ATTACHEMENT 1

Connell Wagner

APPENDIX 4

Traffic and Pedestrian Study
Pontiac Way and Shenton Avenue
City of Joondalup

17 May 2002
Reference C069.05
Revision 0

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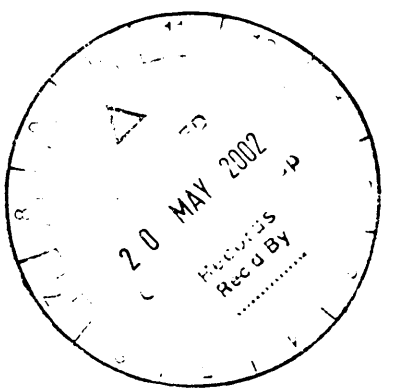

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1. Introduction

Connell Wagner Pty Ltd has been commissioned by the City of Joondalup to conduct a Traffic and Pedestrian study at the intersection of Pontiac Way and Shenton Avenue. Pontiac Way provides access to Shenton Avenue for the Joondalup Service Trades Area (Joondalup Business Park) in the suburb of Joondalup. A locality plan (Plan 1) is available in Appendix A of this report.

The City of Joondalup plans to upgrade Shenton Avenue between east of Marmion Avenue and west of Pontiac Way into a dual carriageway. Due to the length of the railway tunnel, there is a significant constraint in providing a dual carriageway on Shenton Avenue at Pontiac Way intersection. The Council intends to investigate the potential impact on the intersection given the dualisation of Shenton Avenue west of Pontiac Way. Six different intersection treatments are explored to determine the effectiveness of routing traffic on a dual carriageway through a single carriageway at an intersection. The impact each of these treatments would have on the pedestrian access across Shenton Avenue is also investigated.

Based on these objectives Connell Wagner has considered the following issues relating to the existing access between Pontiac Way and Shenton Avenue:

- Access to existing or future developments through Pontiac Way;
- Existing and proposed traffic volumes along Shenton Avenue and the impact of the proposed intersection options on the traffic flow;
- Alternative access through Joondalup Drive;
- Existing pedestrian movement in the vicinity of Pontiac Way along Shenton Avenue; and,
- The impact of the proposed intersection options on pedestrian movements.

The proposed scope of work for the Study includes the following:

- Liaise with City of Joondalup regarding weekly traffic counts;
- Undertake intersection turning counts and pedestrian counts;
- Liaise with local stakeholders and Main Roads WA;
- Run SIDRA analysis on the Pontiac Way intersection layout options;
- Consider the level of service for reduced lanes on Shenton Avenue and comment on the impacts;
- Provide a sketch of the proposed intersection layouts, ensuring that sight distance requirements are satisfied in accordance with Main Roads WA standards; and,
- Outline assessments and make recommendations.

2. Existing Traffic Conditions

2.1 Existing Road Network

The traffic and pedestrian study being undertaken is for the intersection of Shenton Avenue and Pontiac Way in the City of Joondalup. Shenton Avenue is currently an east-west link between Marmion Avenue (west end) and Joondalup Drive (east end), whilst Pontiac Way is currently a north-south access road between Shenton Avenue (north end) and Winton Road (south end). Shenton Avenue near Pontiac Way is currently a divided single carriageway with a median, and Pontiac Way is a single carriageway with no centreline marking. Both Marmion Avenue and Joondalup Drive are dual divided carriageways.

According to Main Roads WA document *Metropolitan Functional Road Hierarchy* (August 1999), Shenton Avenue is defined as a District Distributor A Road and Pontiac Way is an Access Road. Joondalup Drive and Marmion Avenue are District Distributor A roads, and Winton Road is an Access Road.

Mitchell Freeway is the major north-south primary distributor that carries traffic to and from the Perth City Centre, which is located 25 kilometres south of Joondalup. It currently terminates at Hodges Drive as a T-interchange and may be extended further north either up to or past Shenton Avenue within the next five years. The Mitchell Freeway reserve is approximately 400 metres west of Pontiac Way.

