

HUDDLE INVESTMENTS (Pty) Ltd

HUDDLE PARK RESIDENTIAL DEVELOPMENT

TRAFFIC IMPACT STUDY

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1. INTRODUCTION

1.1 BACKGROUND

Goba (Pty) Ltd was appointed by Huddle Investments (Pty) Ltd to conduct a traffic impact assessment for a proposed residential development in Huddle Park, Johannesburg. The site is located on the west of the Linksfield Road / Club Street intersection. The site is currently zoned as a public open space. The locality plan is shown in Figure 1 in Annexure A.

The development will consist of mainly residential with some retail. The roads surrounding the proposed site are all paved and in good condition making the proposed site easily accessible. The N3 freeway is located east of the development which will allow the site to be easily accessed from the south, east and north. The site is bounded by the suburbs of Linksfield and Senderwood to the south, Edenvale to the east, Highlands north to the west and Lombardy East to the north.

This traffic impact study evaluates the current traffic operating conditions of the key intersections surrounding the proposed development and the impact of the newly generated vehicles on these intersections. It also evaluates the access roads to/from the site and makes recommendations in this regard.

1.2 WARRANTS AND EXTENT OF STUDY

In order to identify the relevant input, the following guidelines taken from the Manual for Traffic Impact Studies of the Department of Transport were followed:

- **Threshold Value** (in terms of trips generated) for Traffic Impact Studies: For this development more than 150 trips will be generated in the Peak Hour, therefore a Traffic Impact Study is warranted.
- **Extent of Analysis:** The extent of the study area should be mutually agreed upon by the local authority and should cover all intersections at which the performance will deteriorate significantly (i.e. drop one level of service or the sum of the critical lane flows amounts to 75 vehicles).
- **Assessment Years:** The development is a two phase development generating 150-2000 trips in the peak hour, therefore a Base Year assessment and five (5) years after the base year is required.

2. STUDY OBJECTIVES

The objectives of this study are as follows:

- To evaluate the existing conditions of the road network surrounding the proposed development.
- To identify and quantify problems and provide possible solutions.

- To evaluate the traffic conditions of the surrounding road network after the addition of the generated traffic and the diversion of traffic.
- To evaluate traffic conditions five years after the base year 2014 analysis (design year 2019 with development trips). This is to ensure that existing and proposed upgrading is sustainable for the next five years at least.

3. DATA COLLECTION

12 hour manual traffic count surveys were conducted at the following intersections on the 09th and 10th March 2011 by Trafftrans (Pty) Ltd and shown in Figure 4-1:

- Intersection 1 – Club Street and George Avenue (Traffic Signal)
- Intersection 2 – Club Street; Civin Drive and Linksfield Road (Traffic Signal)
- Intersection 3 – Civin Drive; Chaucer Avenue and St Christopher Road (Traffic Signal)
- Intersection 4 – Club Street and Donné Avenue (Stop Controlled)
- Intersection 5 – Club Street and Shelley Avenue (Stop Controlled)
- Intersection 6 – Club Street and St Andrews Avenue (Stop Controlled)
- Intersection 7 – Club Street and Byron Avenue (Stop Controlled)

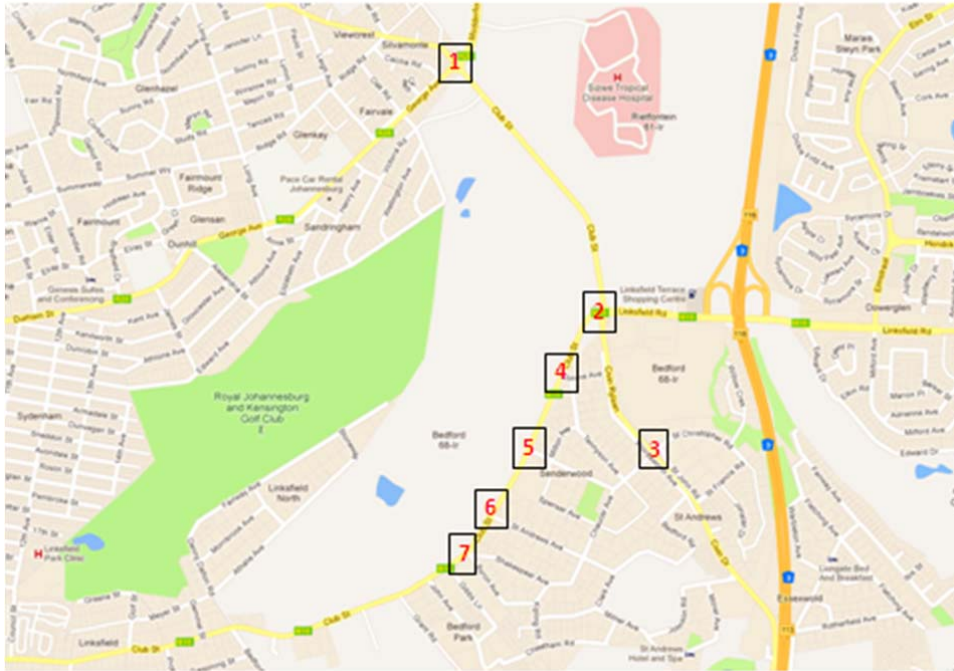
The collected data includes traffic counts, intersection lane configuration and signal timings.

During the data collection of traffic count information traffic observations were performed during the critical peak periods. At the time of these peak traffic observations we visited the intersection of Bedford Street and Club Street and identified significant congestion occurring at just east of the King David School entrance on Club Street. This congestion and safety concern seems to be as a direct result of King David School parents parking on the southern verge of Club Street and within Club Street to drop-off their children. These observations are then also dealt with under the existing traffic evaluation, specifically in Section 4.3.8.

4. STATUS QUO

4.1 ADJACENT ROAD NETWORK AND ROAD HIERARCHY

Figure 4-1 : Adjacent Road Network



The proposed development is located in the vicinity of the following roads as shown in Figure 4-1 above:

4.1.1 N3 Eastern Bypass Freeway:

This is a fully developed class 1 freeway with four lanes to each direction traversing north south. It carries high volumes of traffic during the morning and afternoon peak hours.

4.1.2 N12 Eastern Bypass Freeway:

This is a fully developed class 1 freeway with four lanes to each direction traversing east west. It carries high volumes of traffic during the morning and afternoon peak hours.

4.1.3 Club Street (South of the Development):

This road performs the function of an arterial although it is a class 3 urban collector with one lane in each direction and forms a continuation of Linkfield Road to the west. It carries high volumes of traffic during both the morning and afternoon peaks.

4.1.4 Club Street (North of the Development):

This road performs the function of an arterial although it is a class 3 urban collector with two lanes in each direction and intersects with George Avenue (Modderfontein Road). It carries high volumes of traffic during both the morning and afternoon peaks.

4.1.5 Linksfield Road:

This is a class 2 road arterial with two lanes in each direction and turning lanes at major intersections. It carries high volumes of traffic during peak hours and is directly linked to the N3 Eastern Bypass Freeway.

4.1.6 Civin Road:

This class 3 urban collector road with one lane in each direction traverses north south and is located east of the development. It carries average to high volumes of traffic during both the morning and afternoon peaks.

4.2 INTERSECTION DESCRIPTION

The seven key intersections surrounding the development were identified and are discussed below:

4.2.1 Intersection 1: Club Street and George Avenue

This is a signalised four legged intersection. The south approach is served by two through lanes; a short right turn lane and a short slip lane. The north approach has a through lane, a shared through and left and a short right turn lane. The east approach comprises of a short slip lane; two through lanes and a short right turn lane. The west approach has a shared through and left; two through lanes and a short right turn lane.

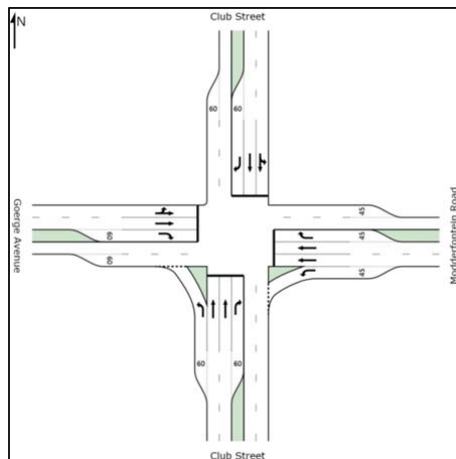


Figure 4-2 : Club Street and George Avenue

4.2.2 Intersection 2: Club Street; Civin Drive and Linksfild Road

This is a signal controlled intersection. The west approach comprises of a through lane; a short right turn lane and a shared through and slip lane. Both the north and south approaches have a short right turn lane and two through lanes and slip lanes. The east approach consists of a short right turn lane; a shared through and right turn lane; a through lane and a slip lane as shown below. Club Street forms a 90 degree turn at this intersection to continue west towards Linksfild.

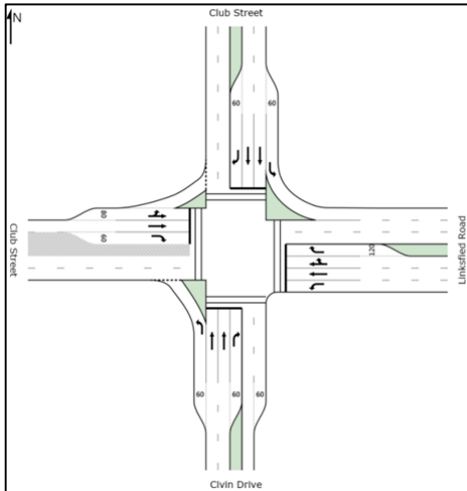


Figure 4-3 : Club Street; Civin Drive and Linksfild Road

4.2.3 Intersection 3: Civin Drive; St Christopher Avenue and St Chaucer Avenue

This is a signalised four legged intersection. The east approach consists of a right turn lane and a through lane. The west approach consists of a shared lane to all directions. The north and south approaches each consists of a short right and a shared through and left.

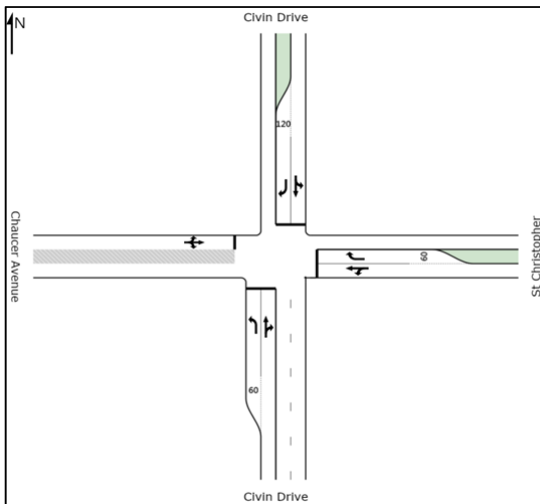


Figure 4-4 : Civin Drive and Chaucer Avenue

4.2.4 Intersection 4: Club Street and Donné Avenue

This is a stop controlled T-junction intersection giving priority to the north and south approaches. The north and south approaches each have one lane in each direction and the east approach has a lane in each direction as well.

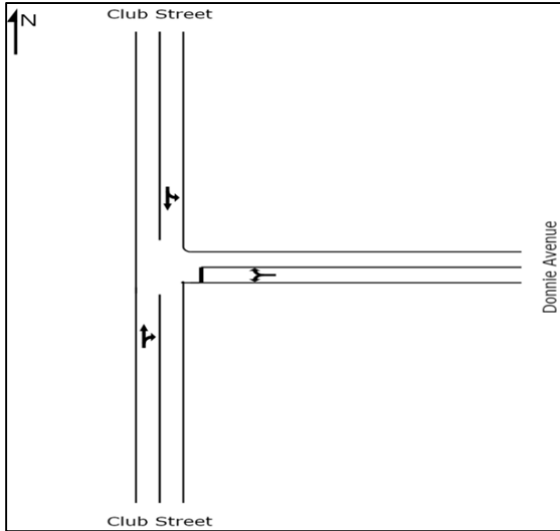


Figure 4-5 : Club Street and Donné Avenue

4.2.5 Intersection 5: Club Street and Shelley Avenue

This is a stop controlled T-junction intersection giving priority to the north and south approaches. The north and south approaches each have one lane in each direction and the east approach has a lane in each direction as well.

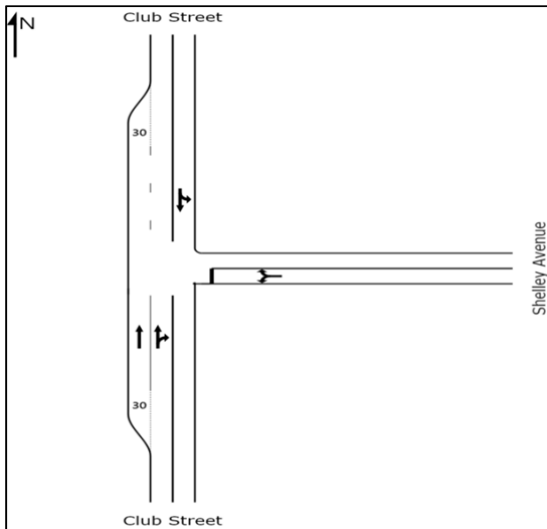


Figure 4-6 : Club Street and Shelley Avenue

4.2.6 Intersection 6: Club Street and St Andrews Avenue

This is a stop controlled T-junction intersection giving priority to the north and south approaches. The north approach consists of one shared through and left lane. The south approach has a short right turn lane and a through lane. The east approach consists of one lane in each direction.

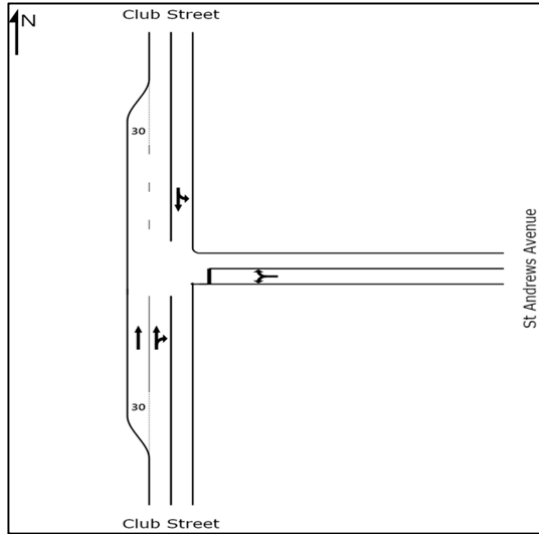


Figure 4-7 : Club Street and St Andrews Avenue

4.2.7 Intersection 7: Club Street and Byron Avenue

This is a stop controlled T-junction intersection giving priority to the north and south approaches. The north and south approaches each have one lane in each direction and the east approach has a lane in each direction as well.

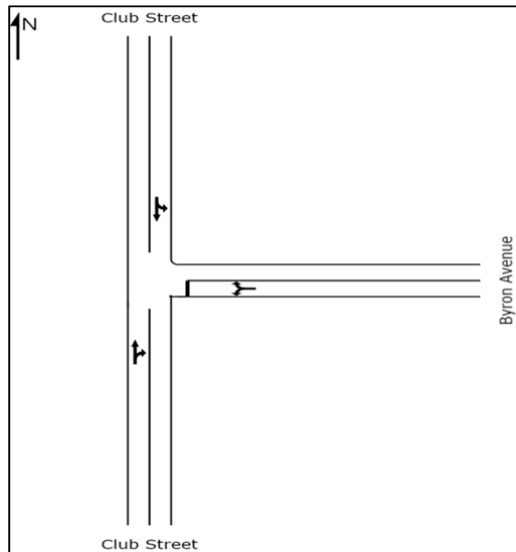


Figure 4-8 : Club Street and Byron Avenue

4.3 EXISTING INTERSECTION EVALUATION

The current 2012 AM; PM and Saturday peak hour traffic volumes are given in Figure 3, Annexure A. The intersections were evaluated using SIDRA traffic software. The Highway Capacity Manual Criteria for Level of Service (LOS) based on control delay were applied in the analysis. The measured peak hour factors for each intersection approach were used to reflect the peak hour traffic demand for the intersection. The existing signal timings were used in the evaluation. The results of the traffic evaluation of the existing condition are attached in Annexure B, Table 3-1 of this report. A brief summary of each intersection performance is discussed below:

4.3.1 Intersection 1: Club Street and George Avenue

The intersection is currently operating at acceptable level of service C during the AM; PM and Saturday peak hours. The highest volume was recorded on the south approach which was 940 vehicles per hour and the approach is shown to be operating at LOS B with a 68% saturation level.

4.3.2 Intersection 2: Club Street; Civin Drive and Linkfield Road

The south approach (Civin Drive) has a demand of 1315 vph in the AM Peak hour and is currently operating at LOS E. Queues were observed during the site visit and were all determined to be the vehicles turning right at the intersection. The queues were also observed in the afternoon but were shorter than the queues recorded earlier.

The queues can be reduced by changing the current signal plan from an exclusive dual right turning phase to a leading exclusive right turn phase to serve the south approach with at least 12 seconds flashing green. This will reduce the queues and reduce the delays at the intersection as shown in Table 3-1 in Annexure B.

4.3.3 Intersection 3: Civin Drive, Chaucer Avenue and St Christopher Road

Long queues were observed during the site visit and that can be attributed to the insufficient green time in the current signal plan. The south approach is currently operating at LOS F. The queues and delays will be reduced once the signal plan is changed giving more green time to the main road (Civin Drive) as shown in Table 3-1 in Annexure B.

4.3.4 Intersection 4: Club Street and Donné Avenue

The recent traffic survey indicates that there is 935 vph travelling north south on Club Street. This makes it very difficult to access Club Street from the side roads. The east approach is currently experiencing high delays (LOS F) due to high volumes on the main road resulting in lack of gaps and long delays.

The solution to this would be to convert the stop controlled intersection to a signalised intersection however the traffic from Donné Avenue is low and does not warrant a traffic signal at present.

4.3.5 Intersection 5: Club Street and Shelley Avenue

The intersection is operating at LOS F due to long delays experienced by the traffic attempting to join Club Street from Shelley Avenue but find it difficult due to the lack of gaps. Once again the solution to this would be to convert the stop controlled intersection to a signalised intersection however the traffic from the minor road is low and does not warrant a traffic signal at present.

4.3.6 Intersection 6: Club Street and St Andrews Avenue

The intersection is operating at LOS F due to long delays experienced by the traffic attempting to join Club Street from the minor road but find it difficult due to the lack of sufficient gaps. Once again the solution to this would be to convert the stop controlled intersection to a signalised intersection however the traffic from the minor road is low and does not warrant a traffic signal at present.

4.3.7 Intersection 7: Club Street and Byron Avenue

The intersection is operating at LOS F due to long delays experienced by the traffic attempting to join Club Street from the minor road but find it difficult due to the lack of gaps. Once again the solution to this would be to convert the stop controlled intersection to a signalised intersection however the traffic from the minor road is low and does not warrant a traffic signal at present.

4.3.8 Club Street extending to Bedford Street

The traffic count conducted indicates that there is about 950 vph per direction on Club Street in both the morning and afternoon peak hours therefore the current saturation of Club Street is 63% of the 1 500 pcu per hour per lane. This means that the current lanes on Club Street are sufficient to cater for the existing traffic demand.

The minor roads along Club Street south of the development are all currently experiencing long delays due to lack of gaps and should be upgraded to signalised intersections however the traffic magnitude at these junctions is minimal and unfortunately do not warrant traffic signals according to the SARTSM criteria of queue length.

Major congestion was observed in the westbound direction at the King David's school entrance during the A.M. Peak period. Parents are parking on the verge, getting out of the car, and accompanying their children to the school gate. In so doing they are completely blocking the westbound lane of Club Street. This existing situation is unsafe and highly problematic.

Certain possible solutions for the problem are noted in various alternatives which are contained in Annexure D. Some proposals are mooted by other Consultants and several others by Goba (Pty) Ltd. These would however need to be entertained by the JRA and King David School themselves.

5. PROPOSED LAND USES

The proposed development land uses are shown in the table below. The development will be phased in 2 parts with Phase 1 assumed to be completed in 2014 and the full Phase referred to as Phase 2 only expected in 2019.

Table 5-1 : Proposed Land Uses

Land Use	Phase	Extent
Residential 1	1	314
Residential 2	1	33 Units
Retail	1	5 000 m ²
Residential 3	2	110 Units
Retail	2	5 000 m ²

The complete development will consist of 347 high income residential units; 110 middle income residential units and a 10 000 m² retail centre.

6. LATENT RIGHTS

Huddle Park Golf Club is located southwest of Club Street and Shelley intersection south of the proposed development site. According to the information at our disposal, the Huddle Park Golf Club intends expanding its development to its full land use rights, and is in the process of doing so.

