Lane Group Flow (vph)	0	132	17	237	238	18	53	1171	225	178	832	0
Confl. Peds. (#/hr)			2			1			6			2
Confl. Bikes (#/hr)			20			9			21			13
Turn Type	Split		Perm	Split		Perm	pm+pt		pm+ov	pm+pt		
Protected Phases	8	8		4	4		1	6	4	5	2	
Permitted Phases			8			4	6		6	2		
Actuated Green, G (s)		14.8	14.8	26.4	26.4	26.4	76.8	70.5	96.9	88.2	76.2	
Effective Green, g (s)		17.8	17.8	29.4	29.4	29.4	80.8	72.8	102.9	90.5	78.5	
Actuated g/C Ratio		0.12	0.12	0.20	0.20	0.20	0.54	0.49	0.69	0.60	0.52	
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	6.0	6.3	7.0	6.0	6.3	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		215	178	329	335	303	346	1718	1041	274	1838	
v/s Ratio Prot		c0.07		c0.14	0.14		0.01	c0.33	0.04	c0.06	0.24	
v/s Ratio Perm			0.01			0.01	0.07		0.11	0.33		
v/c Ratio		0.61	0.09	0.72	0.71	0.06	0.15	0.68	0.22	0.65	0.45	
Uniform Delay, d1		62.8	58.9	56.5	56.3	49.0	17.1	29.7	8.7	22.0	22.3	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		5.1	0.2	7.6	6.9	0.1	0.2	2.2	0.1	5.2	0.8	
Delay (s)		68.0	59.1	64.0	63.3	49.1	17.3	31.9	8.8	27.3	23.1	
Level of Service		E	E	E	E	D	B	C	A	C	C	
Approach Delay (s)		63.4			61.3			26.7			23.9	
Approach LOS		E			E			C			C	

Intersection Summary

HCM Average Control Delay	34.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	67.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Volume (veh/h)	656	75	150	581	37	54
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	820	94	188	726	46	68
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						1
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			924		1568	420
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			924		1568	420
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			74		38	88
cM capacity (veh/h)			729		75	577

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	410	410	94	188	363	363	114
Volume Left	0	0	0	188	0	0	46
Volume Right	0	0	94	0	0	0	68
cSH	1700	1700	1700	729	1700	1700	169
Volume to Capacity	0.24	0.24	0.06	0.26	0.21	0.21	0.67
Queue Length 95th (ft)	0	0	0	26	0	0	98
Control Delay (s)	0.0	0.0	0.0	11.6	0.0	0.0	61.3
Lane LOS				B			F
Approach Delay (s)	0.0			2.4			61.3
Approach LOS							F

Intersection Summary				
Average Delay	4.7			
Intersection Capacity Utilization	39.8%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Volume (veh/h)	769	104	209	714	160	191
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	809	109	220	752	168	201
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						1
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			929		1635	415
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			929		1635	415
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			70		0	65
cM capacity (veh/h)			726		63	582

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	405	405	109	220	376	376	369
Volume Left	0	0	0	220	0	0	168
Volume Right	0	0	109	0	0	0	201
cSH	1700	1700	1700	726	1700	1700	123
Volume to Capacity	0.24	0.24	0.06	0.30	0.22	0.22	2.99
Queue Length 95th (ft)	0	0	0	32	0	0	869
Control Delay (s)	0.0	0.0	0.0	12.1	0.0	0.0	973.6
Lane LOS				B			F
Approach Delay (s)	0.0			2.7			973.6
Approach LOS							F