The definitions for these types of roads were sourced from the same document and are provided below:

Primary Distributor: These provide for major regional and inter-regional traffic movement and carry large volumes of generally fast moving traffic with traffic volumes typically in excess of 15,000 vehicles per day. Some of these roads are strategic freight routes and all are National or State roads. They are managed by Main Roads.

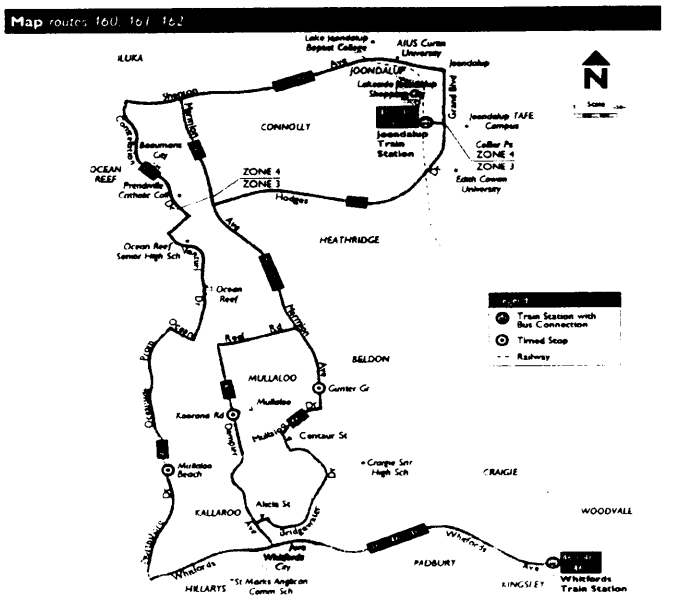
District Distributor A: These carry traffic between industrial, commercial and residential areas and generally connect to Primary Distributors. These are likely to be truck routes and provide only limited access to adjoining property. They are managed by Local Government. Traffic volumes are typically above 8,000 vehicles per day (vpd), and buses are allowed on this type of road.

Access Roads: Provide access to abutting properties with amenity, safety and aesthetic aspects having priority over the vehicle movement function. These roads are bicycle and pedestrian friendly. They are managed by local government.

Transperth bus routes No. 460, 461 and 470 (refer to Figure 2.1 and Figure 2.2 overleaf) services Shenton Avenue, between Marmion Avenue and Joondalup Drive. Transperth also provides a school bus service (refer to Site Plan in Appendix A) along Shenton Avenue for the Lake Joondalup Baptist College with bus-stops located west of the Pontiac Way intersection. The Lake Joondalup Baptist College is located north of the intersection, with its main entrance on Kennedya Drive north of the Shenton Avenue / Joondalup Drive intersection (refer to Site Plan in Appendix A).

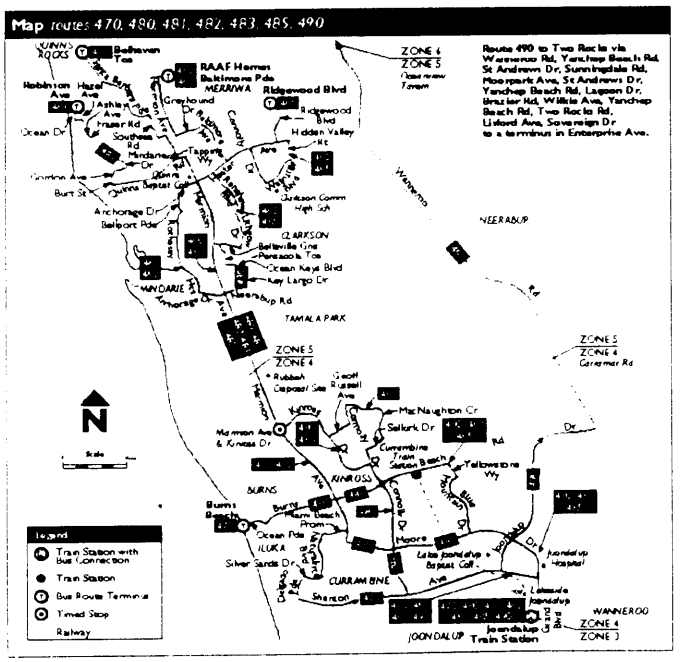
There are no dedicated cycle lanes available on each approach to the intersection, however, there is an existing two-metre footpath available on the northern side of Shenton Avenue for commuting and local accesses.