The full development will have an 18 hole golf course; 9 hole mashie course, a driving range; bar and sports bar, restaurant and conference facilities (150 seats). For the various elements of the development which are wholly related primarily to the two golf courses and driving range, the following has been assumed:

The trip generation for the A.M. Peak hour should be limited to the conference facilities. For 150 seats, using a rate of 0,7 trips per seat, 105 cars are assumed. The golfers will arrive before and leave after this time. The case is very much the same for the Saturday Peak. The significant future traffic scenario which needs to be accounted for is during the PM Peak Hour. Probably golfers may enter the Golf Club during the PM Peak Hour, however they would generally mostly be leaving after the PM Peak Hour. The trip generation assumptions made are:

- Driving Range – 20 persons at a time with half arriving and the rest departing in the PM Peak (10 cars in and 10 cars out);
- 9 Hole Mashie – Say 9 fourballs per hour or 18 cars;
- Full Golf Course – Cannot play 18 holes before sundown but say a similar 24 cars may be exiting.

In all likelihood during the PM Peak Hour, 28 cars could be entering and 34 cars departing. During the P.M. Peak the 105 cars will be exiting from the conference facilities.

As we have assumed that the background traffic growth rate is 2.5% per annum $[(1.025)^4=1.104]$ and the P.M. Peak 2 way flow on Club Street is typically 1630 vph, this will be 170 vehicles (10.4% over 4 years). We have assumed that the cars 139 exiting during the P.M. Peak hour are accommodated within the traffic growth of the background traffic and therefore the latent rights have not been exclusively evaluated, but nevertheless are accounted for. The traffic evaluation of the entrance and exit is nevertheless provided so the Level of Service can be determined.

7. TRIP GENERATION

The standard formula of the South African Trip Generation Manual (SATGM) of 1992 and the Manual for traffic impact studies by BKS of 1995 was used to estimate the number of peak hour trips to/from the residential development. A peak hour rate of 1.5 during the weekday AM and PM Peak Hours was assumed to determine the expected high income residential development trips (for Res. 1 and Res. 2). A peak hour rate of 1.1 during the weekday AM and PM Peak Hours was assumed to determine the expected middle income residential development trips.

The trip rate formulas $224.5(\text{GLA})^{-0.34}$ and $250.2(\text{GLA})^{-0.3}$ provided in the traffic manual were used to determine the AM and PM peak hour traffic respectively for the retail development. Retail developments normally generate three types of traffic:-

Primary Trips: completely new trips on the road network in the vicinity of the development mainly attracted by the development. The visit to the shopping centre is the primary reason for the trip.

Pass-by trips: these are trips that are already on the road and are intercepted by the shopping centre without diversion on their way to their primary destination.

Diverted trips: these are trips attracted from neighbouring streets in the vicinity of the development. These streets have no direct access to the centre and necessitate a diversion to reach the shopping centre.

Based on the 2nd edition of the South African Trip Generation Rates Manual by BKS, 42% of the total retail centre generated trips will be **primary trips** and were assigned on the road network as completely new trips. 35% was allocated to pass-by trips and 23% to diverted trips. The development's residential component will account for about 20% of the new trips generated by the retail centre and these trips are referred to as **internal trips**. A reduction of 20% should be applied on the retail's development new trips as these trips are already accounted for in the residential development trips however for the purpose of this report this reduction was not applied in order to test the worst case scenario. **New trips** expected to be generated by the development in both Phase1 and Phase 2 are shown in the tables below.

Table 7-1 : New Trips (Phase 1)

LAND USE	Weekday AM Peak Hour			Weekday PM Peak Hour			Weekend Saturday Peak Hour		
	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL
Residential	130	391	521	391	130	521	-	-	-
Retail	68	8	76	103	103	206	166	166	332
TOTAL	198	399	597	494	233	727	166	166	332

Table 7-2 : New Trips (Phase 2 or Full Phase)

LAND USE	Weekday AM Peak Hour			Weekday PM Peak Hour			Weekend Saturday Peak Hour		
	IN	OUT	TOTAL	IN	OUT	TOTAL	IN	OUT	TOTAL
Residential 1	130	391	521	391	130	521	-	-	-
Residential 3	30	91	121	91	30	121	-	-	-
Retail	135	15	150	206	206	412	332	332	664
TOTAL	295	497	792	688	366	1054	332	332	664

It should be noted that at the time of producing this report the extent of residential development proposed was some 15% higher than that finalised. Our traffic volumes and evaluation therefore reflect conservative traffic conditions some 15% higher than would actually be generated by the development.

8. TRIP DISTRIBUTION

The new trips that are expected to be generated by the proposed development were distributed and assigned to the adjacent road network based on the existing proportions of origins and destinations observed on the network. Refer to Figures 4; 5; 6 and 7 for the trip generation distribution in Annexure A for more details.

9. FUTURE SCENARIO: 2014 BACKGROUND TRAFFIC

The increase in traffic demand in the future design years 2014 and 2019 was achieved by applying a 2.5% per annum growth rate to the existing 2012 background traffic. This rate is in line with the current South African GDP forecast.

9.1 TRAFFIC EVALUATION FOR 2014

The development is expected to be operational by year 2014 and as such 2014 was chosen as a base year. The base year 2014 traffic was analysed using the existing 2012 road network plus the relevant upgrades proposed. The analysis results are shown in Table 3-2 in Annexure B of this report. A brief summary of the intersections' performance is discussed below:-

9.1.1 Intersection 1: Club Street and George Avenue

All approaches are expected to operate at acceptable LOS ranging from B to C during all peak hours.

9.1.2 Intersection 2: Club Street; Civin Drive and Linksfield Road

All approaches are expected to operate at accepted LOS ranging from B to D during all peak hours.

9.1.3 Intersection 3: Club Street; Chaucer Avenue and St Christopher Road

The west approach is expected to operate at unacceptable LOS E in the AM peak due to insufficient green time on the signal plan. This is a result of the reduction in green time which was done to increase the green time on the south approach in the 2012 scenario in order to meet the demand. A short receiving lane of about 60m is proposed on the north approach so that the exclusive short left turn lane on the south approach can be converted to a shared through and left in order to increase capacity and reduce delays on the south approach and afford the west approach some more green time to reduce delays. This upgrade will improve the flow and reduce delays from 64 seconds to 44 seconds on the west approach during the morning peak as shown in Table 3-2.

9.1.4 Intersection 4: Club Street and Donné Avenue

The side road is expected to experience delays due to lack of gaps on Club Street however the traffic demand will be very low and will not warrant a traffic signal.

9.1.5 Intersection 5: Club Street and Shelley Avenue

The side road is expected to experience delays due to lack of gaps on Club Street however the traffic demand will be very low and will not warrant a traffic signal.

9.1.6 Intersection 6: Club Street and St Andrews Avenue

The side road is expected to experience delays due to lack of gaps on Club Street however the traffic demand will be very low and will not warrant a traffic signal. Despite this, it is deemed appropriate as a traffic management measure to signalise this intersection. The signalisation of this intersection will not only provide an outlet for Senderwood traffic to divert to it in order to more easily get out of Senderwood at the signal, but it will also create larger gaps in the Club Street traffic for all the intersections such as Donné, Shelley, Huddle Park Golf Course, Byron, Gibbs, Johan and Grant to better access Club Street.

9.1.7 Intersection 7: Club Street and Byron Avenue

The side road is expected to experience delays due to lack of gaps on Club Street however the traffic demand will be very low and will not warrant a traffic signal.

9.1.8 Club Street

A growth rate of 2.5% was used to forecast the future traffic on the surrounding road network and links. Using this growth rate, the traffic on Club Street links is expected to increase to 1 050 vehicles per hour northbound which is 70% of the capacity of a one lane in each direction road according to the Highway Capacity Manual and therefore deemed sufficient to accommodate the increased background traffic for the 5 year period. At present the single lane per direction section of Club Street between Bedford Street and Louis Botha Avenue is the constraint which creates the bottleneck to traffic demand along the whole of Club Street. It is only when this section is upgraded to two lanes per direction, that it may be beneficial to traffic to upgrade the section east of Bedford Street. Any background traffic growth beyond the five years evaluated will be constrained by the section mentioned above.

Related to this is also the congestion at the King David School access point, which is an existing problem that needs to be addressed and for which alternatives have been mooted as contained in Annexure D.

10. PROPOSED ACCESSES

A new public link road will be created with an access onto Club Street (North) [Intersection 9] and on Club Street (Southwest) opposite Donn  Avenue [Intersection 4]. This link road has been called Huddle Crescent for ease of reference. A third access will provide exclusive access to the retail centre and is located 200m Southwest of the Club/Civin/Linksfield intersection along Club Street (Southwest) [Intersection 8]. All three access points will need to be signalised.

The residential development will gain access off the link road [Huddle Crescent].

10.1 HUDDLE CRESCENT/CLUB STREET [INT. 9]

This intersection is proposed off Club Street approximately 230m north of the Civin Drive and Linksfield Road intersection. The access will be signalised and served by one lane in and two lanes out as shown below. An exclusive 60m right turn lane should be provided on the north approach of Club Street.

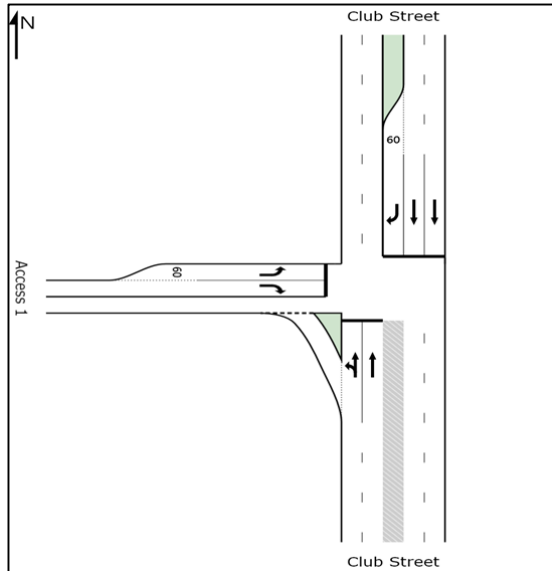


Figure 10-1 : Huddle Crescent and Club Street [Int. 9]

10.2 RETAIL ACCESS 1 AND CLUB STREET [INT. 8]

The Retail Centre Main Access is proposed off Club Street approximately 200m south of the Club Street, Civin Drive and Linksfield Road intersection. The access will be signalised and served by one lane in and two lanes out as shown below.

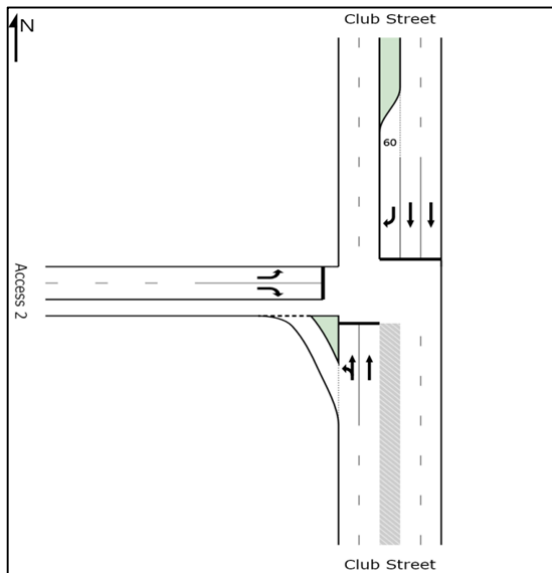


Figure 10-2 : Retail Access 1 and Club Street

10.3 HUDDLE CRESCENT/CLUB STREET/DONNÉ AVENUE [INT. 4]

This access Intersection is proposed at the Club Street and Donné Avenue intersection. The proposed link road (Huddle Crescent) will be served by one lane in each direction with 2 approach lanes as shown below. This intersection will also be signalised.

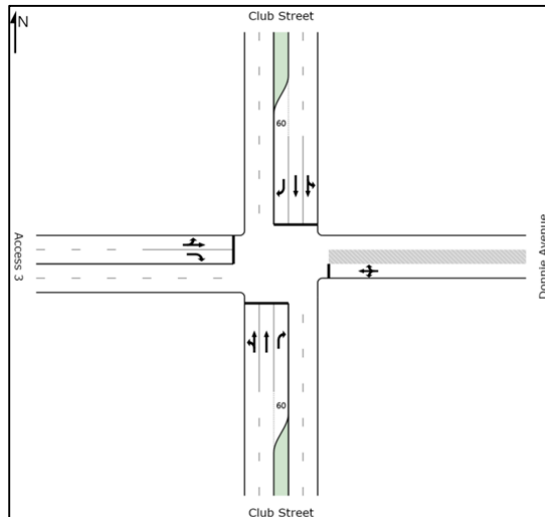


Figure 10-3 : Huddle Crescent/Club Street/Donné Intersection

Direct access to the Residential development is proposed at three locations along Huddle Crescent.

The easternmost of these accesses will be a T-junction serving the Residential 3 part of the development. We have designated this intersection 10. The second residential access along Huddle Crescent will be controlled by a roundabout and has been designated intersection 11. There will be a boomed security gate to the residential estate on the northern leg of this roundabout. The third residential access on Huddle Crescent will serve the balance of the residential estate and this stop controlled T-junction has been designated intersection 12. It's northern leg will also have a security boomed gate.

A fourth access on Huddle Crescent served as secondary access to the Retail Centre, designated intersection 13, and is also a stop controlled T-junction.

A provisional Development layout is shown in Annexure C.

11. FUTURE SCENARIO: 2014 TRAFFIC + DEVELOPMENT

This scenario takes into account the new trips expected to be generated by the proposed development and evaluates the traffic impact against the 2014 Base Year road network plus relevant upgrades if any.

Figure 19 and 20 in Annexure A depicts the percentage of new trips at each intersection for both Phase 1 and Phase 2 in relation to the total traffic on the road network.

11.1 TRAFFIC EVALUATION

The intersection evaluation results are shown Table 3-3 in Annexure B. A brief summary of the evaluation is discussed below:-

11.1.1 Intersection 1: Club Street and George Avenue

The intersection is expected to operate at acceptable LOS C during the AM; PM and Saturday peak hours. The impact of the new traffic will be slight at this intersection in 2014.

11.1.2 Intersection 2: Club Street; Civin Drive and Linksfield Road

The west approach is expected to operate at LOS F due to the additional traffic and requires more green time to clear the intersection. Due to high right turning demand on the south approach, a couple of seconds were taken from the west approach and allocated to the south approach to reduce the existing queues and therefore the west approach is expected to suffer and will battle to service the additional trips from the development 2014. An additional right turning lane is proposed on south approach to increase capacity at the intersection and reduce the delays on the west approach as shown in Table 3-3.

11.1.3 Intersection 3: Civin Drive; Chaucer Avenue and St Christopher Road

The intersection is expected to operate at LOS C, C and B during the AM; PM and Saturday peak hours respectively.

11.1.4 Intersection 4: Club Street; Donn  Avenue and Huddle Crescent

Access 3 is proposed at this intersection forming a fourth leg on the west approach. The intersection will be converted to a signalised intersection and was analysed as such. The intersection is expected to operate at acceptable LOS B at worst during all the peak hours as shown in Table 3-3.

11.1.5 Intersection 5: Club Street and Shelley Avenue

The side road is expected to experience delays due to lack of gaps on Club Street however the traffic demand will be very low and will not warrant a traffic signal. The introduction of traffic signals at Club Street; Public Road and Donn  Avenue is expected to reduce delays at this intersection because more gaps will be available as soon as the signal turns red on Club Street.

11.1.6 Intersection 6: Club Street and St Andrews Avenue

The side road is expected to experience delays due to lack of gaps on Club Street however the traffic demand will be very low and will not warrant a traffic signal. This intersection is central to both Byron Avenue and Shelley Avenue and therefore can be used to alleviate the delays at all three intersections by introducing a traffic signal which will attract the traffic that was to use these intersections to divert to St Andrews for easy access onto Club Street.

11.1.7 Intersection 7: Club Street and Byron Avenue

The side road is expected to experience delays due to lack of gaps on Club Street however the traffic demand will be very low and will not warrant a traffic signal. The introduction of traffic signals at Club Street and St Andrews Avenue is expected to reduce delays at this intersection because more gaps will be available on Club Street as soon as the signal turns red for the traffic on Club Street.

11.1.8 Intersection 8: Club Street and Main Retail Access

The signalised intersection is expected to operate at acceptable LOS B during all peak hours.

11.1.9 Intersection 9: Club Street and Huddle Crescent (North)

The signalised intersection is expected to operate at acceptable LOS B during the AM peak; LOS B in the PM peak and LOS A during the Saturday peak hour.

11.1.10 Club Street

Club Street in the current state is a mobility road with a vehicle capacity of 1 500 vph per direction. The intersections along Club Street are stop controlled from the side giving priority to traffic on Club Street which ensures free flow from Club Street; Civin Drive and Linksfield Road all the way to the next pedestrian Signal at King George School. The conversion of Club Street & Donné Avenue and Club Street & St Andrews Avenue intersections from stop controlled intersections to signalised intersections means that the flow will be disrupted and therefore reduce the capacity to 1 200 pcu/h/lane. The 2014 background traffic on Club Street makes up about 87% of the required capacity which is very close to saturation.

The forecasted year 2014 traffic + Development on the links indicate that the new road capacity (1 200 pcu/h/lane) on Club Street south of the development will be exceeded therefore Dualling of this road is proposed to accommodate future traffic. The proposed upgrade extent spans 1050m from Linksfield/Club/Civin intersection to south of Club/Huddle Park Golf Course entrance.

12. CAPACITY ANALYSIS – FIVE YEAR HORIZON: 2019 BACKGROUND TRAFFIC

The proposed development will generate more than 150 trips, thus it is required that the traffic condition of five years after the base year be evaluated. From previous traffic studies conducted by Goba (Pty) Ltd in the same area the traffic growth was conservatively estimated to be 2.5% for all vehicles. To forecast the 2019 traffic, the total 2012 traffic was increased by this growth rate for seven years.

12.1 TRAFFIC EVALUATION

The projected 2019 traffic volumes are shown in Figure 12, Annexure A. This scenario was analysed using the future 2019 road network plus proposed upgrades from the previous scenarios. The

analysis results for this scenario are shown in Table 3-4; Annexure B. The brief summary of the output is discussed below:-

12.1.1 Intersection 1: Club Street and George Avenue

The intersection will operate at LOS C during all peak hours.

12.1.2 Intersection 2: Club Street; Civin Drive and Linkfield Road

All approaches are expected to operate at accepted LOS ranging from B to D during all peak hours.

12.1.3 Intersection 3: Civin Drive; Chaucer Avenue and St Christopher Road

The south approach is expected to suffer in the AM peak because of the lack of capacity to receive the traffic on the north approach therefore the short 60m lane proposed in the 2014 traffic + development scenario has to be extended to 120m to accommodate the future traffic. The south approach is expected to improve to LOS C once the upgrade is in place as shown in the upgrade table.

12.1.4 Intersection 4: Club Street and Donné Avenue

The intersection is expected to operate at acceptable LOS B with lots of spare capacity to accommodate the traffic expected to divert from Shelley Avenue.

12.1.5 Intersection 5: Club Street and Shelley Avenue

The intersection with the current traffic forecasted to 2019 is expected to struggle to enter Club Street but with the traffic signal operating the Club Street and Donné Avenue intersection, gaps are bound to appear for the traffic utilising this intersection thus reducing delays.

12.1.6 Intersection 6: Club Street and St Andrews Avenue

This intersection will be signalised in 2019 and will operate at acceptable LOS B in the morning peak.

12.1.7 Intersection 7: Club Street and Byron Avenue

This intersection is expected to improve as well due to the traffic signal at Club Street and St Andrews resulting gaps on Club Street. Some motorists are expected to divert to St Andrews which is easily accessible from Byron Avenue prior to reaching Club Street.

13. TRAFFIC EVALUATION – FIVE YEAR HORIZON: 2019 TRAFFIC + DEVELOPMENT

This scenario takes into account the new trips expected to be generated by the proposed development and measures the traffic impact against the future 2019 road network plus proposed

upgrades. The future 2019 background traffic + development volumes are shown in Figure 18 in Annexure A.

13.1 TRAFFIC EVALUATION

The traffic evaluation was done assuming that all upgrades proposed in all the previous scenarios will be in place. The intersection results are shown in Table 3-5 in Annexure B. A brief summary of each intersection's performance is discussed below:-

13.1.1 Intersection 1: Club Street and George Avenue

The intersection is expected to operate at LoS D during the AM peak hour which is the worst case scenario. The additional traffic from the development will not have negative effect on the intersection.

13.1.2 Intersection 2: Club Street; Civin Drive and Linksfild Road

The additional traffic from the development will have the west approach operating at LOS E in the AM peak. The south approach was upgraded in the 2014 scenario to dual right turning lanes; two through lanes and a slip lane therefore a few seconds on the signal plan can be taken off the full phase and allocate it to the west approach to improve the delays. The delays will be reduced once the signal plan has been changed to accommodate the extra traffic on the west approach as can be seen in Table 3-5.

13.1.3 Intersection 3: Civin Drive; Chaucer Avenue and St Christopher Road

The intersection is expected to operate at LOS C, and B during the AM, PM and Saturday peak hours respectively.

13.1.4 Intersection 4: Club Street; Donn  Avenue and Huddle Crescent

New Public Road (Huddle Crescent) is proposed at this intersection forming a fourth leg on the northwest approach. The intersection is expected to operate at acceptable LOS B at worst during all the peak hours as shown in Table 3-5.