Intersection Summary			
Average Delay	160.3		
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	43	17	50	205	37	84	77	708	70	51	831	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	0.97	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00	0.95	0.97	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1798	1538	1681	1710	1541	1770	3539	1544	1770	3503	
Flt Permitted		0.97	1.00	0.95	0.97	1.00	0.23	1.00	1.00	0.32	1.00	
Satd. Flow (perm)		1798	1538	1681	1710	1541	425	3539	1544	587	3503	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	47	18	54	223	40	91	84	770	76	55	903	54
RTOR Reduction (vph)	0	0	49	0	0	79	0	0	19	0	2	0
Lane Group Flow (vph)	0	65	5	132	131	12	84	770	57	55	955	0
Confl. Peds. (#/hr)			1									
Confl. Bikes (#/hr)			6			9			21			18
Turn Type	Split		Perm	Split		Perm	pm+pt		pm+ov	pm+pt		
Protected Phases	8	8		4	4		1	6	4	5	2	
Permitted Phases			8			4	6		6	2		
Actuated Green, G (s)		11.1	11.1	17.6	17.6	17.6	97.0	89.0	106.6	93.0	87.0	
Effective Green, g (s)		14.1	14.1	20.6	20.6	20.6	101.0	91.3	112.6	97.0	89.3	
Actuated g/C Ratio		0.09	0.09	0.14	0.14	0.14	0.67	0.61	0.75	0.65	0.60	
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	6.0	6.3	7.0	6.0	6.3	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		169	145	231	235	212	376	2154	1159	443	2085	
v/s Ratio Prot		c0.04		c0.08	0.08		c0.01	0.22	0.01	0.01	c0.27	
v/s Ratio Perm			0.00			0.01	0.14		0.03	0.07		
v/c Ratio		0.38	0.04	0.57	0.56	0.06	0.22	0.36	0.05	0.12	0.46	
Uniform Delay, d1		63.9	61.8	60.6	60.4	56.3	10.2	14.7	4.8	10.1	16.9	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.5	0.1	3.4	2.9	0.1	0.3	0.5	0.0	0.1	0.7	
Delay (s)		65.3	61.9	64.0	63.3	56.4	10.5	15.1	4.9	10.2	17.6	
Level of Service		E	E	E	E	E	B	B	A	B	B	
Approach Delay (s)		63.8			61.8			13.9			17.2	
Approach LOS		E			E			B			B	

Intersection Summary			
HCM Average Control Delay	24.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	85	55	118	370	87	84	65	1077	291	164	737	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00	0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	0.95	1.00	1.00	0.98	1.00	1.00	0.96	1.00	1.00	
Flpb, ped/bikes		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00	0.95	0.97	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1808	1499	1681	1716	1544	1770	3539	1518	1770	3489	
Flt Permitted		0.97	1.00	0.95	0.97	1.00	0.25	1.00	1.00	0.11	1.00	
Satd. Flow (perm)		1808	1499	1681	1716	1544	461	3539	1518	204	3489	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	60	128	402	95	91	71	1171	316	178	801	65
RTOR Reduction (vph)	0	0	112	0	0	73	0	0	93	0	3	0
Lane Group Flow (vph)	0	152	16	245	252	18	71	1171	223	178	863	0
Confl. Peds. (#/hr)			2			1			6			2
Confl. Bikes (#/hr)			20			9			21			13
Turn Type	Split		Perm	Split		Perm	pm+pt		pm+ov	pm+pt		
Protected Phases	8	8		4	4		1	6	4	5	2	
Permitted Phases			8			4	6		6	2		
Actuated Green, G (s)		15.6	15.6	27.0	27.0	27.0	77.1	69.0	96.0	85.1	73.0	
Effective Green, g (s)		18.6	18.6	30.0	30.0	30.0	81.1	71.3	102.0	89.1	75.3	
Actuated g/C Ratio		0.12	0.12	0.20	0.20	0.20	0.54	0.48	0.68	0.59	0.50	
Clearance Time (s)		7.0	7.0	7.0	7.0	7.0	6.0	6.3	7.0	6.0	6.3	
Vehicle Extension (s)		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		224	186	336	343	309	337	1682	1032	268	1751	
v/s Ratio Prot		c0.08		0.15	c0.15		0.01	c0.33	0.04	c0.06	0.25	
v/s Ratio Perm			0.01			0.01	0.10		0.10	0.33		
v/c Ratio		0.68	0.09	0.73	0.73	0.06	0.21	0.70	0.22	0.66	0.49	
Uniform Delay, d1		62.8	58.2	56.2	56.3	48.6	17.6	30.9	9.0	23.0	24.7	
Progression Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		7.9	0.2	7.7	7.9	0.1	0.3	2.4	0.1	6.1	1.0	
Delay (s)		70.8	58.4	63.9	64.2	48.7	17.9	33.3	9.1	29.1	25.7	
Level of Service		E	E	E	E	D	B	C	A	C	C	
Approach Delay (s)		65.1			61.7			27.7			26.3	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM Average Control Delay	36.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Volume (veh/h)	656	57	134	581	35	52
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Hourly flow rate (vph)	820	71	168	726	44	65
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						1
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			901		1528	420
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			901		1528	420
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			77		47	89
cM capacity (veh/h)			744		83	577