13.1.5 Intersection 5: Club Street and Shelley Avenue

The side road is expected to experience delays due to lack of gaps on Club Street however the traffic demand will be very low and will not warrant a traffic signal. The introduction of traffic signals at Club Street; Access 3 and Donn  Avenue is expected to reduce delays at this intersection because more gaps will be available on Club Street.

13.1.6 Intersection 6: Club Street and St Andrews Avenue

The traffic signal controlled intersection will operate at acceptable LOS B during all peak hours. This will allow the concentration of Senderwood traffic to exit, but also will provide longer gaps for the other Club Street intersections to access Club Street.

13.1.7 Intersection 7: Club Street and Byron Avenue

The side road is expected to experience delays due to lack of gaps on Club Street however the traffic demand will be very low and will not warrant a traffic signal. The introduction of traffic signals at Club Street and St Andrews Avenue is expected to reduce delays at this intersection because more gaps will be available on Club Street.

13.1.8 Intersection 8: Club Street and Retail Centre Access

The signalised intersection is expected to operate at acceptable LOS B during AM and PM peak hours and LOS C during the weekend Saturday peak hour.

13.1.9 Intersection 9: Club Street and Huddle Crescent (North)

The signalised intersection is expected to operate at acceptable LOS B during the AM peak; LOS B in the PM peak and LOS A during the Saturday peak hour.

13.1.10 Intersection 10 : Huddle Crescent and Res 3 Access

This stop controlled intersection always operates at LoS A.

13.1.11 Intersection 11 : Huddle Crescent and (North Residential Access)

This traffic circle controlled intersection is expected to operate at LoS B during all peak periods. It is proposed to provide a 10m inner circle radius (20m diameter) with 4m circle roadway to operate as a proper roundabout.

13.1.12 Intersection 12: Huddle Crescent and West Residential Access

This stop controlled T-junction is expected to operate at LoS C during the A.M. Peak period and at LoS B during the P.M. Peak and Saturday Peak periods.

13.1.13 Intersection 13 : Huddle Crescent and 2nd Retail Access

This stop-controlled T-junction always operates at LoS B.

13.1.14 Intersection 14 : Huddle Park Golf Course and Club Street

During the A.M. Peak at the exit the left turn traffic is operating at LoS C but the right turn traffic operates at LoS F.

During the P.M. Peak at the exit the left turn operates at LoS E and the right turn at LoS F.

At all times the right turning traffic into the Golf Course operates at LoS C or better.

An intersection upgrade is proposed whereby the exit and entrance accesses are combined at the location of the current entrance. This provides an opportunity to create a protected traffic refuge for right turn exiting traffic, by utilising the space model longitudinally opposite the exclusive right turn from the north. In so doing a 35m protected lane is created which will merge with the southbound traffic. The traffic demand exiting the Huddle Park Golf Course is not sufficient to warrant a traffic signal, but with this arrangement and the signalisation of the St. Andrews and Club Street intersection upstream, opportunities of sufficient gaps will be created for the Golf Club traffic to exit safely under satisfactory operating conditions. The proposed intersection layout is shown in Figure 13-1 below.

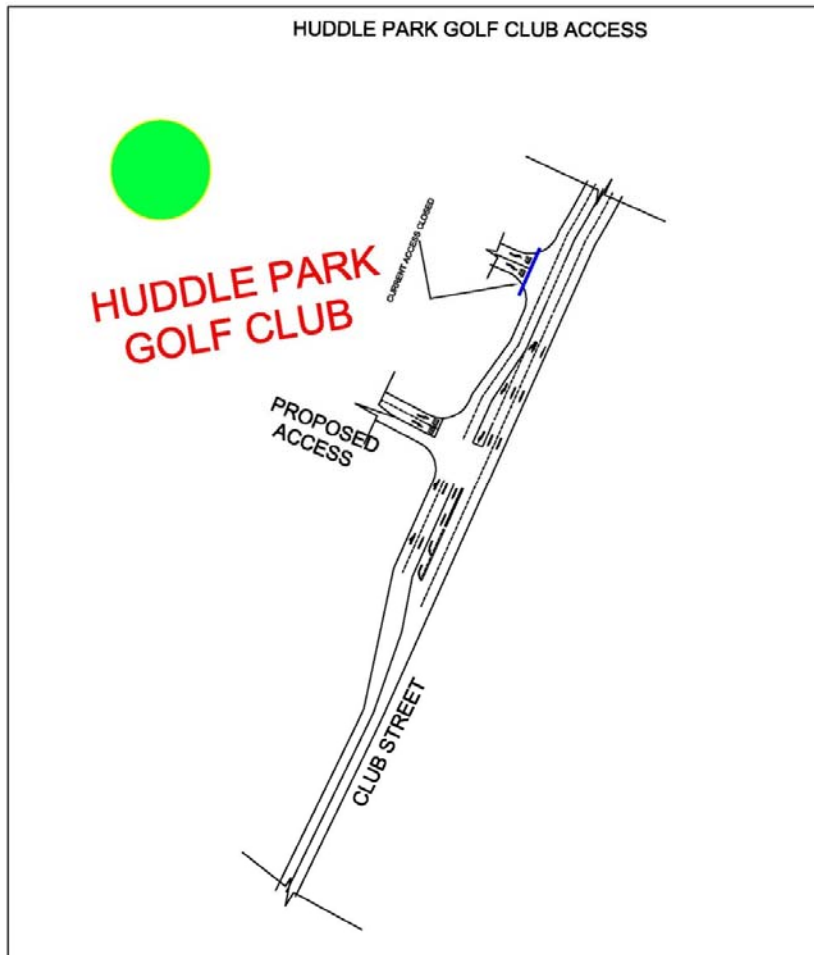


Figure 13-1 : Proposed Upgrade of Consolidated Golf Club Access

13.1.15 North and West Access controlled gates to Residential Estate

The total Residential (1 & 2) demand is 521 vehicles per hour. The critical period is during the afternoon peak when 75% of 521 cars (391) will be returning home. The worst split between two entrances would be 0.67 : 0,33. This is 262 vehicles per hour entering the complex. As we know that this arrival may be very peaked in nature we should apply a PHF of 0,85 at least to determine a peak 15 minute flow rate. The result is a peak 15min flow rate of 308 vph. As a worst case we can assume a 10% visitors arrival of 30 vph.

Since these visitors can take up to 2 minutes to be processed one entrance lane will need to be dedicated for visitors.

A queuing analysis has been performed for the flow rate of 308 vph assuming a smart card scan/swipe service time of 8 sec. The results indicate that one service lane for residents will be sufficient, only generating a queue of 2.2 vehicles. The analysis results are shown in Annexure B.

Since this is an exclusive residential development it is proposed that three service lanes be provided for the entrance and two lanes for the exit. This will ensure that even if the visitors lane is continually occupied, the queue generated will never exceed 3 vehicles. It is proposed to place the boom at least 30m away from the access intersection, so that no backing up will occur onto Huddle Crescent.

As per JRA requirements, one of the entrance/exit lanes should be at least 4,2 wide with a clearance of 5m to allow a fire truck clear access in an emergency.

14. PROPOSED UPGRADES

A drawing layout depicting the road network with associated upgrades and proposed accesses is attached in Annexure C. The following upgrades are proposed according to design years and responsibilities:

14.1 DESIGN YEAR 2012

Club Street; Civin Drive and Linksfield Road

- Signal optimisation is proposed to meet the high right turning demand on the south approach.

Civin Drive and Chaucer Avenue and St Christopher Avenue

- Signal optimisation is proposed to meet the high demand on the south approach.

14.2 DESIGN YEAR 2014

Club Street

- Dualling of Club Street is proposed from Club/Chaucer/Linksfield intersection spanning 1050m to south of Club/Huddle Golf Course access.

Club Street; Civin Drive and Linksfield Road

- A second right turning lane is proposed on the south approach.

Civin Drive and Chaucer Avenue and St Christopher Avenue

- A short 60m receiving lane is proposed on the north approach.

Club Street; Donné Avenue and Access 3

- A traffic signal accompanied by a short right turn lane on the north approach and a left slip lane on the south approach are proposed.

Club Street and St Andrews Road/Avenue

- A traffic signal is proposed.

14.3 DESIGN YEAR 2019

Club Street; Civin Drive and Linksfield Road

- Signal optimisation to accommodate additional traffic from the development on the west approach is proposed.

Civin Drive and Chaucer Avenue and St Christopher Avenue

- An extension to 120m of the proposed short 60m accepting lane on the north approach is proposed to accommodate future traffic.

15. ACCESS TO PUBLIC TRANSPORT

15.1 BACKGROUND

In terms of the National Land Transport Act (NLTA), Section 29, it is a requirement that an assessment of the public transport be included in traffic impact assessments. The following comments are relevant in respect of the public transport availability/provision for the proposed development.

15.2 EXISTING PUBLIC TRANSPORT FACILITIES

A number of public transport facilities were noted along Club Street further south of the Club Street/Civin Drive and Linksfield Road intersection. The facilities noted were bus shelters without bus bays. The buses make use of the on street stop to pick up passengers. These facilities will have to be moved to appropriate new positions when the road is upgraded to two lanes to each direction in the form of public transport laybys with paved sidewalks to the nearest safe pedestrian crossing.

Additional public transport facilities are proposed on both sides of all three accesses on the far side of intersections to the JRA standard requirements.

15.3 PEDESTRIAN MOVEMENT

All proposed accesses will be stop controlled and therefore will accommodate pedestrians crossing the road to access the development. The signal plans must ensure pedestrians safely cross the road and should be designed by a registered traffic engineer.

15.4 PEDESTRIAN WALKWAYS

A 1.5m wide sidewalk is proposed on the western side of Club Street (north of Linksfield & Civin Drive intersection) and the northern side of Club Street (west of the Linksfield & Civin Drive intersection). A similarly wide sidewalk is proposed from the location of the southern side public transport laybys to the nearest signalised intersection.

16. CONCLUSIONS

The following is concluded:

- The existing traffic evaluation indicated that several of the intersections along Club Street are currently experiencing unacceptable levels of service and require upgrading even before any development is mooted. These are:
 - Club/Civin/Linksfield intersection during the A.M. Peak.
 - Civin/Chaucer/St Christopher intersection during A.M. Peak.
 - Club Street & Donné Avenue
 - Club Street & Shelley Avenue
 - Club Street & St Andrews Avenue
 - Club Street & Byron Avenue
 - Club Street & King David School Access
- The proposed development will be located at north western corner of Club Street; Civin Drive and Linksfield Road intersection in Senderwood Edenvale.
- The development will generate a total of 792 vehicle trips in the AM; 1054 vehicle trips in the PM and a total of 664 vehicle trips during the Saturday Peak hour.

- Three full accesses are proposed to serve the development. Access 1 (Huddle Crescent Int. 9) is proposed 230m north of Club Street/Civin Drive/Linksfield Road intersection; Access 2 (Retail Centre Int. 8) is proposed 200m south of Club Street/Civin Drive/Linksfield Road. Access 3 (Huddle Crescent Int. 4) is proposed at the Donn  Avenue/Club Street intersection. This will form a fourth leg at intersection Club Street and Donn  Avenue.
- Access 1 will serve both the residential and retail portions of the development via Huddle Crescent at intersection 9.
- Access 2 will serve the retail development at Intersection 8.
- Access 3 will serve both the residential and retail portions of the development via Huddle Crescent at intersection 4.
- Public Transport layby facilities to JRA standards are proposed on both sides of all three proposed access intersections (4, 8 & 9).
- The intersections of Byron Avenue, Shelley Avenue and St Andrews Avenue do not warrant traffic signals however a traffic signal to help alleviate delays is proposed at St Andrews/Club Street intersection. This will provide the Senderwood traffic two opportunities to enter the stream along Club Street namely Donn  Avenue and St Andrews Avenue. With the envisaged consolidation of side road traffic demand, the St Andrews/Club Street intersection signalisation is deemed warranted.
- A 1.5m wide sidewalk is proposed on the western side of Club Street (north of Linksfield & Civin Drive intersection) and northern side of Club Street (west of the Linksfield & Civin Drive intersection). A similarly wide sidewalk is proposed from the location of the southern side public transport laybys to the nearest signalised intersection so that pedestrians can cross safely.
- The proposed road and intersection improvements will satisfy both the needs of the additional traffic generated by the proposed development while simultaneously significantly improving the current unacceptable levels of service on the existing local road system.

16.1.1 The following upgrades are proposed to address the traffic operational problems:

16.1.1.1 Club Street

- An upgrade of Club Street south of the development to a two lane per direction road from the Club Street/Linksfield Road/Civin intersection to a point 60m south of the Club Street/Huddle Park Golf Course access is proposed.

16.1.1.2 Club Street, Civin Drive and Linksfield Road intersection.

- Signal optimisation is proposed to meet the high right turning demand on the south approach.
- A second right turning lane is proposed on the south approach.
- Signal optimisation to accommodate additional traffic from the development on the west approach is proposed.

16.1.1.3 Civin Drive, Chaucer Avenue and St Christopher Drive

- Signal optimisation is proposed to meet the high demand on the south approach.
- A short 60m receiving lane is proposed on the north approach.
- An extension to 120m of the proposed short 60m accepting lane on the north approach is proposed to accommodate future traffic.

16.1.1.4 Club Street and St Andrews intersection.

- A traffic signal is proposed at this intersection.

16.1.1.5 Club Street and Huddle Park Golf Club Access

It is proposed to consolidate this intersection at the location of the entrance by providing a protected exit right turn lane with the four lane cross section at this location. The detailed layout is shown in Figure 13-1. Traffic will be able to exit under priority control because of the gaps created by the proposed St. Andrews Road/Club Street intersection signalisation.

16.1.1.6 Development Accesses

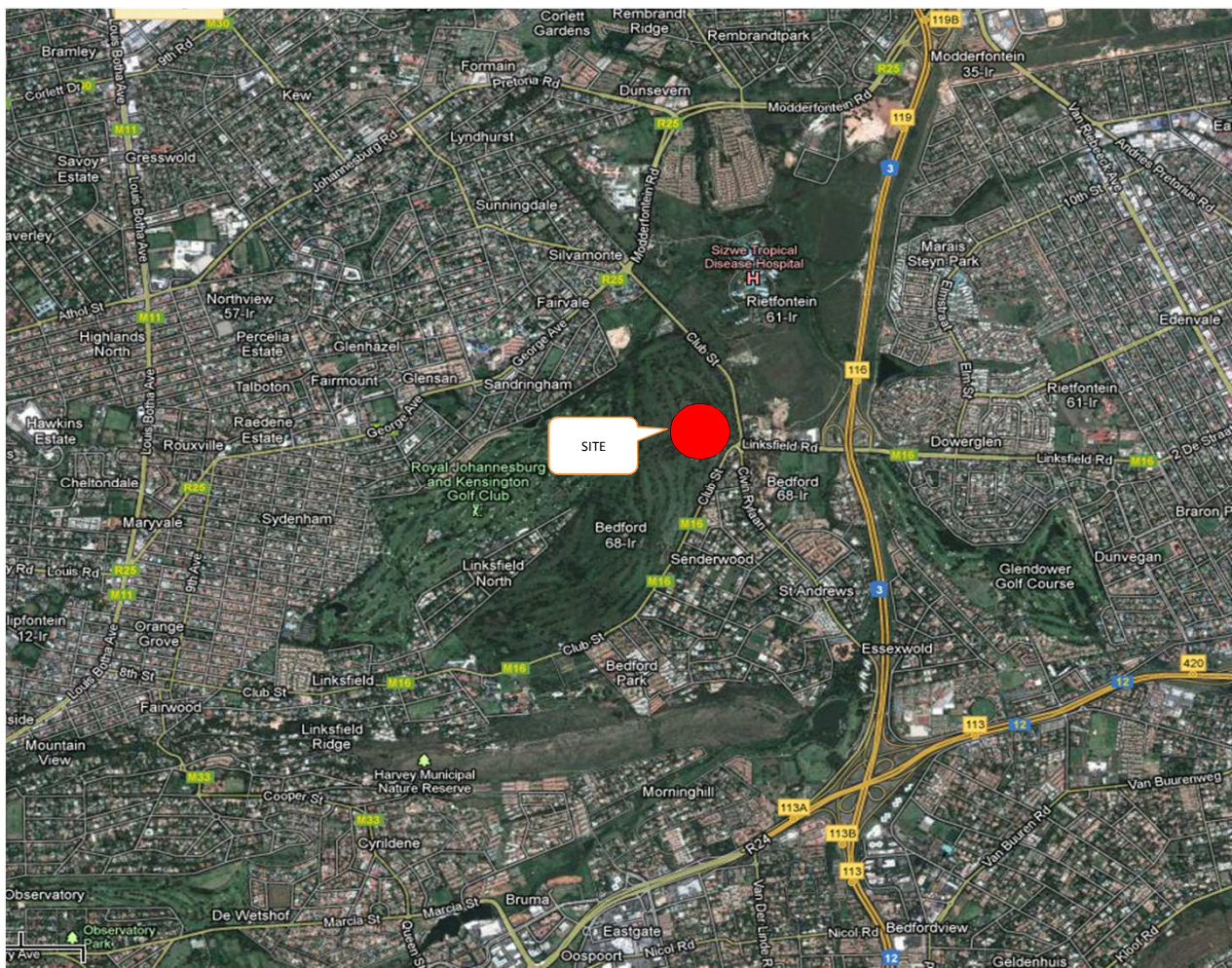
- The developer will construct the Huddle Crescent public road with access onto Club Street at intersection 4 and 9 and the new proposed signalised intersection to the retail centre (Intersection 8). All these intersections will require signalisation.
- A roundabout with a mountable internal circle 20m diameter and outer circle diameter of 28m is proposed for the northern residential access on Huddle Crescent [Int. 11].
- A stop control T-junction is proposed for the Res. 3 and westernmost residential access off Huddle Crescent (Intersection 10 & 12).
- Three entrance lanes and two exit lanes are proposed for each of the security access controlled residential estate access points. The entrance stoplines should be at least 30m set back from the Huddle Crescent intersections and at least one of the lanes should be 4.2 wide and 5m high to allow emergency vehicle access.

17. RECOMMENDATIONS

It is recommended that this Huddle Park Residential Development Traffic Impact Study be approved in support of the development with due consideration for the overall findings. The design of the proposed accesses and upgrades should be designed by a professional engineer to the road custodian standards.

ANNEXURE A - FIGURES

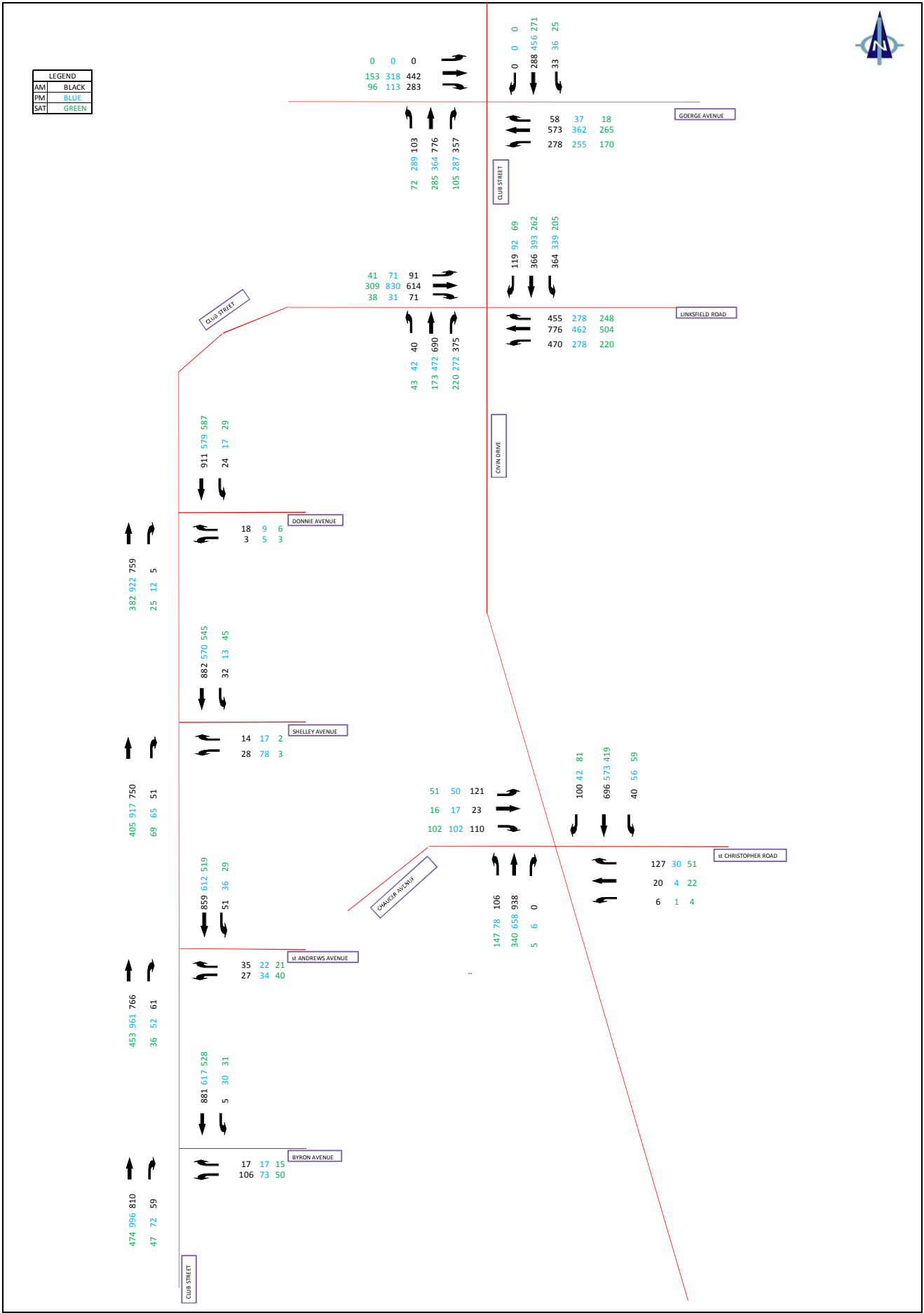
ANNEXURE A - LIST OF FIGURES



LOCALITY MAP

FIGURE 1

LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN

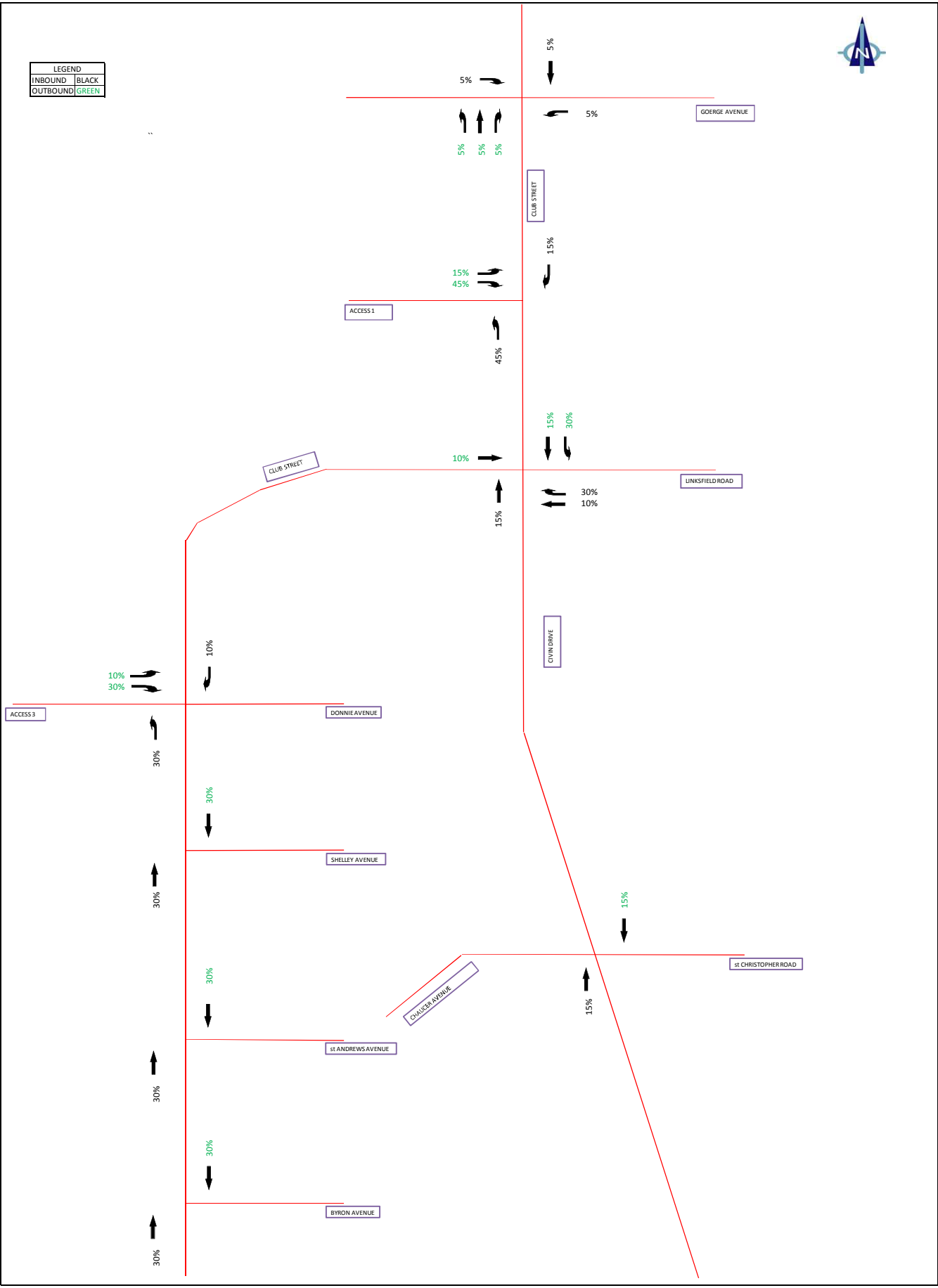


2012 EXISTING TRAFFIC (Weekday AM; PM and Saturday)

FIGURE 2



LEGEND	
INBOUND	BLACK
OUTBOUND	GREEN

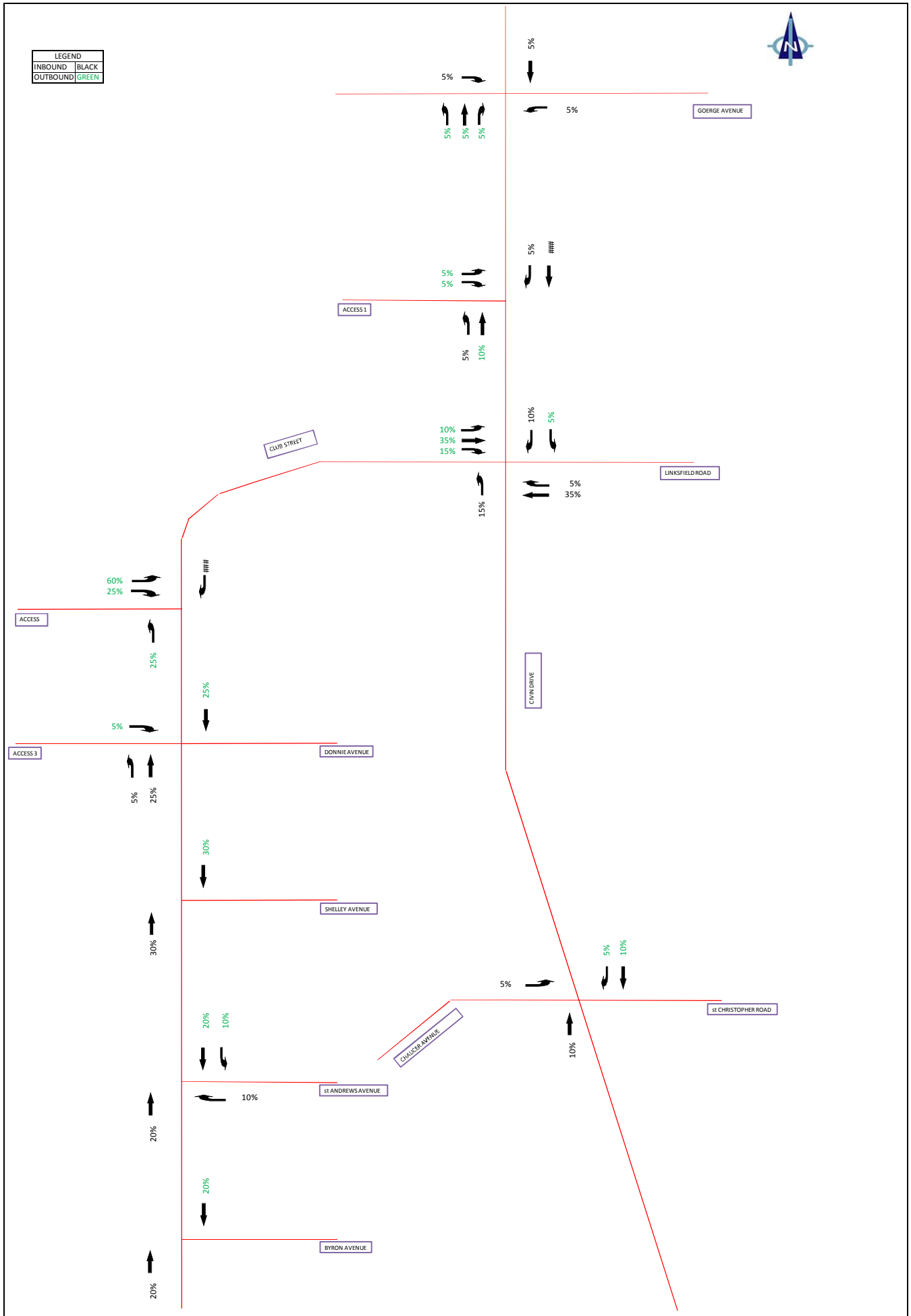


TRIP DISTRIBUTION IN PERCENTAGES
(RESIDENTIAL)

FIGURE 3



LEGEND	
INBOUND	BLACK
OUTBOUND	GREEN

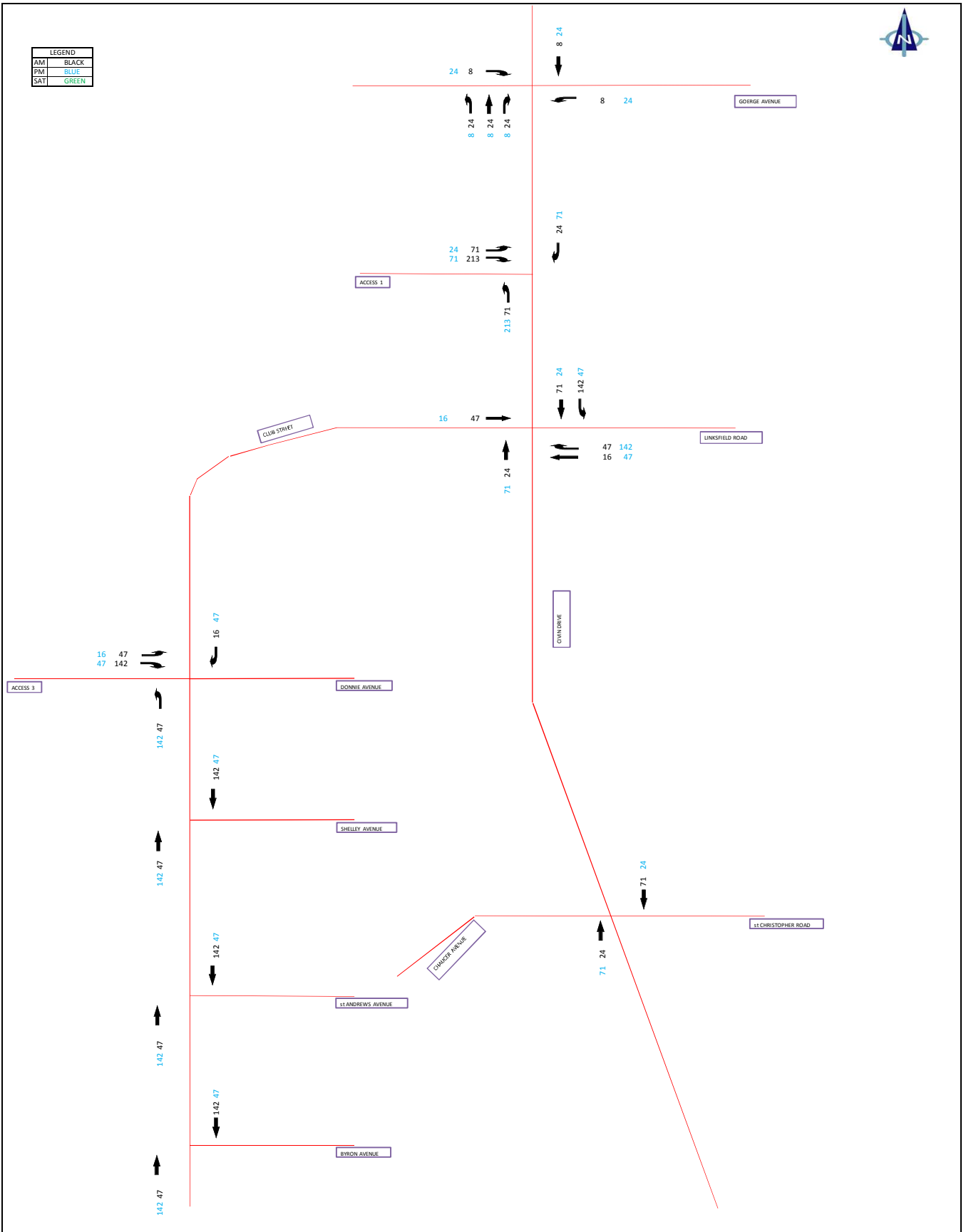


TRIP DISTRIBUTION IN PERCENTAGES
(RETAIL)

FIGURE 4



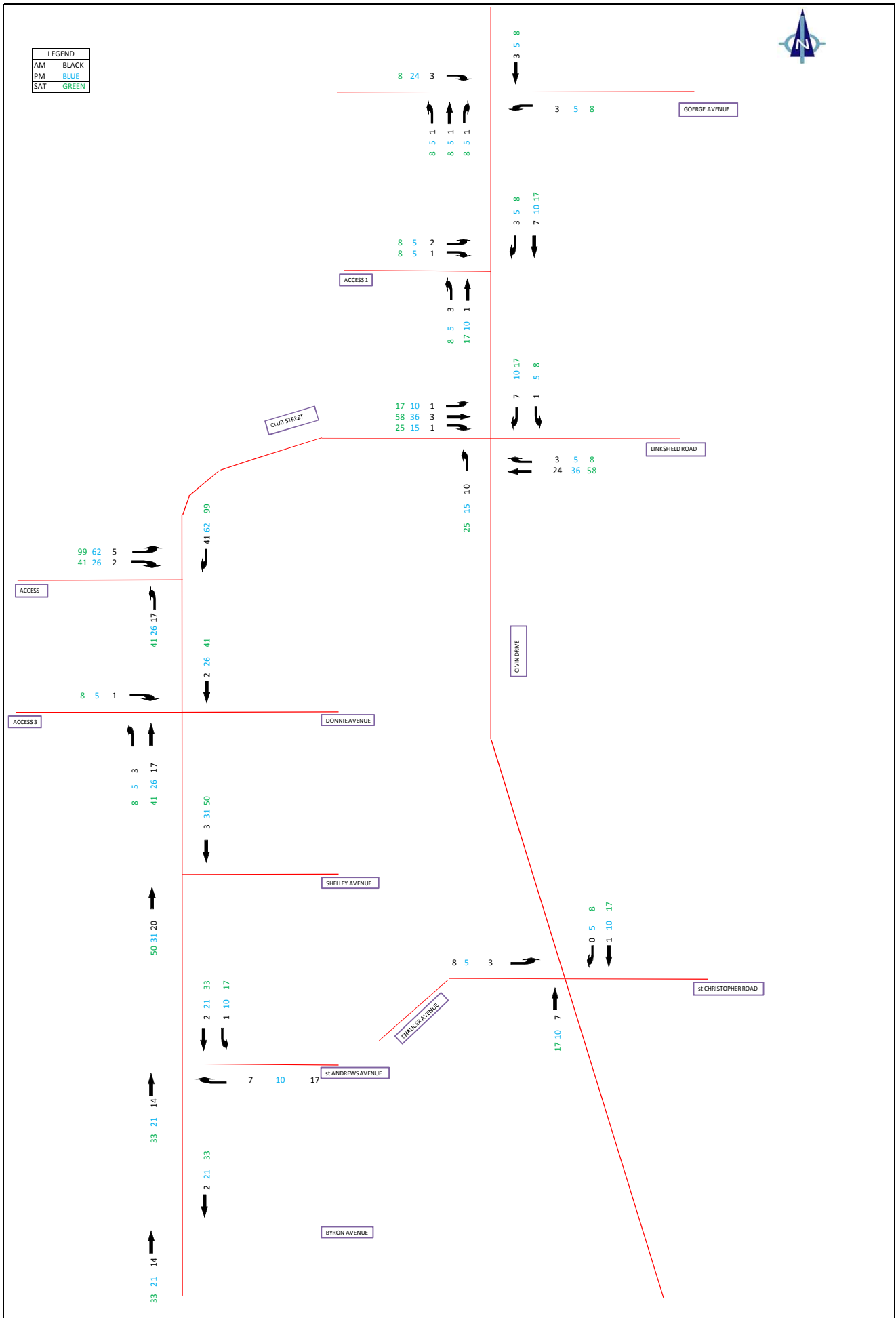
LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



TRIP ASSIGNMENT
(RESIDENTIAL PHASE 1)

FIGURE 5

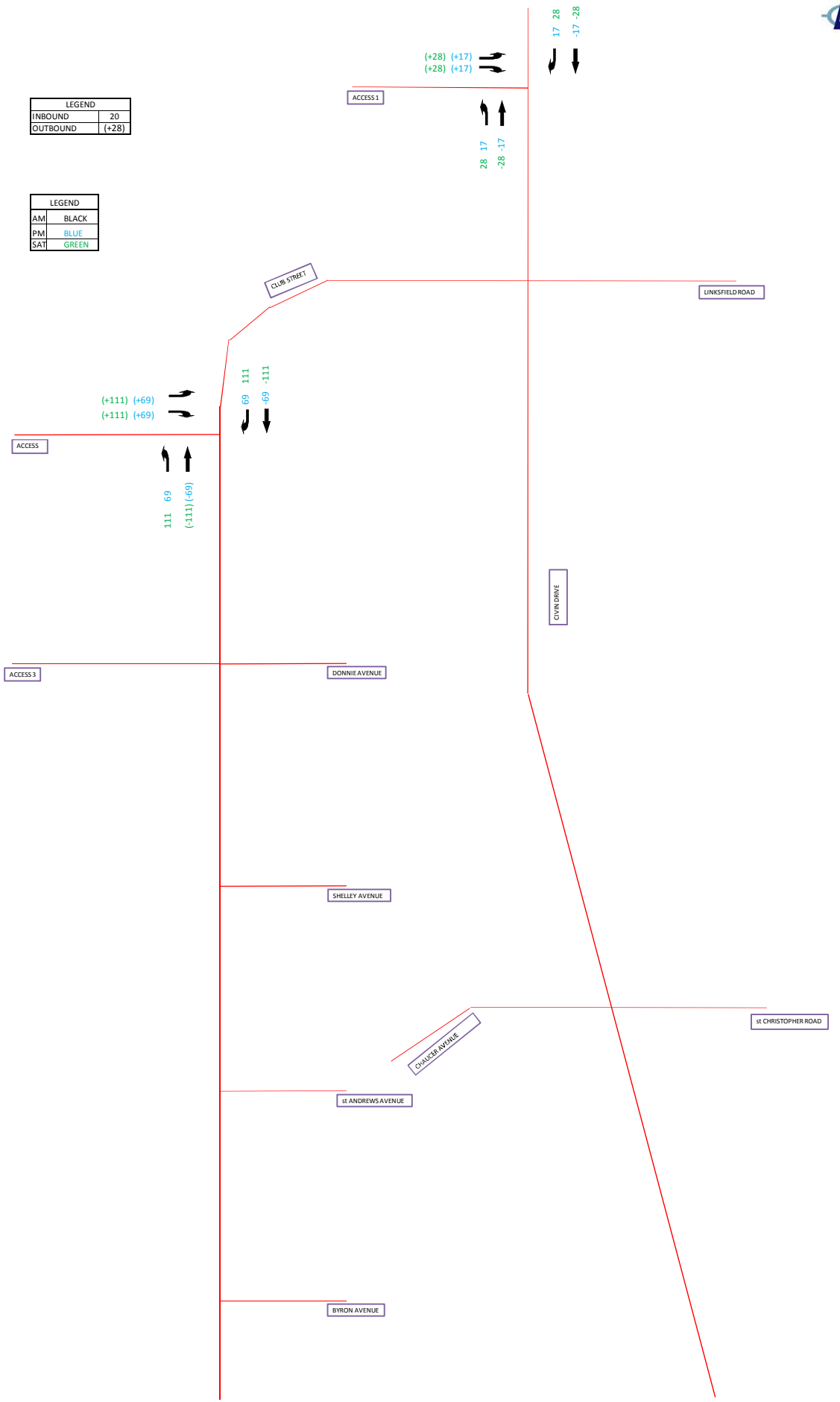
LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN





LEGEND	
INBOUND	20
OUTBOUND	(+28)

LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



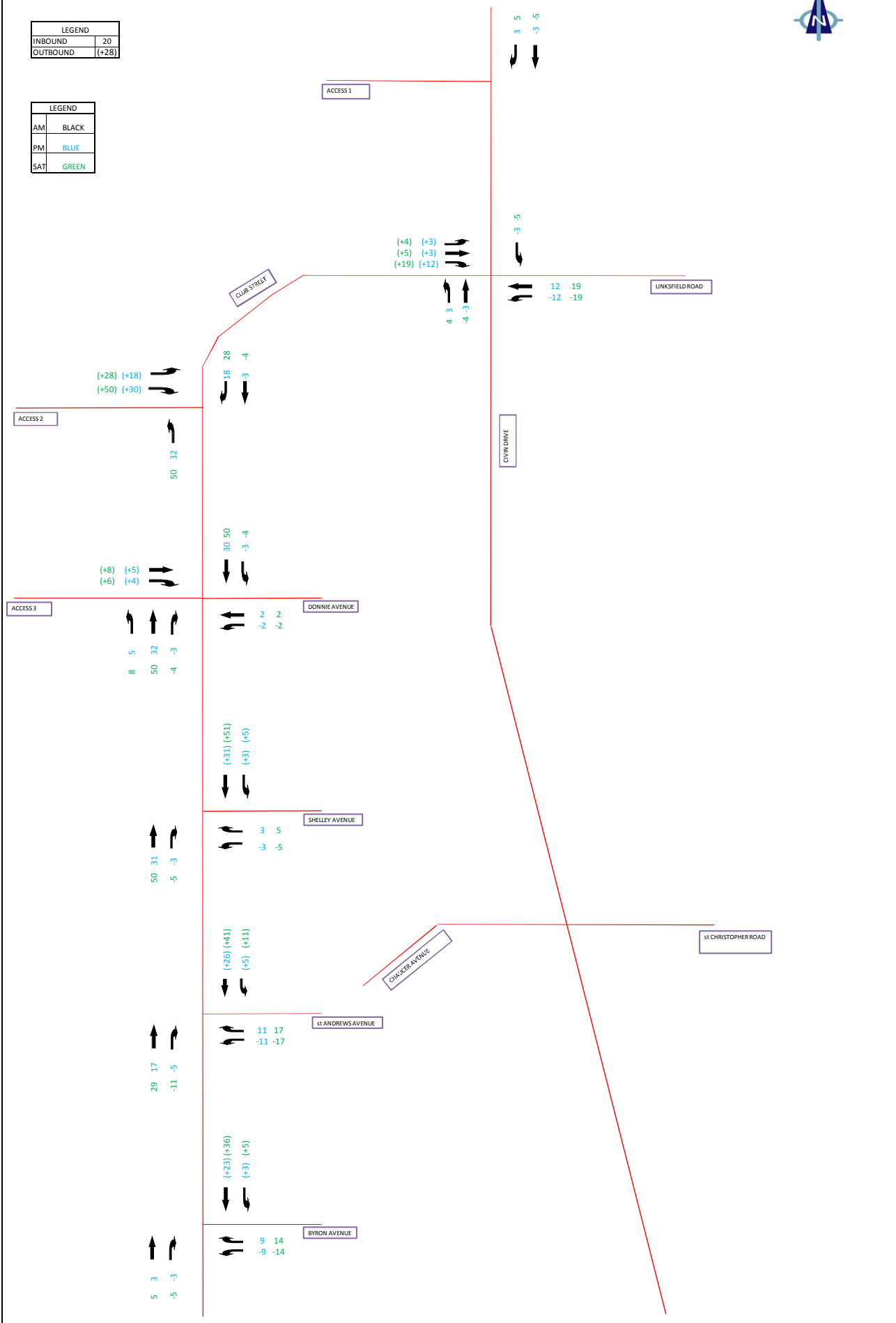
PASS-BY (PHASE 1)

FIGURE 7



LEGEND	
INBOUND	20
OUTBOUND	(+28)

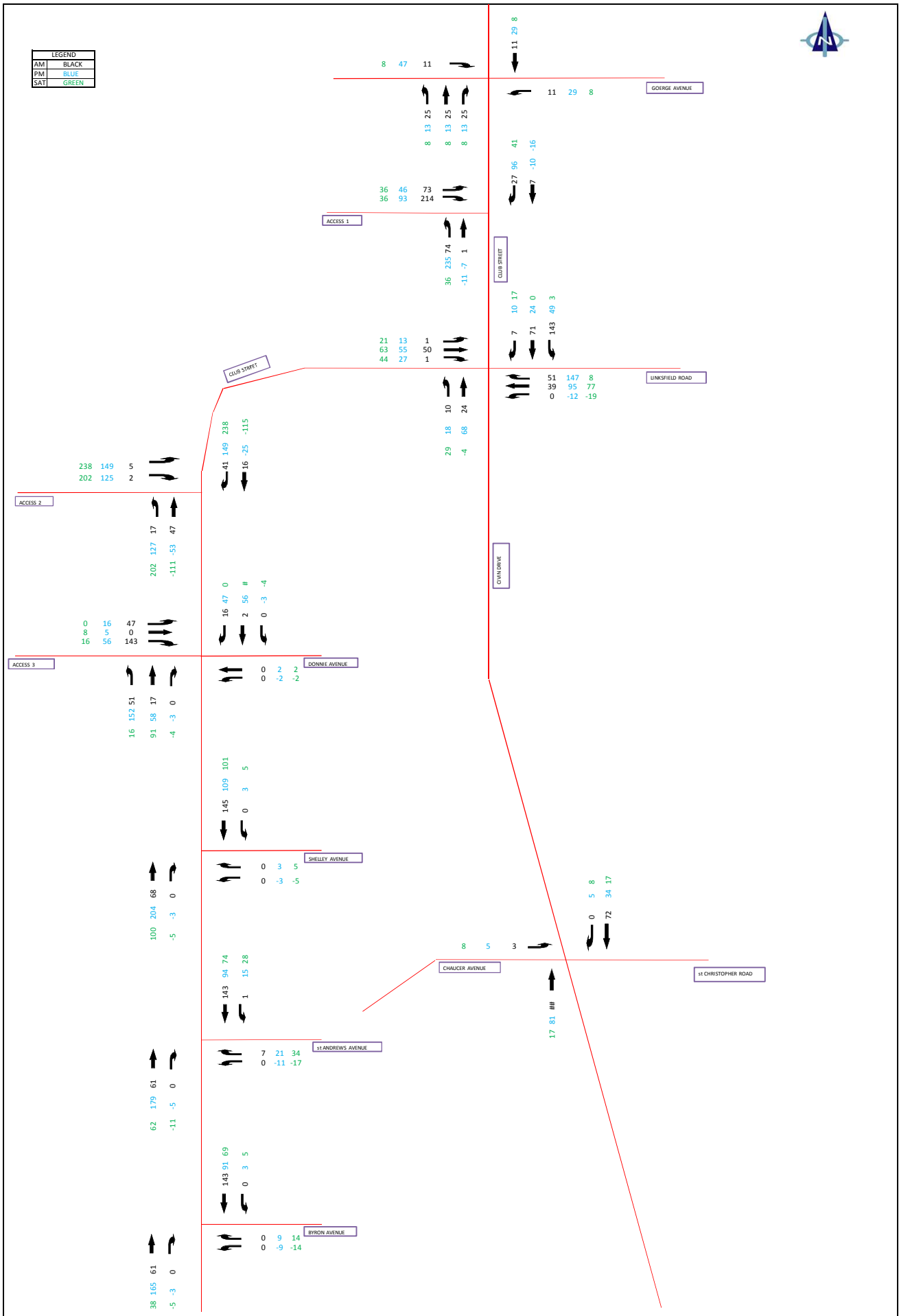
LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



DIVERTED TRIPS (PHASE 1)

FIGURE 8

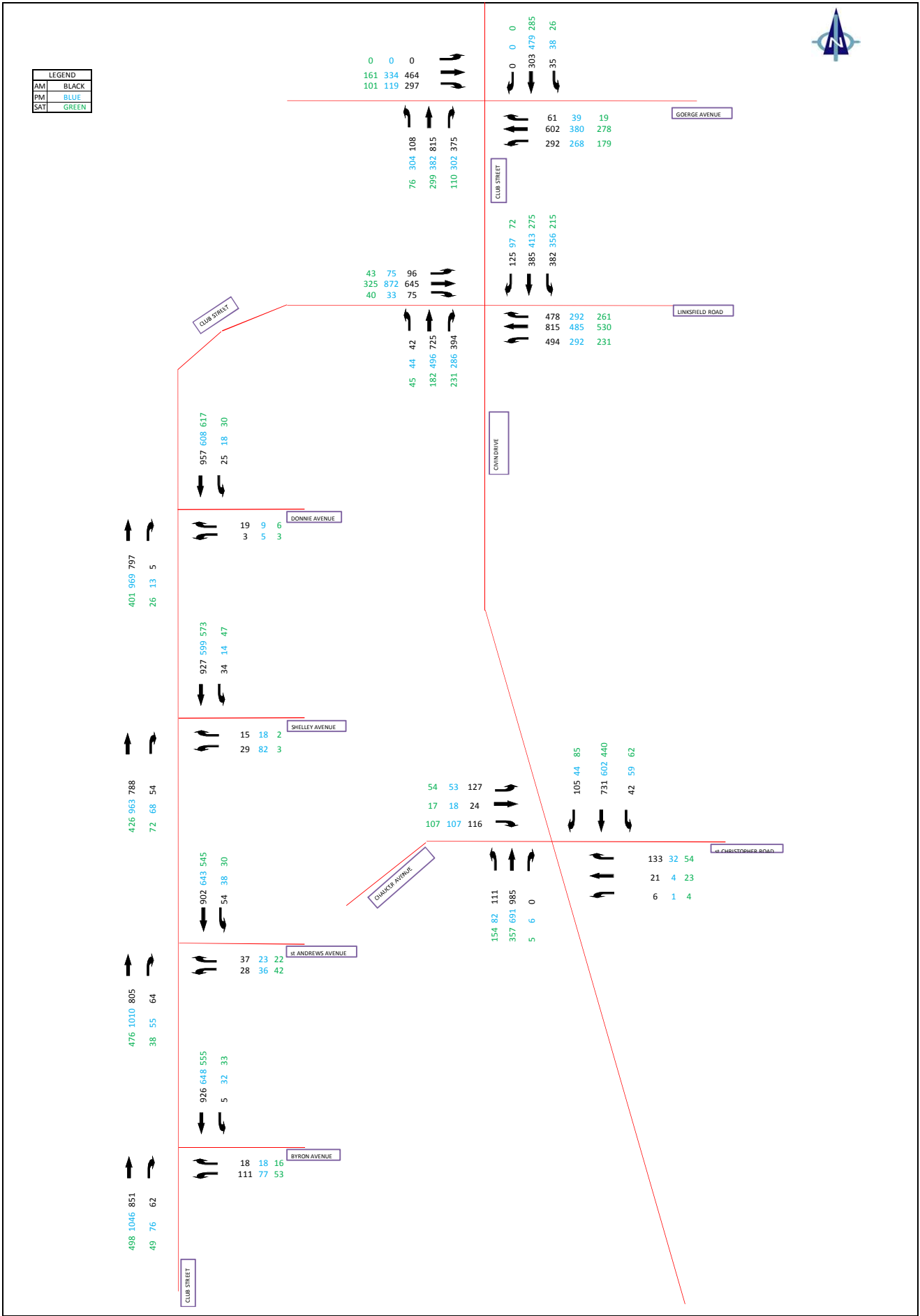
LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



DEVELOPMENT GENERATED TRAFFIC
(PHASE 1)