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	410	410	71	168	363	363	109
Volume Left	0	0	0	168	0	0	44
Volume Right	0	0	71	0	0	0	65
cSH	1700	1700	1700	744	1700	1700	188
Volume to Capacity	0.24	0.24	0.04	0.23	0.21	0.21	0.58
Queue Length 95th (ft)	0	0	0	22	0	0	78
Control Delay (s)	0.0	0.0	0.0	11.2	0.0	0.0	47.5
Lane LOS				B			E
Approach Delay (s)	0.0			2.1			47.5
Approach LOS							E

Intersection Summary				
Average Delay	3.7			
Intersection Capacity Utilization	38.9%	ICU Level of Service		A
Analysis Period (min)	15			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↱	↰	↑↑	↰	↱
Volume (veh/h)	769	104	224	74	131	161
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	809	109	236	78	138	169
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						1
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			929		1330	415
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			929		1330	415
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			68		0	71
cM capacity (veh/h)			726		98	582

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	405	405	109	236	39	39	307
Volume Left	0	0	0	236	0	0	138
Volume Right	0	0	109	0	0	0	169
cSH	1700	1700	1700	726	1700	1700	184
Volume to Capacity	0.24	0.24	0.06	0.32	0.02	0.02	1.67
Queue Length 95th (ft)	0	0	0	35	0	0	524
Control Delay (s)	0.0	0.0	0.0	12.3	0.0	0.0	371.0
Lane LOS				B			F
Approach Delay (s)	0.0			9.3			371.0
Approach LOS							F

Intersection Summary			
Average Delay	75.9		
Intersection Capacity Utilization	50.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	43	17	50	205	37	84	77	708	70	51	851	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	7.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1569	3433	1863	1563	1770	3539	1546	1770	3539	1540
Flt Permitted	1.00	1.00	1.00	0.95	1.00	1.00	0.23	1.00	1.00	0.30	1.00	1.00
Satd. Flow (perm)	1863	1863	1569	3433	1863	1563	421	3539	1546	555	3539	1540
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	47	18	54	223	40	91	84	770	76	55	925	59
RTOR Reduction (vph)	0	0	46	0	0	71	0	0	22	0	0	17
Lane Group Flow (vph)	47	18	8	223	40	20	84	770	54	55	925	42
Confl. Peds. (#/hr)			1									
Confl. Bikes (#/hr)			6			9			21			18
Turn Type	pm+pt		pm+ov	Prot		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	7	4	1	3	8	5	1	6	3	5	2	7
Permitted Phases	4		4			8	6		6	2		2
Actuated Green, G (s)	10.5	3.2	9.4	14.0	9.9	15.5	57.1	50.9	64.9	55.9	50.3	57.6
Effective Green, g (s)	10.5	6.2	15.4	17.0	12.9	21.5	61.1	53.2	70.9	59.9	52.6	57.6
Actuated g/C Ratio	0.10	0.06	0.15	0.17	0.13	0.22	0.61	0.53	0.71	0.60	0.53	0.58
Clearance Time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.0	6.3	7.0	6.0	6.3	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	189	116	242	584	240	336	368	1883	1096	425	1862	887
v/s Ratio Prot	0.02	0.01	0.00	c0.06	c0.02	0.01	c0.02	0.22	0.01	0.01	c0.26	0.00
v/s Ratio Perm	0.01		0.00			0.01	0.12		0.03	0.07		0.02
v/c Ratio	0.25	0.16	0.03	0.38	0.17	0.06	0.23	0.41	0.05	0.13	0.50	0.05
Uniform Delay, d1	41.1	44.4	36.0	36.8	38.8	31.2	9.1	14.0	4.4	8.7	15.2	9.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	0.6	0.1	0.4	0.3	0.1	0.3	0.7	0.0	0.1	1.0	0.0
Delay (s)	41.8	45.0	36.0	37.3	39.1	31.3	9.4	14.7	4.4	8.9	16.2	9.3
Level of Service	D	D	D	D	D	C	A	B	A	A	B	A
Approach Delay (s)		39.7			35.9			13.3			15.4	
Approach LOS		D			D			B			B	