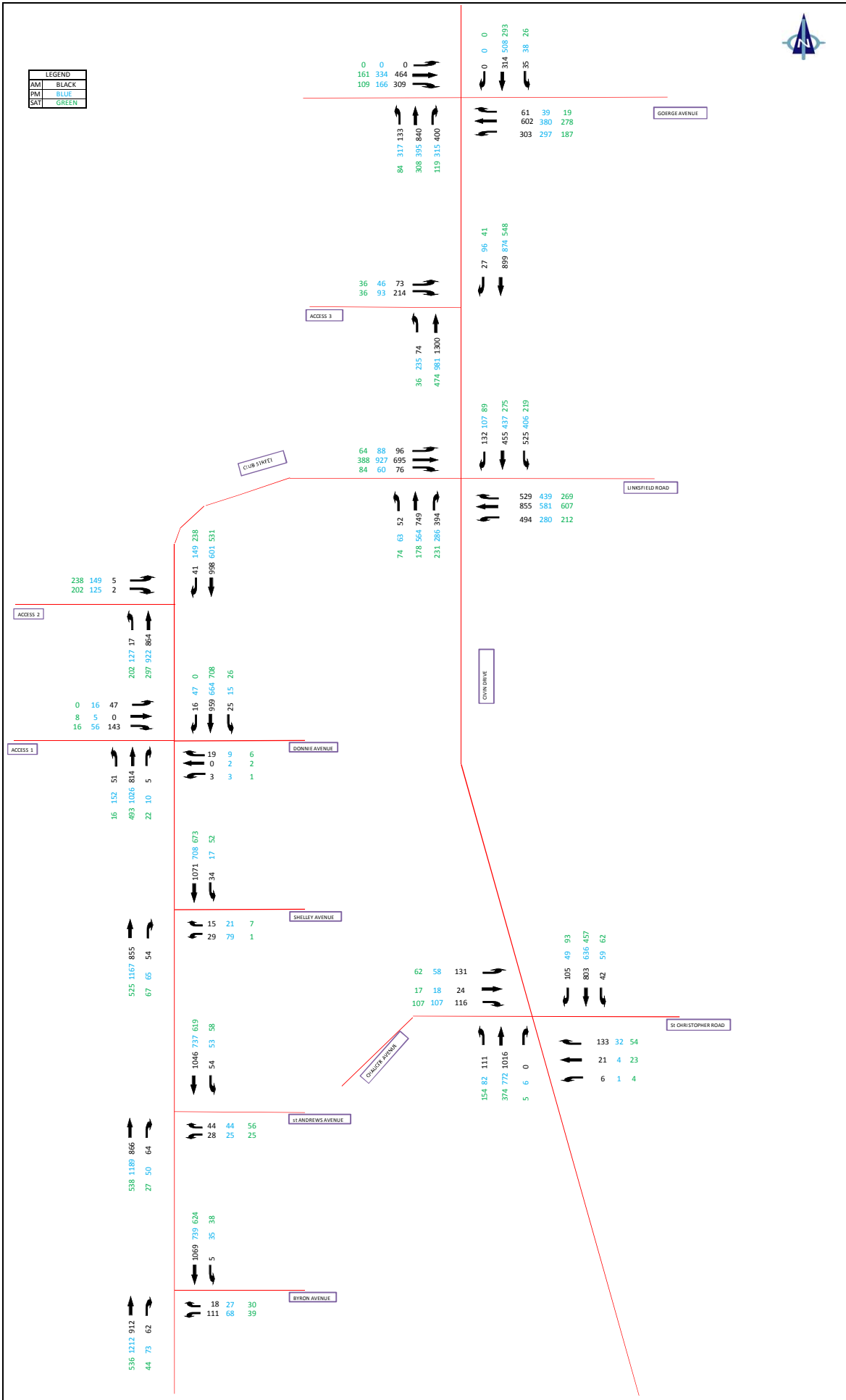
FIGURE 9

LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN

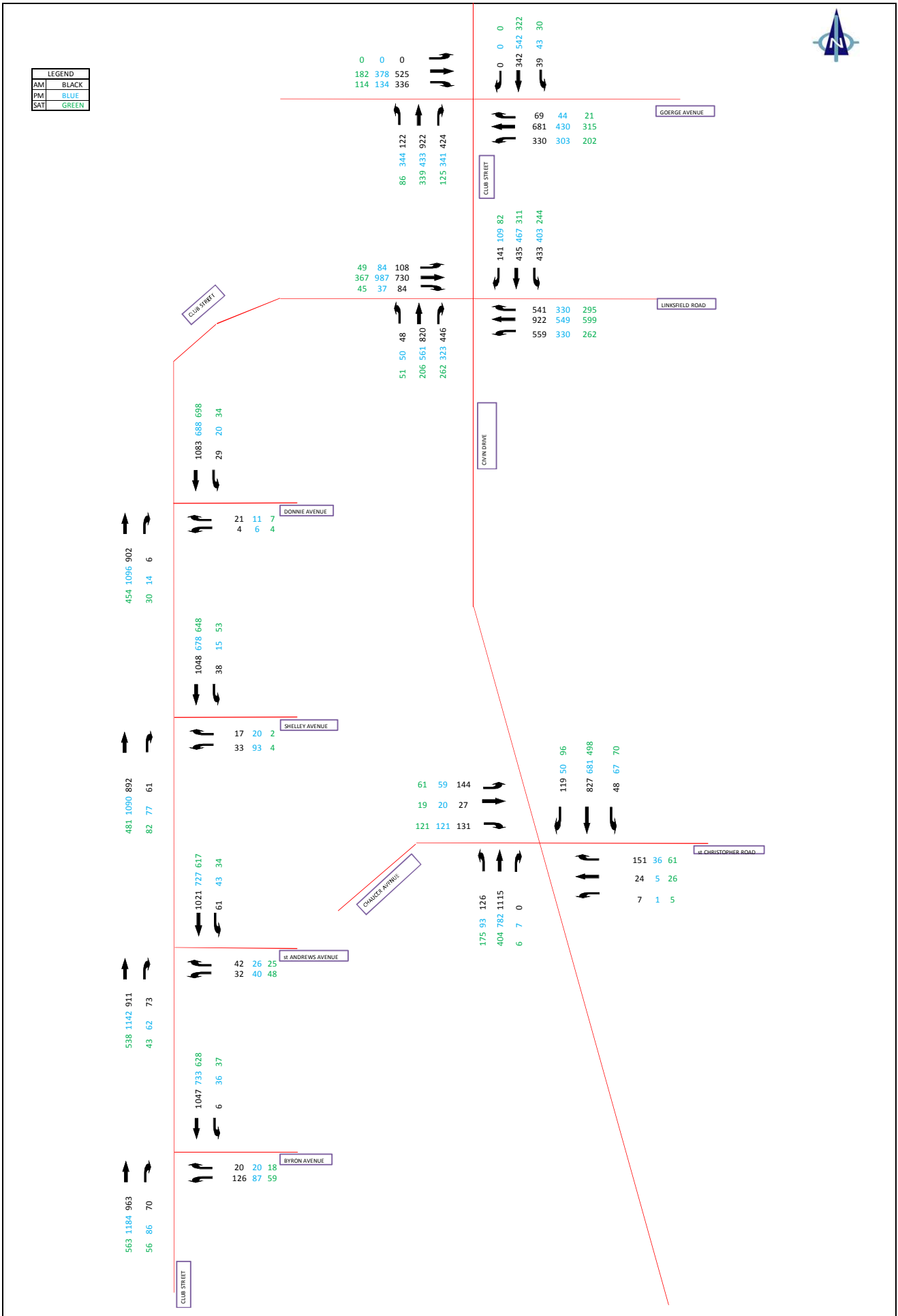


2014 BACKGROUND TRAFFIC
(Weekday AM; PM and Saturday)

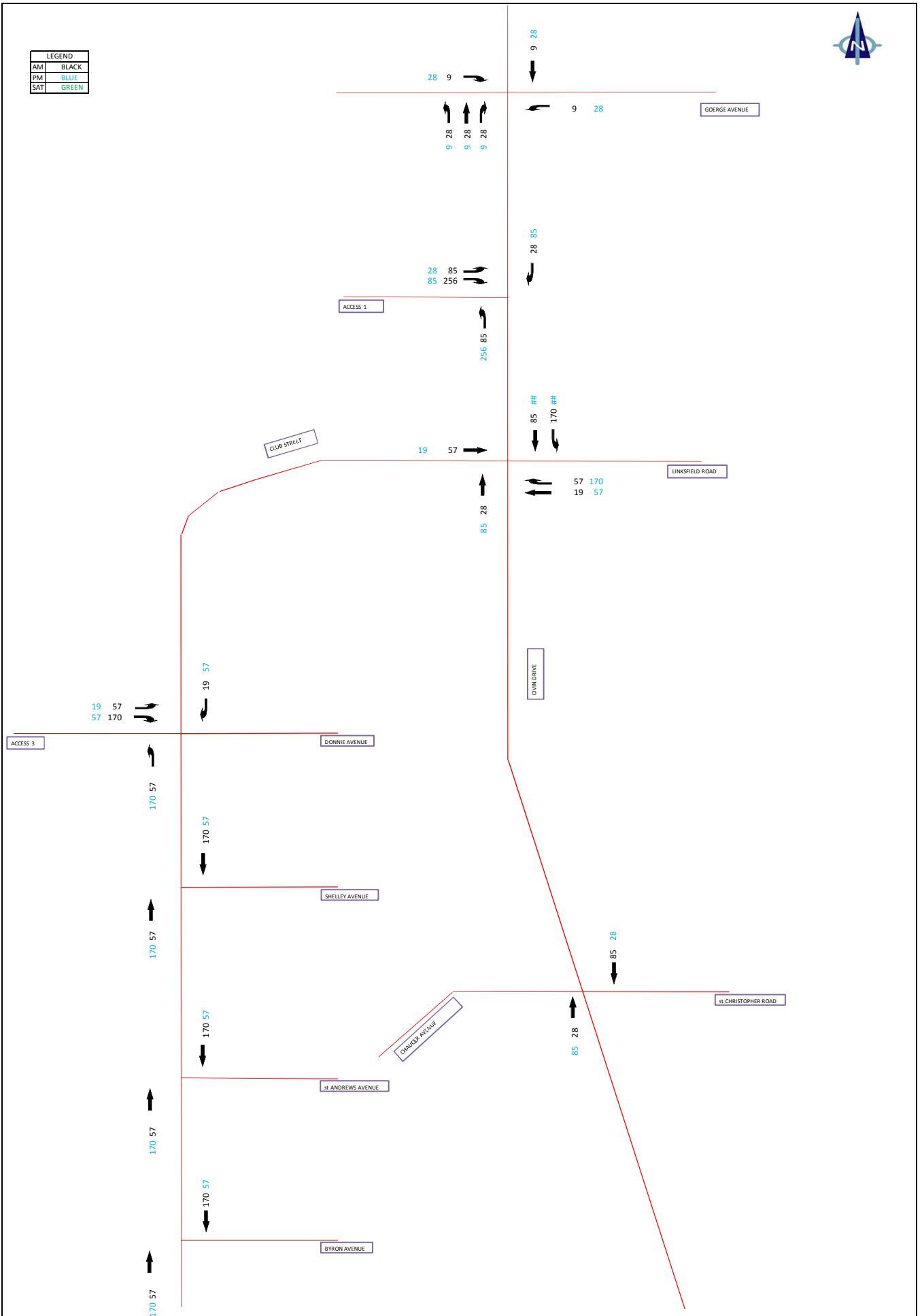
FIGURE 10



LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN

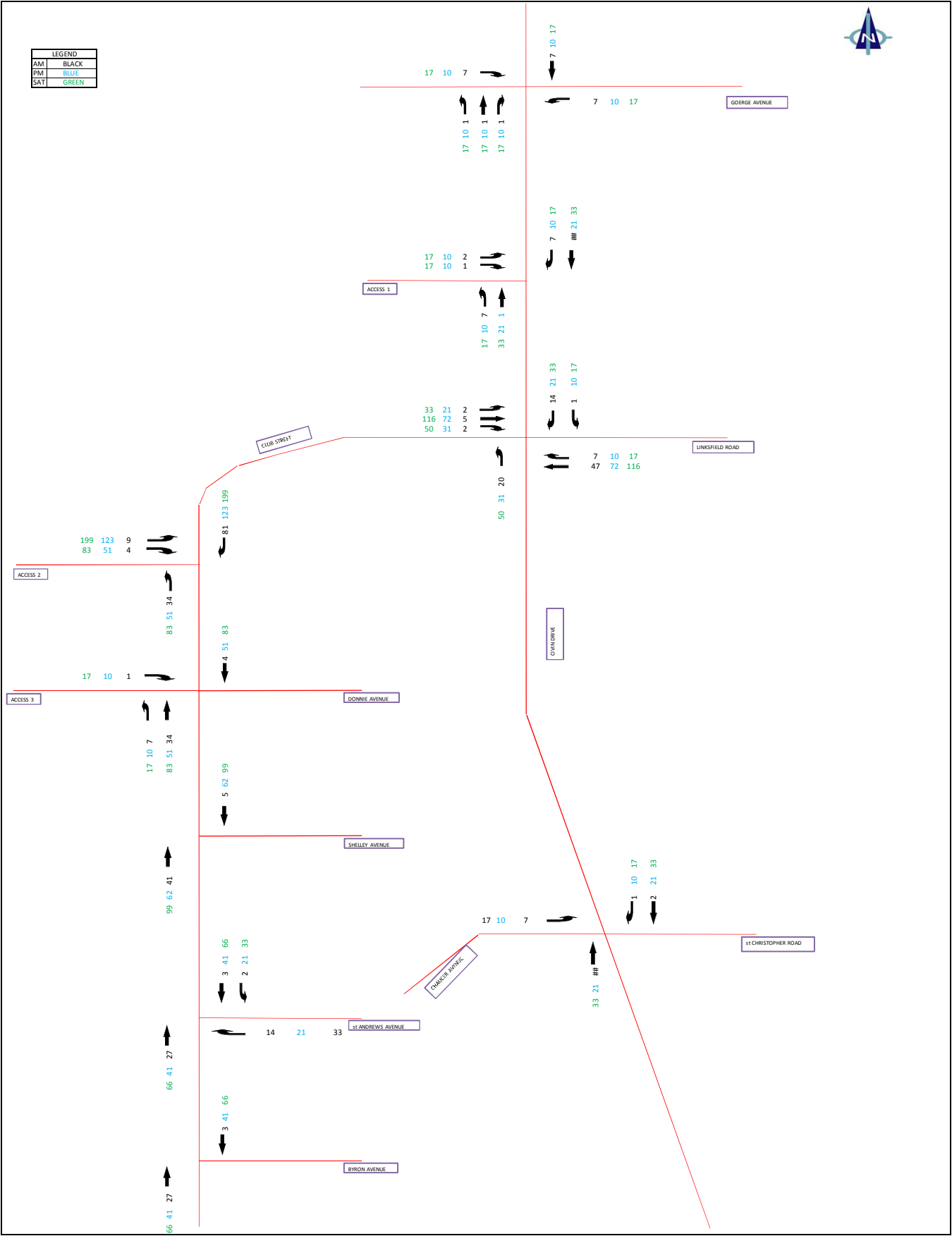


LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN





LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



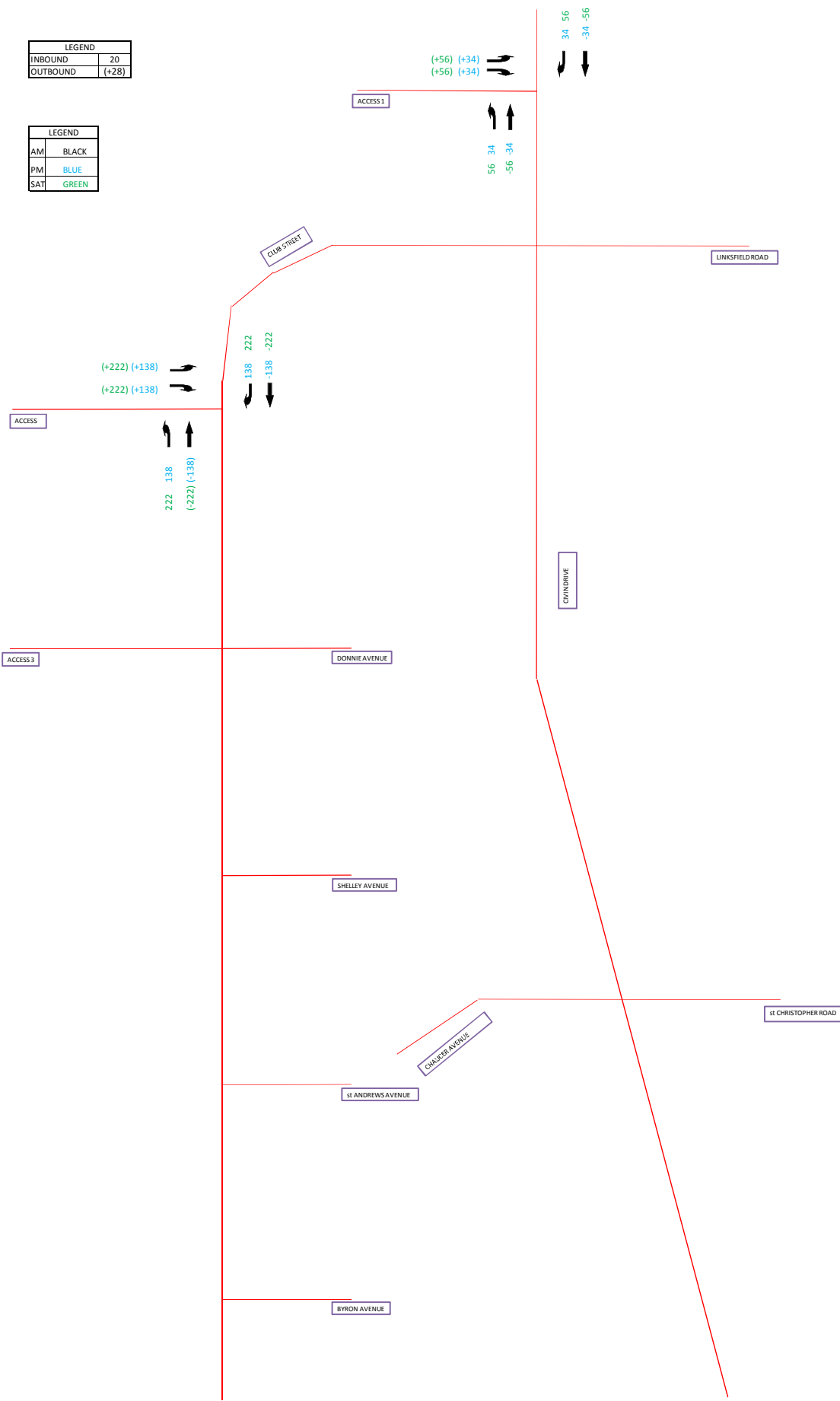
PRIMARY OR NEW TRIPS
(RETAIL FULL PHASE)

FIGURE 14



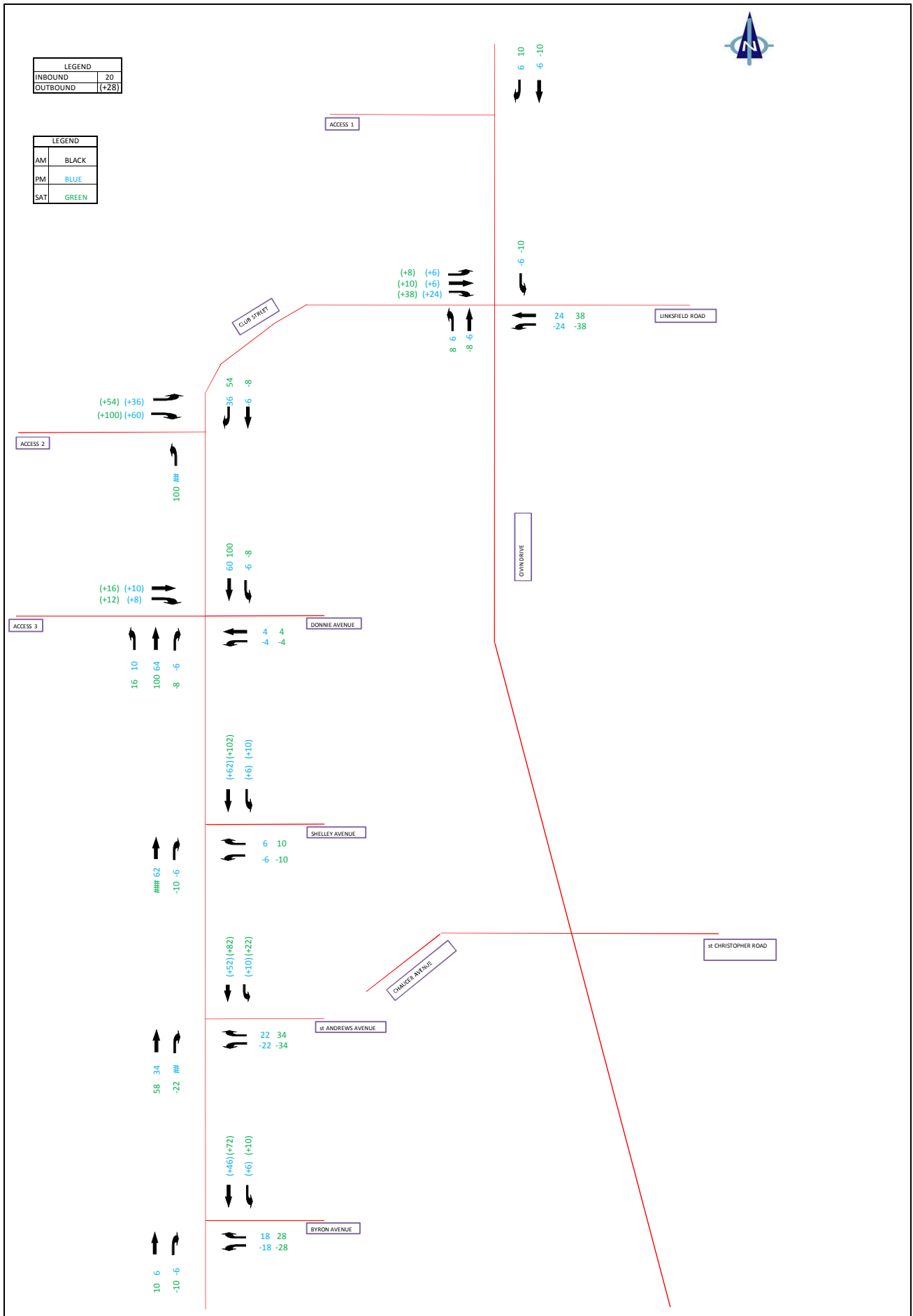
LEGEND	
INBOUND	20
OUTBOUND	(+28)

LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



PASS-BY TRIPS (FULL PHASE)

FIGURE 15

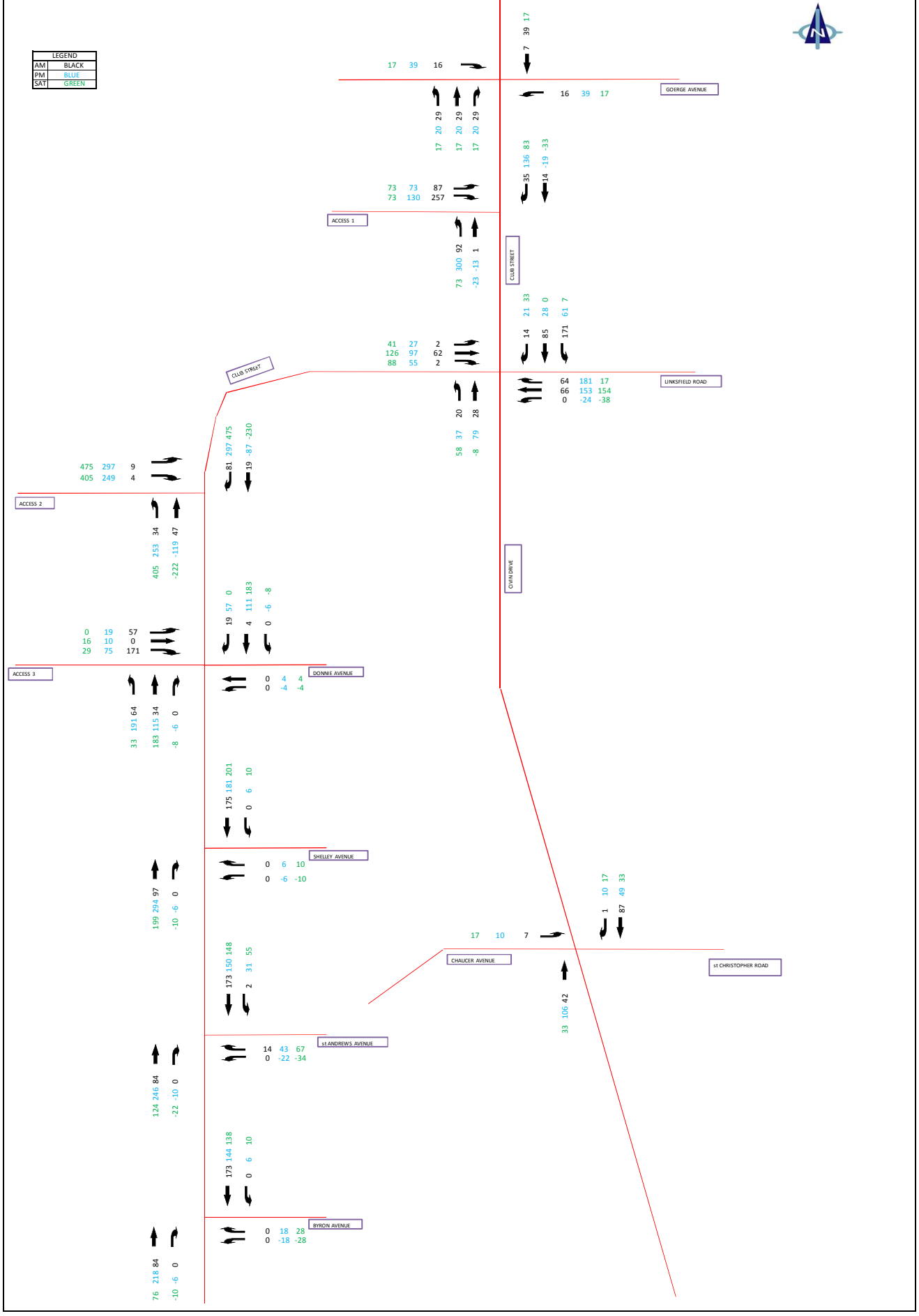


DIVERTED TRIPS (FULL PHASE)

FIGURE 16



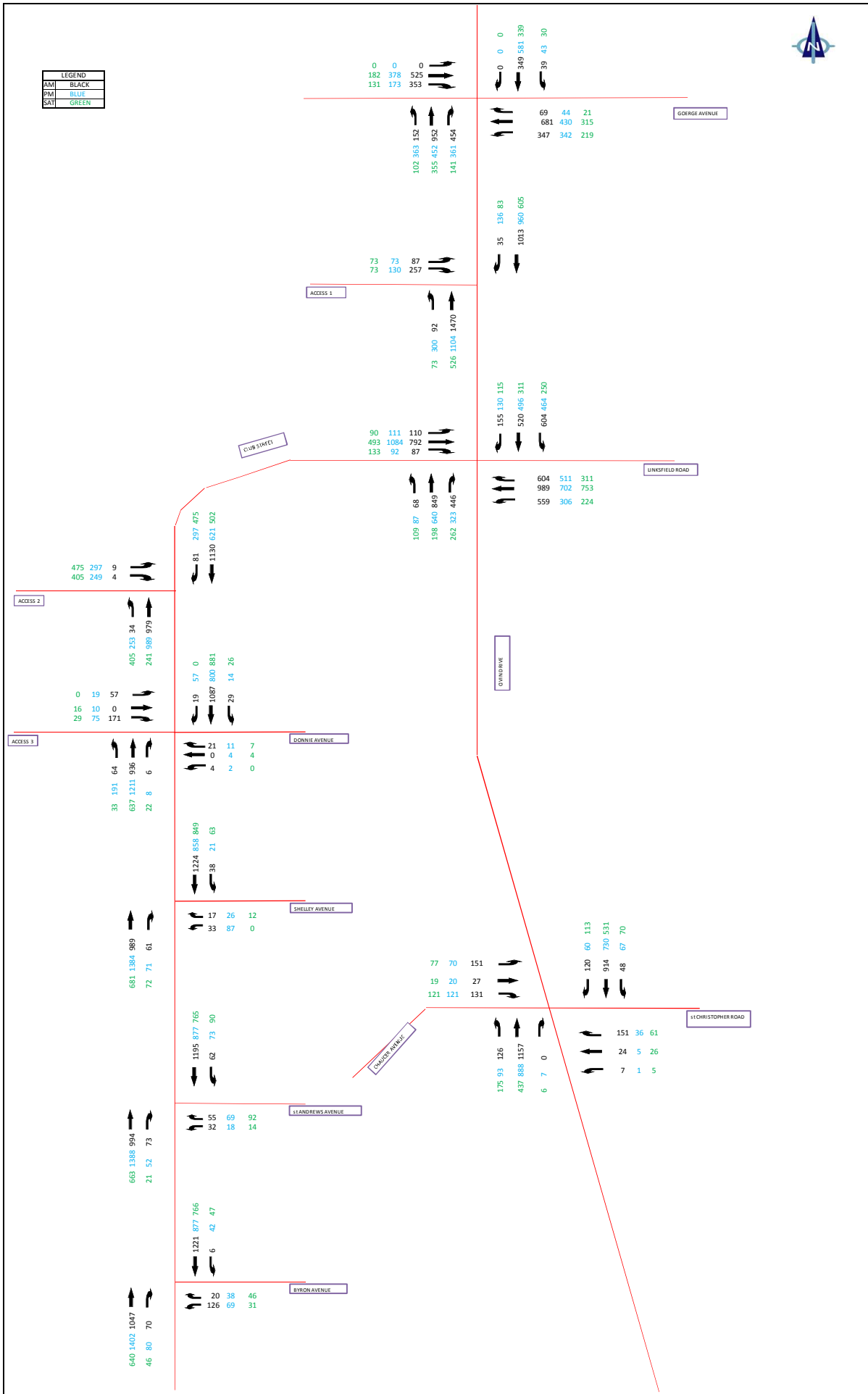
LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