Intersection Summary

HCM Average Control Delay	18.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.0%	ICU Level of Service	A
Analysis Period (min)	15		

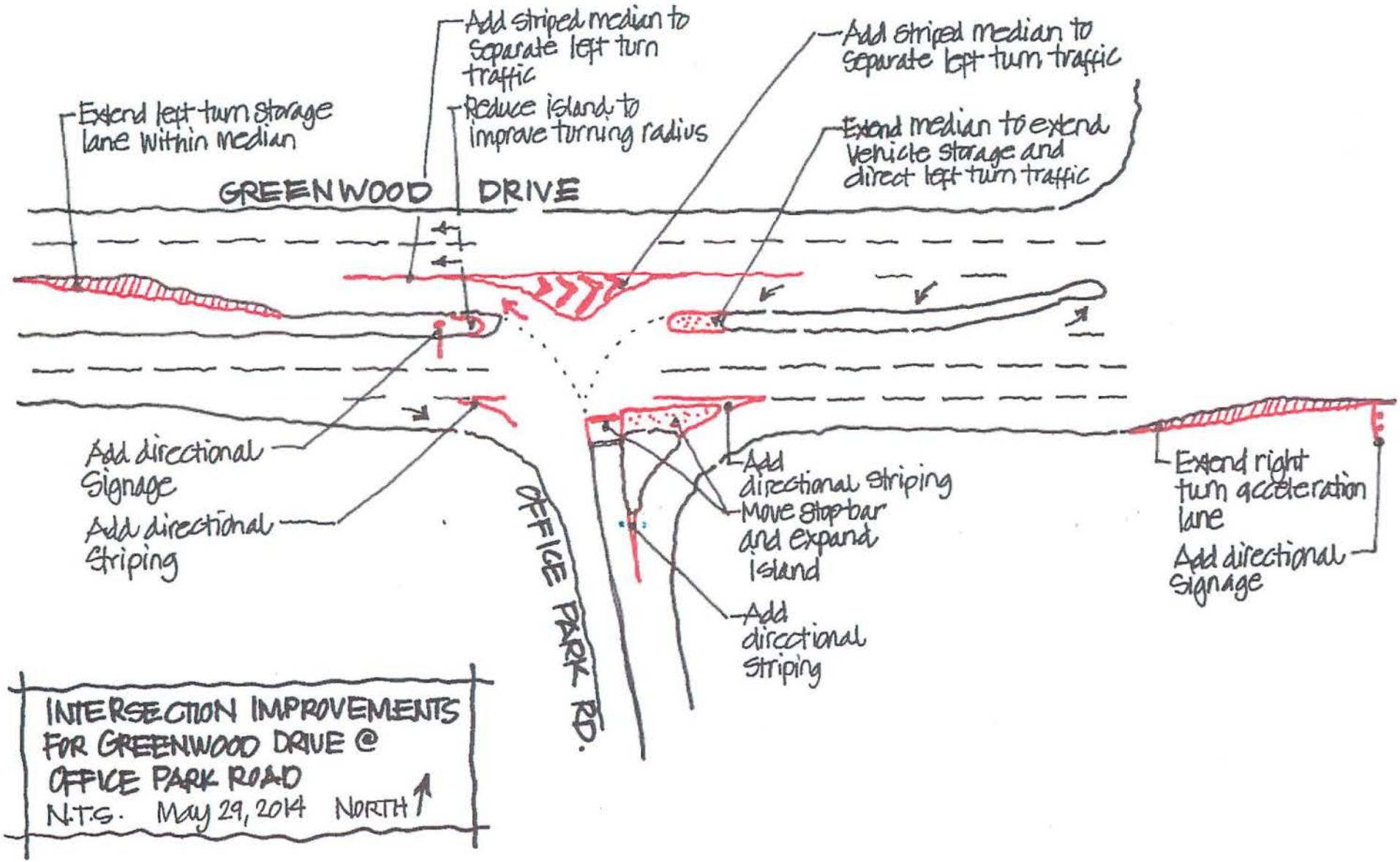
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	85	55	118	370	87	84	65	1077	291	164	737	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	4.0	4.0	4.0	7.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	0.96	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1554	3433	1863	1565	1770	3539	1526	1770	3539	1536
Flt Permitted	0.70	1.00	1.00	0.95	1.00	1.00	0.27	1.00	1.00	0.09	1.00	1.00
Satd. Flow (perm)	1295	1863	1554	3433	1863	1565	509	3539	1526	173	3539	1536
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	60	128	402	95	91	71	1171	316	178	801	65
RTOR Reduction (vph)	0	0	46	0	0	63	0	0	121	0	0	26
Lane Group Flow (vph)	92	60	82	402	95	28	71	1171	195	178	801	39
Confl. Peds. (#/hr)			2			1			6			2
Confl. Bikes (#/hr)			20			9			21			13
Turn Type	pm+pt		pm+ov	Prot		pm+ov	pm+pt		pm+ov	pm+pt		pm+ov
Protected Phases	7	4	1	3	8	5	1	6	3	5	2	7
Permitted Phases	4		4			8	6		6	2		2
Actuated Green, G (s)	15.6	7.6	15.0	14.5	14.1	24.5	48.6	41.2	55.7	54.6	44.2	52.2
Effective Green, g (s)	15.6	10.6	21.0	17.5	17.1	30.5	52.6	43.5	61.7	58.6	46.5	52.2
Actuated g/C Ratio	0.16	0.11	0.21	0.18	0.17	0.30	0.53	0.44	0.62	0.59	0.46	0.52
Clearance Time (s)	7.0	7.0	6.0	7.0	7.0	6.0	6.0	6.3	7.0	6.0	6.3	7.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	240	197	326	601	319	477	386	1539	942	299	1646	802
v/s Ratio Prot	0.03	0.03	0.03	c0.12	c0.05	0.01	0.02	c0.33	0.04	c0.07	0.23	0.00
v/s Ratio Perm	0.03		0.03			0.01	0.08		0.09	0.27		0.02
v/c Ratio	0.38	0.30	0.25	0.67	0.30	0.06	0.18	0.76	0.21	0.60	0.49	0.05
Uniform Delay, d1	37.6	41.3	32.9	38.5	36.2	24.6	12.2	23.9	8.4	16.8	18.5	11.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	0.9	0.4	2.8	0.5	0.1	0.2	3.6	0.1	3.2	1.0	0.0
Delay (s)	38.6	42.2	33.4	41.4	36.7	24.6	12.4	27.5	8.5	19.9	19.5	11.7
Level of Service	D	D	C	D	D	C	B	C	A	B	B	B
Approach Delay (s)		37.0			38.0			22.9			19.1	
Approach LOS		D			D			C			B	

Intersection Summary

HCM Average Control Delay	25.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



INTERSECTION IMPROVEMENTS FOR GREENWOOD DRIVE @ OFFICE PARK ROAD

N.T.S. May 29, 2014 NORTH ↑