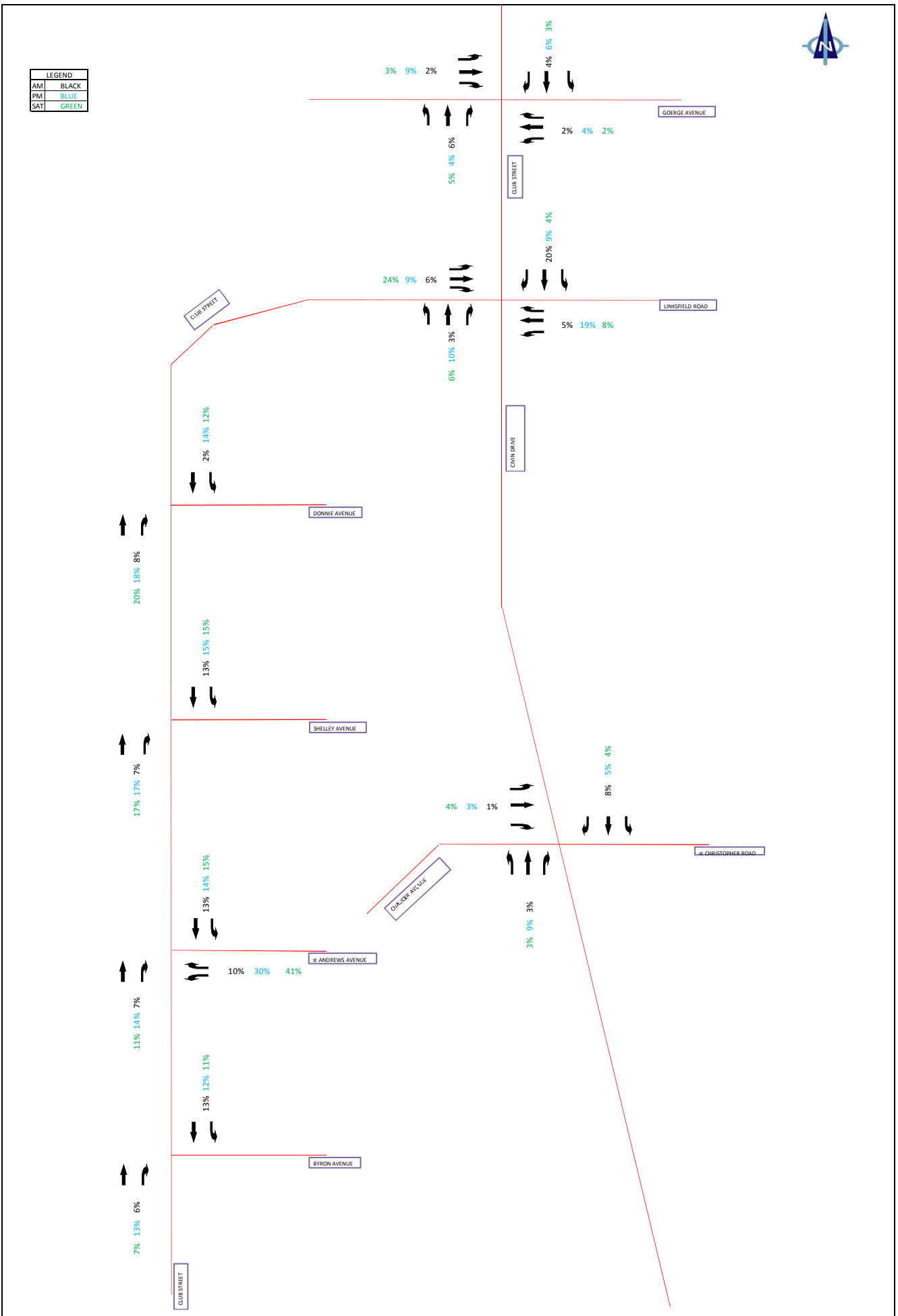
DEVELOPMENT GENERATED TRAFFIC
(FULL PHASE)

FIGURE 17

LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



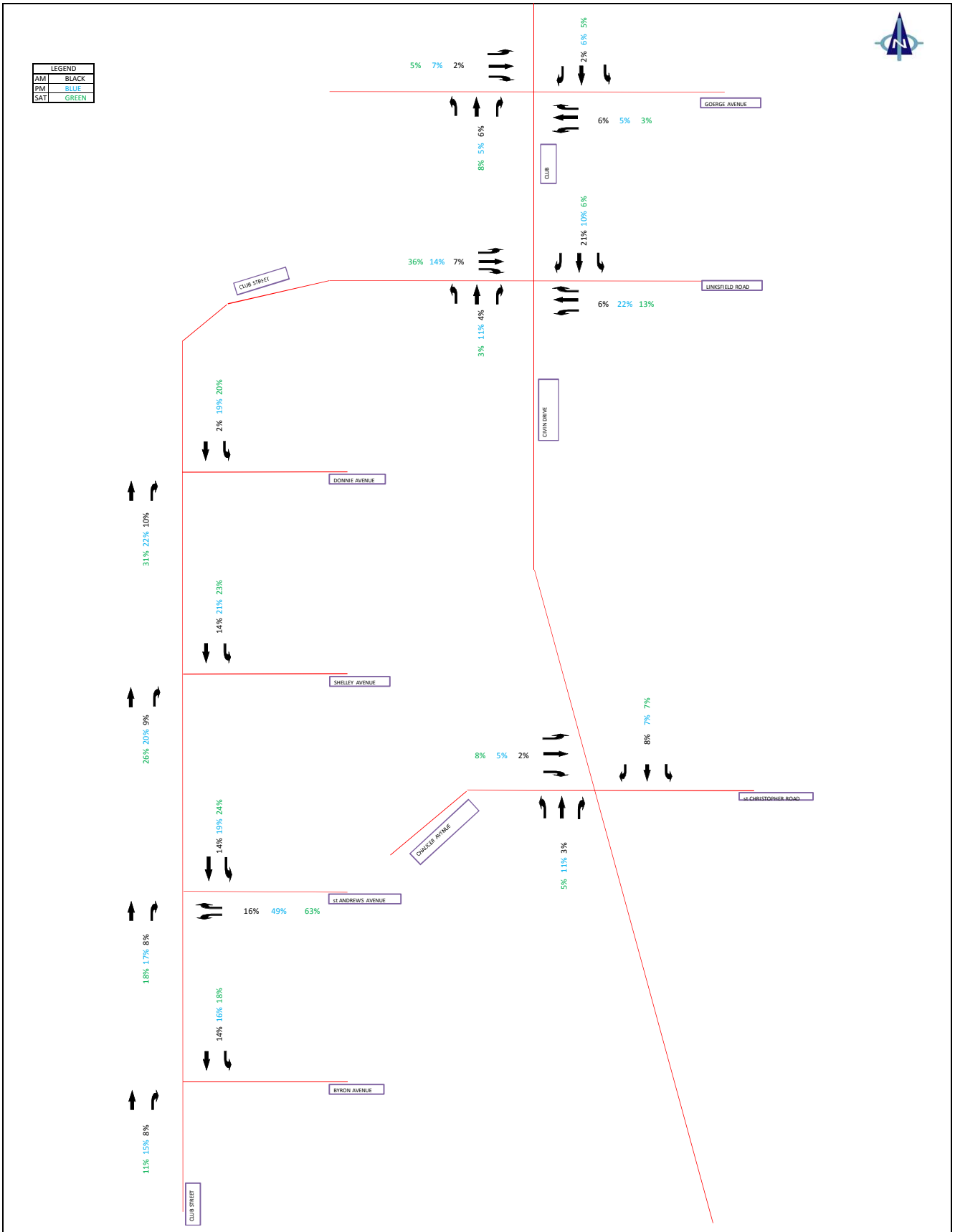
LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



2014 Development Contribution (Phase 1)
(Weekday AM; PM and Saturday)

FIGURE 19

LEGEND	
AM	BLACK
PM	BLUE
SAT	GREEN



2019 Development Contribution (Phase 2)
(Weekday AM; PM and Saturday)

FIGURE 20

ANNEXURE B - SIDRA INTERSECTIONS RESULTS

T able 3-1: Existing 2012 interesection results

Peak	ID	Intersection	OPERATIONAL CONDITIONS							
			Approach	Approach				Intersection		
				Demand	V/C	Delay	LOS	V/C	Delay	LOS
AM	1	Club Street & Goerge Avenue	South	1301	0.74	22	C	0.73	26	C
			East	957	0.80	26	C			
			North	339	0.31	29	C			
			West	764	0.82	98	C			
	2	Club Street & Civin & Linksfield Road	South	1315	1.00	56	E	0.75	36	D
			East	1849	0.62	23	C			
			North	894	0.58	23	C			
			West	808	0.84	50	D			
	3	Civin Drive & Chaucer & St Christopher Road	South	1188	1.21	204	F	1.00	108	F
			East	182	0.38	25	C			
			North	871	0.87	26	C			
			West	330	0.56	23	C			
	4	Club Street & Donie Avenue	South	813	0.43	23	C	0.49	15	N/A
			East	33	1.00	292	F			
			North	1027	0.53	0	N/A			
			West							
	5	Club Street & Shelley Avenue	South	861	0.48	19	N/A	0.51	12	N/A
			East	72	0.78	87	F			
			North	1027	0.53	0	N/A			
			West							
	6	Club Street & St Andrews Avenue	South	871	0.53	23	N/A	0.54	21	N/A
			East	78	1.16	292	F			
			North	1071	0.55	1	N/A			
			West							
	7	Club Street & Byron Avenue	South	887	0.67	50	N/A	0.61	87	N/A
			East	168	1.86	850	F			
			North	1108	0.57	0	N/A			
			West							
PM	1	Club Street & Goerge Avenue	South	989	0.68	18	B	0.56	23	C
			East	688	0.50	21	C			
			North	519	0.48	30	C			
			West	455	0.47	28	C			
	2	Club Street & Civin & Linksfield Road	South	845	0.93	40	D	0.70	30	C
			East	1095	0.42	19	B			
			North	916	0.65	22	C			
			West	991	0.86	40	D			
	3	Civin Drive & Chaucer & St Christopher Road	South	789	0.82	19	B	0.75	19	B
			East	56	0.10	21	C			
			North	729	0.78	18	B			
			West	206	0.35	22	C			
	4	Club Street & Donie Avenue	South	983	0.52	11	N/A	0.45	10	N/A
			East	24	0.78	258	F			
			North	662	0.34	0	N/A			
			West							
	5	Club Street & Shelley Avenue	South	1045	0.49	8	N/A	0.43	7	N/A
			East	120	0.51	31	D			
			North	634	0.33	0	N/A			
			West							
	6	Club Street & St Andrews Avenue	South	1089	0.51	10	N/A	0.45	17	N/A
			East	72	1.09	295	F			
			North	712	0.37	1	N/A			
			West							
	7	Club Street & Byron Avenue	South	1136	0.67	19	N/A	0.55	29	N/A
			East	113	1.20	318	F			
			North	711	0.37	0	N/A			
			West							
SATURDAY	1	Club Street & Goerge Avenue	South	486	0.25	17	B	0.26	20	C
			East	477	0.32	18	B			
			North	313	0.25	25	C			
			West	263	0.21	24	C			
	2	Club Street & Civin & Linksfield Road	South	525	0.60	20	B	0.49	19	B
			East	1314	0.50	18	B			
			North	602	0.44	19	B			
			West	485	0.39	22	C			
	3	Civin Drive & Chaucer & St Christopher Road	South	593	0.49	14	B	0.56	16	B
			East	80	0.11	20	B			
			North	699	0.68	16	B			
			West	204	0.35	22	C			
	4	Club Street & Donie Avenue	South	509	0.30	9	N/A	0.35	4	N/A
			East	16	0.16	45	E			
			North	742	0.38	0	N/A			
			West							
	5	Club Street & Shelley Avenue	South	585	0.33	7	N/A	0.35	4	N/A
			East	7	0.03	23	C			
			North	728	0.38	1	N/A			
			West							
	6	Club Street & St Andrews Avenue	South	582	0.28	6	N/A	0.32	5	N/A
			East	97	0.47	35	D			
			North	677	0.35	0	N/A			
			West							
	7	Club Street & Byron Avenue	South	532	0.32	8	N/A	0.34	5	N/A
			East	86	0.36	29	D			
			North	673	0.35	1	N/A			
			West							
UPGRADES										
Peak	ID	Intersection	OPERATIONAL CONDITIONS							
			Approach	Approach				Intersection		
				Demand	V/C	Delay	LOS	V/C	Delay	LOS
AM	2	Club Street & Civin & Linksfield Road	South	1315	1.00	28	C	0.78	29	C
			East	1849	0.67	25	C			
			North	894	0.61	24	C			
			West	808	0.84	48	D			
	3	Civin Drive & Chaucer & St Christopher Road	South	1188	0.92	25	C	0.82	24	C
			East	182	0.75	35	D			
			North	871	0.66	12	B			
			West	330	0.93	48	D			
PM	2	Club Street & Civin & Linksfield Road	South	845	0.84	27	C	0.67	27	C
			East	1095	0.47	21	C			
			North	916	0.57	21	C			
			West	991	0.87	39	D			
	3	Civin Drive & Chaucer & St Christopher Road	South							
			East							
			North							
			West							
SATURDAY	3	Civin Drive & Chaucer & St Christopher Road	South							
			East							
			North							
			West							

Table 3-2: Background 2014 base year intersection results

Peak	ID	Intersection	OPERATIONAL CONDITIONS							
			Approach				Intersection			
			Approach	Demand	V/C	Delay	LOS	V/C	Delay	LOS
AM	1	Club Street & Goerge Avenue	South	1366	0.78	24	C	0.77	28	C
			East	939	0.84	29	C			
			North	357	0.33	29	C			
			West	802	0.88	35	C			
	2	Club Street & Civin & Linksfield Road	South	1382	1.00	28	C	0.82	31	D
			East	1942	0.71	27	C			
			North	939	0.70	25	C			
			West	850	0.88	50	D			
	3	Civin Drive & Chaucer & St Christopher Road	South	1247	0.96	38	D	0.89	33	C
			East	190	0.82	37	D			
			North	915	0.76	12	B			
			West	347	0.98	64	E			
	4	Club Street & Donie Avenue	South	853	0.46	28	N/A	0.52	17	N/A
			East	35	1.00	272	F			
			North	1079	0.55	0	N/A			
			West							
	5	Club Street & Shelley Avenue	South	905	0.53	24	N/A	0.54	18	N/A
			East	76	1.01	191	F			
			North	1080	0.56	1	N/A			
			West							
	6	Club Street & St Andrews Avenue	South	915	0.59	30	N/A	0.58	25	N/A
			East	81	1.20	309	F			
			North	1125	0.58	1	N/A			
			West							
	7	Club Street & Byron Avenue	South	932	0.45	2	N/A	0.53	83	N/A
			East	177	2.09	1057	F			
			North	1164	0.60	0	N/A			
			West							
PM	1	Club Street & Goerge Avenue	South	1040	0.73	19	B	0.59	23	C
			East	723	0.53	21	C			
			North	545	0.50	30	C			
			West	478	0.49	28	C			
	2	Club Street & Civin & Linksfield Road	South	888	0.90	31	C	0.72	29	C
			East	1149	0.50	22	C			
			North	962	0.60	22	C			
			West	1043	0.91	41	D			
	3	Civin Drive & Chaucer & St Christopher Road	South	829	0.87	23	C	0.78	22	C
			East	59	0.10	21	C			
			North	766	0.81	20	C			
			West	217	0.37	22	C			
	4	Club Street & Donie Avenue	South	1034	0.55	12	N/A	0.48	13	N/A
			East	24	1.00	426	F			
			North	696	0.36	1	N/A			
			West							
	5	Club Street & Shelley Avenue	South	1097	0.52	9	N/A	0.45	8	N/A
			East	127	0.63	39	E			
			North	666	0.34	0	N/A			
			West							
	6	Club Street & St Andrews Avenue	South	1145	0.54	11	N/A	0.48	18	N/A
			East	76	1.11	287	F			
			North	748	0.39	1	N/A			
			West							
	7	Club Street & Byron Avenue	South	1194	0.57	1	N/A	0.49	20	N/A
			East	119	1.22	333	F			
			North	747	0.35	0	N/A			
			West							
SATURDAY	1	Club Street & Goerge Avenue	South	511	0.26	17	B	0.28	20	C
			East	501	0.33	19	B			
			North	328	0.26	25	C			
			West	277	0.23	24	C			
	2	Club Street & Civin & Linksfield Road	South	552	0.64	20	C	0.52	19	B
			East	1381	0.53	18	B			
			North	631	0.46	19	B			
			West	510	0.41	22	C			
	3	Civin Drive & Chaucer & St Christopher Road	South	622	0.51	14	B	0.59	16	B
			East	84	0.12	20	B			
			North	734	0.71	17	B			
			West	214	0.37	22	C			
	4	Club Street & Donie Avenue	South	534	0.32	10	N/A	0.37	5	N/A
			East	16	0.19	53	F			
			North	780	0.40	1	N/A			
			West							
	5	Club Street & Shelley Avenue	South	615	0.36	8	N/A	0.38	4	N/A
			East	7	0.03	24	C			
			North	765	0.39	1	N/A			
			West							
	6	Club Street & St Andrews Avenue	South	612	0.30	6	N/A	0.33	6	N/A
			East	102	0.55	41	E			
			North	710	0.37	1	N/A			
			West							
	7	Club Street & Byron Avenue	South	558	0.26	1	N/A	0.32	3	N/A
			East	91	0.37	28	D			
			North	708	0.36	1	N/A			
			West							
UPGRADES										
Peak	ID	Intersection	OPERATIONAL CONDITIONS							
			Approach				Intersection			
			Approach	Demand	V/C	Delay	LOS	V/C	Delay	LOS
AM	3	Civin Drive & Chaucer & St Christopher Road	South	1247	0.89	20	C	0.83	22	C
			East	190	0.73	34	C			
			North	915	0.71	13	B			
			West	347	0.90	44	D			
PM	3	Civin Drive & Chaucer & St Christopher Road	South	829	0.77	16	B	0.72	18	B
			East	59	0.10	21	C			
			North	766	0.81	20	C			
			West	217	0.37	22	C			
SATURDAY	3	Civin Drive & Chaucer & St Christopher Road	South	622	0.51	14	B	0.56	16	B
			East	84	0.12	20	B			
			North	734	0.71	16	B			
			West	214	0.37	22	C			

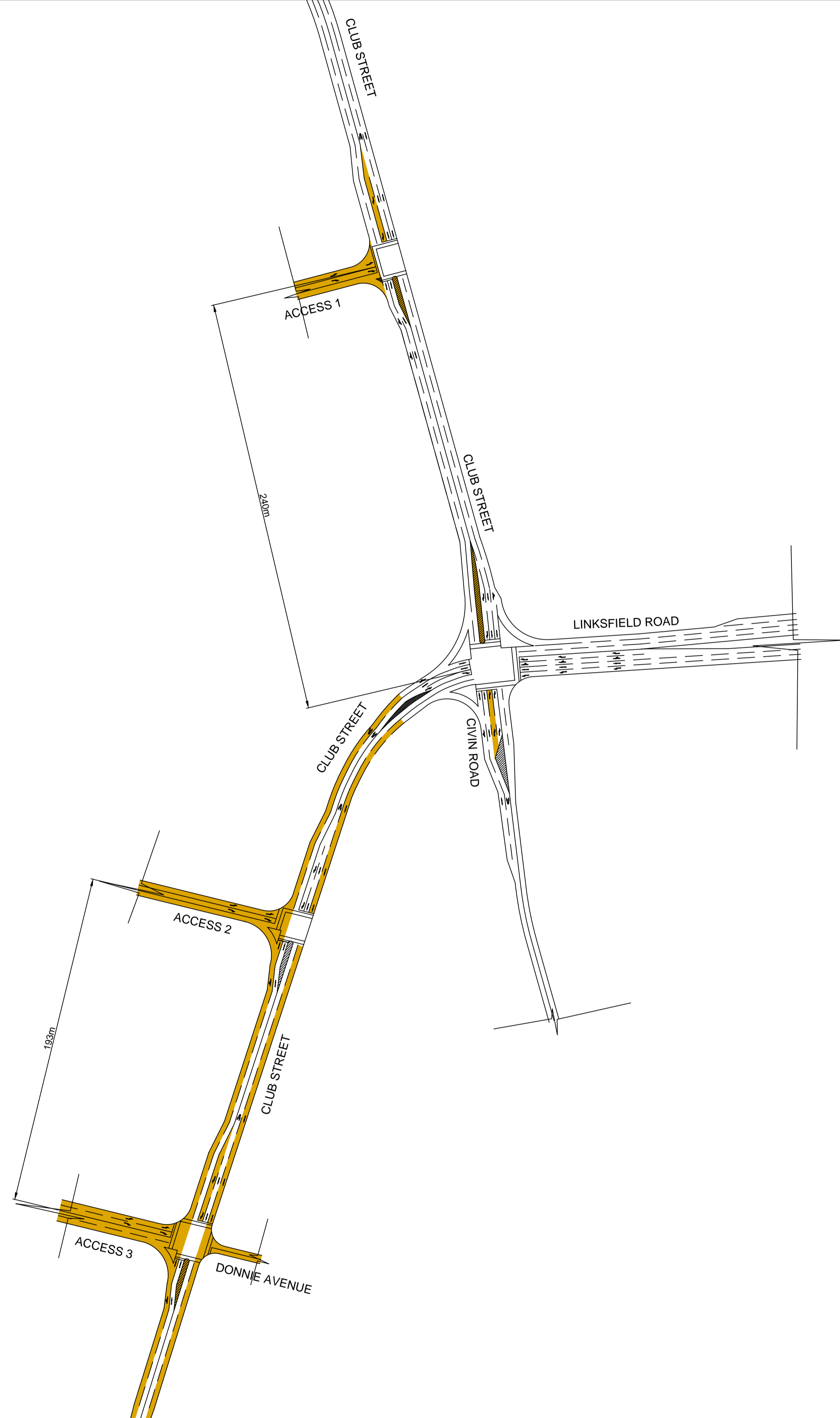
T table 3-3: Background 2014 base year + Development interesection results

Peak	ID	Intersection	OPERATIONAL CONDITIONS								
			Approach					Intersection			
			Approach	Demand	V/C	Delay	LOS	V/C	Delay	LOS	
AM	1	Club Street & Goerge Avenue	South	1424	0.84	23	C	0.81	28	C	
			East	1017	0.84	27	C				
			North	368	0.34	29	C				
			West	815	0.92	37	D				
	2	Club Street & Civin & Linksfield Road	South	1423	1.00	28	C	0.92	39	D	
			East	2041	0.89	33	C				
			North	1171	0.79	24	C				
			West	903	1.06	89	F				
	3	Civin Drive & Chaucer & St Christopher Road	South	1282	0.95	32	C	0.88	27	C	
			East	190	0.67	32	C				
			North	990	0.80	17	B				
			West	352	0.85	37	D				
	4	Club Street & Donie Avenue & Access 3 (Res & Retail)	South	907	0.48	30	N/A	0.73	126	N/A	
			East	36	1.00	310	F				
			North	1096	0.60	24	N/A				
			West	201	2.50	1086	N/A				
	5	Club Street & Shelley Avenue	South	977	0.68	53	N/A	0.66	35	N/A	
			East	76	1.26	377	F				
North			1242	0.64	0	N/A					
West											
6	Club Street & St Andrews Avenue	South	979	0.80	83	N/A	0.72	51	N/A		
		East	90	1.37	434	F					
		North	1294	0.66	1	N/A					
		West									
7	Club Street & Byron Avenue	South	994	0.59	4	N/A	0.65	131	N/A		
		East	177	2.94	1842	F					
		North	1343	0.69	1	N/A					
		West									
8	Club Street & Access 1 (North Residences Access)	South	1446	0.77	10	A	0.65	11	B		
		East									
		North	975	0.46	7	A					
		West	302	0.69	27	C					
9	Club Street & Access 2 (Retail Access)	South	942	0.75	10	A	0.79	12	B		
		East									
		North	1094	0.84	14	B					
		West	7	0.02	30	C					
PM	1	Club Street & Goerge Avenue	South	1081	0.78	19	B	0.61	24	C	
			East	754	0.53	21	C				
			North	576	0.53	31	C				
			West	527	0.49	28	C				
	2	Club Street & Civin & Linksfield Road	South	982	0.93	31	C	0.83	32	C	
			East	1398	0.79	26	C				
			North	1056	0.63	21	C				
			West	1144	0.97	51	D				
	3	Civin Drive & Chaucer & St Christopher Road	South	915	0.85	20	C	0.80	22	C	
			East	59	0.11	21	C				
			North	809	0.86	24	C				
			West	223	0.38	22	C				
	4	Club Street & Donie Avenue & Access 3 (Res & Retail)	South	1194	0.63	17	N/A	0.64	39	N/A	
			East	25	0.73	217	F				
			North	745	0.61	6	N/A				
			West	69	1.00	194	F				
	5	Club Street & Shelley Avenue	South	1311	0.63	16	N/A	0.54	30	N/A	
			East	127	1.13	310	F				
North			788	0.41	1	N/A					
West											
6	Club Street & St Andrews Avenue	South	1145	0.54	11	N/A	0.48	18	N/A		
		East	76	1.11	287	F					
		North	748	0.39	1	N/A					
		West									
7	Club Street & Byron Avenue	South	1367	0.66	1	N/A	0.58	17	N/A		
		East	119	1.24	326	F					
		North	851	0.44	1	N/A					
		West									
8	Club Street & Access 1 (North)	South	1280	0.80	14	B	0.68	12	B		
		East									
		North	1021	0.59	10	A					
		West	146	0.26	20	B					
9	Club Street & Access 2 (Retail Access)	South	1104	0.83	13	B	0.77	15	B		
		East									
		North	789	0.67	9	A					
		West	288	0.85	42	D					
UPGRADES											
SATURDAY	1	Club Street & Goerge Avenue	South	538	0.27	17	B	0.28	20	C	
			East	509	0.33	18	B				
			North	337	0.27	25	C				
			West	285	0.24	24	C				
	2	Club Street & Civin & Linksfield Road	South	582	0.63	19	B	0.59	20	B	
			East	1470	0.66	18	B				
			North	655	0.46	19	B				
			West	670	0.50	23	C				
	3	Civin Drive & Chaucer & St Christopher Road	South	642	0.54	14	B	0.61	17	B	
			East	84	0.12	20	B				
			North	765	0.74	17	B				
			West	224	0.39	22	C				
	4	Club Street & Donie Avenue & Access 3 (Res & Retail)	South	551	0.33	10	N/A	0.37	9	N/A	
			East	17	0.16	42	E				
			North	781	0.40	6	N/A				
			West	26	0.19	53	F				
	5	Club Street & Shelley Avenue	South	731	0.43	12	N/A	0.45	6	N/A	
			East	12	0.14	51	F				
North			895	0.46	1	N/A					
West											
6	Club Street & St Andrews Avenue	South	612	0.30	6	N/A	0.33	6	N/A		
		East	102	0.55	41	E					
		North	710	0.37	1	N/A					
		West									
7	Club Street & Byron Avenue	South	592	0.28	1	N/A	0.35	4	N/A		
		East	91	0.67	59	D					
		North	798	0.41	1	N/A					
		West									
8	Club Street & Access 1 (North)	South	537	0.35	7	A	0.34	8	A		
		East									
		North	620	0.37	8	A					
		West	76	0.10	20	B					
9	Club Street & Access 2 (Retail Access)	South	525	0.69	11	B	0.70	14	B		
		East									
		North	809	0.72	13	B					
		West	463	0.67	22	C					
AM	2	Club Street & Civin & Linksfield Road	South	1423	0.68	27	C	0.75	28	C	
			East	2041	0.76	27	C				
			North	1171	0.73	22	C				
			West	903	0.88	42	D				
	4	Club Street & Donie Avenue & Access 3 (Res & Retail)	South	907	0.59	9	A	0.61	10	B	
			East	36	0.10	19	B				
			North	1098	0.69	10	A				
			West	201	0.38	20	C				
	6	Club Street & St Andrews Avenue	South	979	0.43	15	B	0.53	16	B	
			East	90	0.15	32	C				
			North	1294	0.61	15	B				
			West								
	PM	2	Club Street & Civin & Linksfield Road	South	982	0.56	29	C	0.67	26	C
				East	1398	0.64	23	C			
				North	1056	0.63	20	C			
				West	1144	0.81	33	C			
	4	Club Street & Donie Avenue & Access 3 (Res & Retail)	South	1262	0.81	14	B	0.65	12	B	
			East	21	0.06	19	B				
North			796	0.48	9	A					
West			81	0.15	15	B					
6	Club Street & St Andrews Avenue	South	1304	0.59	15	B	0.53	15	B		
		East	86	0.14	31	C					
		North	929	0.44	14	B					
		West									
SATURDAY	2	Club Street & Civin & Linksfield Road	South	582	0.33	22	C	0.50	20	B	
			East	1470	0.58	18	B				
			North	655	0.46	18	B				
			West	670	0.51	22	C				
	4	Club Street & Donie Avenue & Access 3 (Res & Retail)	South	565	0.35	8	A	0.44	8	A	
			East	13	0.04	18	B				
			North	808	0.52	8	A				
			West	26	0.04	17	B				
	6	Club Street & St Andrews Avenue	South	595	0.27	12	B	0.33	14	B	
			East	101	0.17	32	C				
			North	796	0.38	13	B				
			West								

T able 3-4: Background 2014 year interesection results

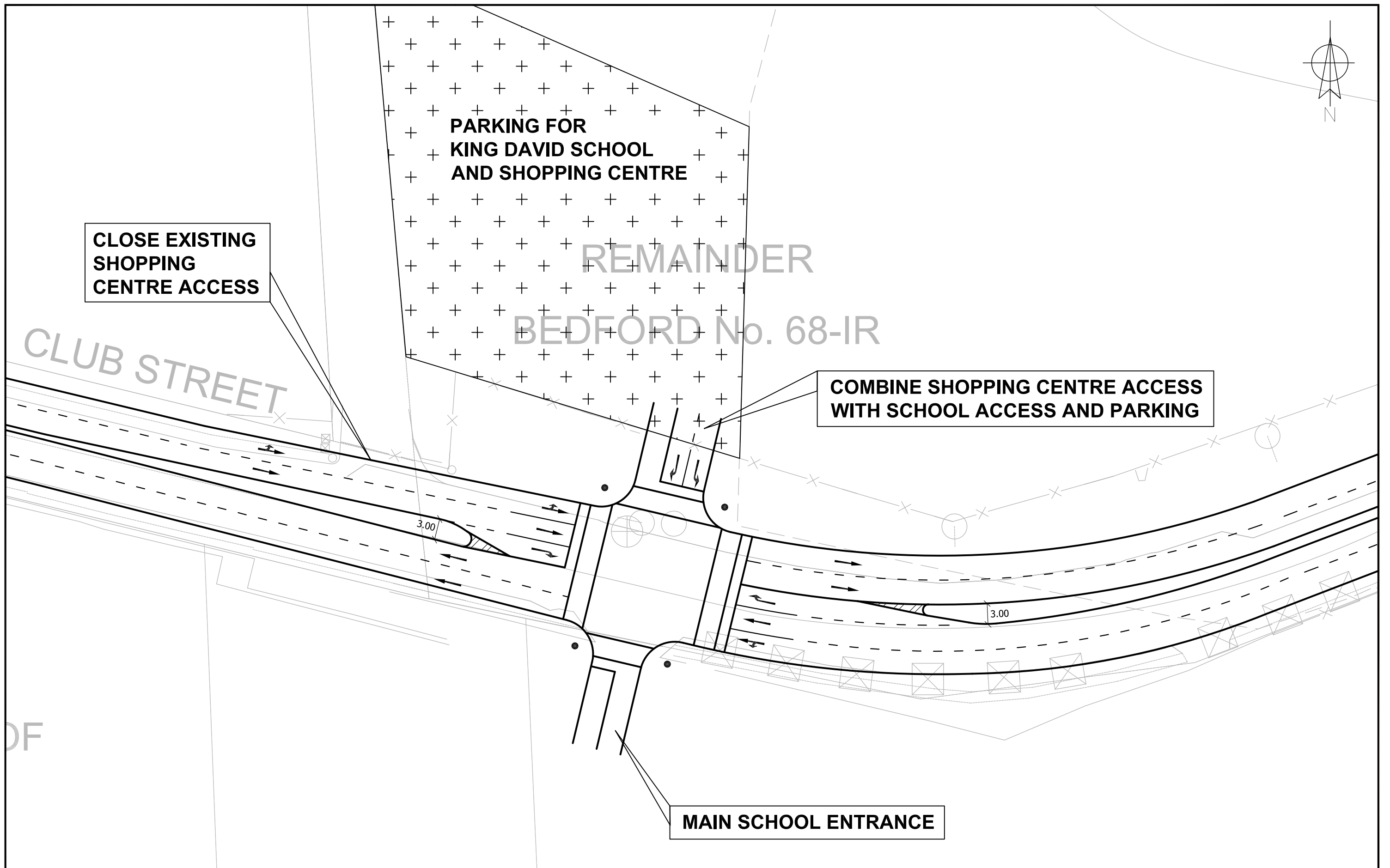
Peak	ID	Intersection	OPERATIONAL CONDITIONS								
			Approach					Intersection			
			Approach	Demand	V/C	Delay	LOS	V/C	Delay	LOS	
AM	1	Club Street & Goerge Avenue	South	1545	0.92	25	C	0.89	32	C	
			East	1137	0.95	36	D				
			North	402	0.37	29	C				
			West	907	1.00	40	D				
	2	Club Street & Civin & Linksfield Road	South	1564	0.75	29	C	0.81	32	C	
			East	2198	0.80	30	C				
			North	1062	0.89	26	C				
			West	960	0.85	45	D				
	3	Civin Drive & Chaucer & St Christopher Road	South	1411	1.04	73	E	0.96	50	D	
			East	217	0.83	37	D				
			North	1035	0.86	20	B				
			West	392	0.96	55	D				
	4	Club Street & Donie Avenue	South	966	0.62	8	A	0.70	11	B	
			East	40	0.11	20	B				
			North	1222	0.78	12	B				
			West								
	5	Club Street & Shelley Avenue	South	1025	0.35	7	N/A	0.33	15	N/A	
			East	86	1.20	315	F				
			North	1220	0.31	0	N/A				
			West								
	6	Club Street & St Andrews Avenue	South	1036	0.46	15	B	0.54	16	B	
			East	93	0.16	32	C				
			North	1273	0.60	15	B				
			West								
	7	Club Street & Byron Avenue	South	1054	0.27	2	N/A	0.31	71	N/A	
			East	200	1.93	909	F				
			North	1316	0.34	71	N/A				
			West								
PM	1	Club Street & Goerge Avenue	South	1177	0.87	22	C	0.69	25	C	
			East	818	0.60	22	C				
			North	617	0.57	31	C				
			West	540	0.55	29	C				
	2	Club Street & Civin & Linksfield Road	South	1004	0.56	30	C	0.66	27	C	
			East	1300	0.56	22	C				
			North	1088	0.68	21	C				
			West	1179	0.87	38	D				
	3	Civin Drive & Chaucer & St Christopher Road	South	938	0.88	23	C	0.84	27	C	
			East	67	0.12	21	C				
			North	867	0.92	33	C				
			West	244	0.42	22	C				
	4	Club Street & Donie Avenue	South	1181	0.75	11	B	0.64	10	A	
			East	27	0.07	20	B				
			North	778	0.50	8	A				
			West								
	5	Club Street & Shelley Avenue	South	1241	0.36	4	N/A	0.30	14	N/A	
			East	143	1.05	179	F				
			North	753	0.19	0	N/A				
			West								
	6	Club Street & St Andrews Avenue	South	1267	0.57	15	B	0.51	15	B	
			East	83	0.14	32	C				
			North	906	0.43	13	B				
			West								
	7	Club Street & Byron Avenue	South	1351	0.32	1	N/A	0.28	20	N/A	
			East	134	1.25	339	F				
			North	845	0.22	0	N/A				
			West								
SATURDAY	1	Club Street & Goerge Avenue	South	579	0.30	18	B	0.32	21	C	
			East	566	0.38	19	B				
			North	372	0.30	25	C				
			West	313	0.27	25	C				
	2	Club Street & Civin & Linksfield Road	South	625	0.38	23	C	0.51	20	B	
			East	1562	0.60	19	B				
			North	716	0.52	18	B				
			West	576	0.39	21	C				
	3	Civin Drive & Chaucer & St Christopher Road	South	705	0.59	15	B	0.67	18	B	
			East	96	0.13	20	B				
			North	830	0.81	20	C				
			West	242	0.42	22	C				
	4	Club Street & Donie Avenue	South	515	0.31	8	A	0.43	8	A	
			East	17	0.05	19	B				
			North	804	0.52	8	A				
			West								
	5	Club Street & Shelley Avenue	South	695	0.25	4	N/A	0.23	2	N/A	
			East	9	0.05	27	D				
			North	865	0.22	1	N/A				
			West								
	6	Club Street & St Andrews Avenue	South	612	0.27	13	B	0.32	14	B	
			East	91	0.15	32	C				
			North	766	0.36	13	B				
			West								
	7	Club Street & Byron Avenue	South	632	0.15	1	N/A	0.18	3	N/A	
			East	101	0.52	38	E				
			North	801	0.21	1	N/A				
			West								
UPGRADES											
Peak	ID	Intersection	OPERATIONAL CONDITIONS								
			Approach					Intersection			
			Approach	Demand	V/C	Delay	LOS	V/C	Delay	LOS	
AM	3	Civin Drive & Chaucer & St Christopher Road	South	1411	0.93	26	C	0.90	27	C	
			East	217	0.75	34	C				
			North	1035	0.86	22	C				
			West	392	0.89	41	D				
PM	3	Civin Drive & Chaucer & St Christopher Road	South	938	0.76	15	C	0.77	24	C	
			East	67	0.12	21	C				
			North	867	0.92	33	C				
			West	244	0.42	22	C				
SATURDAY	3	Civin Drive & Chaucer & St Christopher Road	South	705	0.57	15	B	0.63	18	B	
			East	96	0.13	20	B				
			North	830	0.81	20	C				
			West	242	0.42	22	C				

ANNEXURE C - DRAWINGS

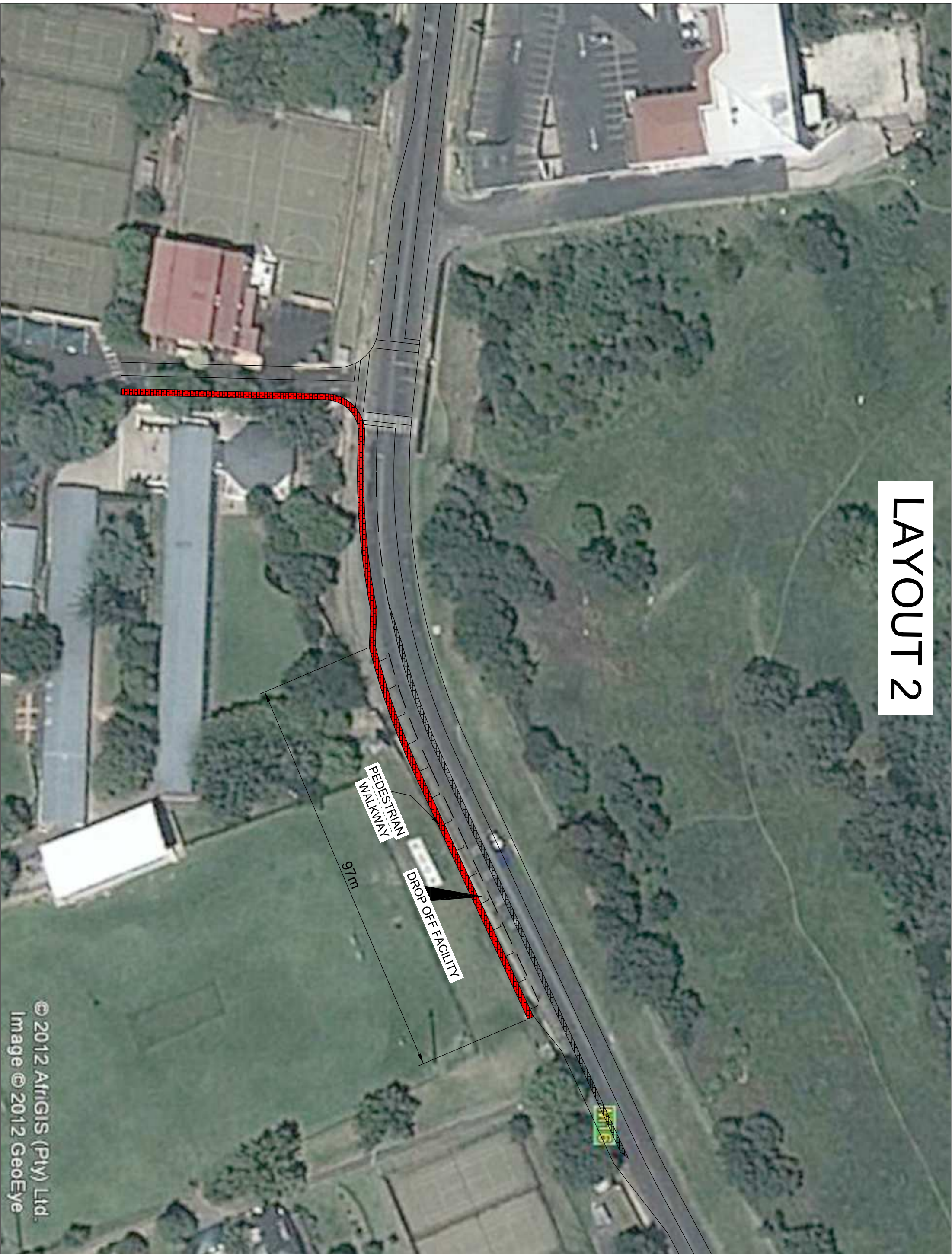


GENERAL LAYOUT

ANNEXURE D –OPTIONS FOR KING DAVID SCHOOL TRAFFIC PROBLEMS



LAYOUT 2



LAYOUT 3



LAYOUT 4



Upgrade required

Primary Access

Secondary Access