Figure 2.1: Bus Routes No. 460, 461 Servicing Study Area



Source: Transperth (www.transperth.wa.gov.au)

Figure 2.2: Bus Route No. 470 Servicing Study Area



Source: Transperth (www.transperth.wa.gov.au)

2.2 Land Uses

The traffic volumes through the Shenton Avenue/Pontiac Way intersection are governed by the adjacent major roads (distributors) and land usage.

It is projected that traffic volumes on Shenton Avenue will significantly increase. This increase will mainly be due to the Mitchell Freeway exit and entry onto Shenton Avenue. In support of this assumption, the population projections were sought from the *Western Australia Tomorrow – Population Projections for the Statistical Divisions, Planning Regions and Local Government Areas of Western Australia* (WAPC, October 2000). It stated that in the "medium" scenario, the population projections for the Local Government Area of Joondalup is as such:

Table 2.2: Joondalup Population Projections to 2016

YEAR	POPULATION PROJECTIONS
1996	148,369
2001	160,927
2006	164,907
2011	163,697
2016	166,846

These projections indicate that majority of the population growth occurred between 1996 and 2001, with another significant growth occurring between 2011 and 2016.

Furthermore, Shenton Avenue forms an east-west link through three major distributors: Marmion Avenue (west), Joondalup Drive (east) and Grand Boulevard Drive (east). The other major east-west links are Moore Drive (approximately 800 metres north of Shenton Avenue) and Hodges Drive (1.5 kilometres south of Shenton Avenue). These east-west links currently carry traffic volumes in excess of 12,000 vehicles per day and form the main thoroughfare for residents living west of the Mitchell Freeway Reserve to both the Mitchell Freeway, and the various land uses east of the Mitchell Freeway Reserve.

These major land uses includes:

- Joondalup Business Park – south of Shenton Avenue/Pontiac Way intersection.
- Lake Joondalup Baptist College – north of Shenton Avenue/Pontiac Way intersection.
- Lakeside Joondalup Shopping City – 750 metres southeast of Shenton Avenue/Pontiac Way intersection.
- A.I.U.S. Curtin University – 300 metres east of Shenton Avenue/Pontiac Way intersection.
- Joondalup Arena – 500 metres north of Shenton Avenue/Pontiac Way intersection.
- Joondalup Health Campus – 1.5 kilometres north of Shenton Avenue/Pontiac Way intersection.
- Joondalup TAFE Campus – 2 kilometres southwest of Shenton Avenue/Pontiac Way intersection.
- Edith Cowan University – 3 kilometres southwest of Shenton Avenue/Pontiac Way intersection.
- Joondalup Golf Course – 3 kilometres southeast of Shenton Avenue/Pontiac Way intersection.

2.3 Traffic Volume Trends

Historic traffic volume information collected from the Main Roads Western Australia database indicates that traffic volumes along Shenton Avenue in the vicinity of Pontiac Way have been gradually increasing up until the year 2002.

The increase in traffic along Shenton Avenue from 1994/1995 to 2001/2002 is indicated Figure 2.3 and Figure 2.4 below.

Figure 2.3: Traffic Volumes for Shenton Avenue east of Marmion Avenue

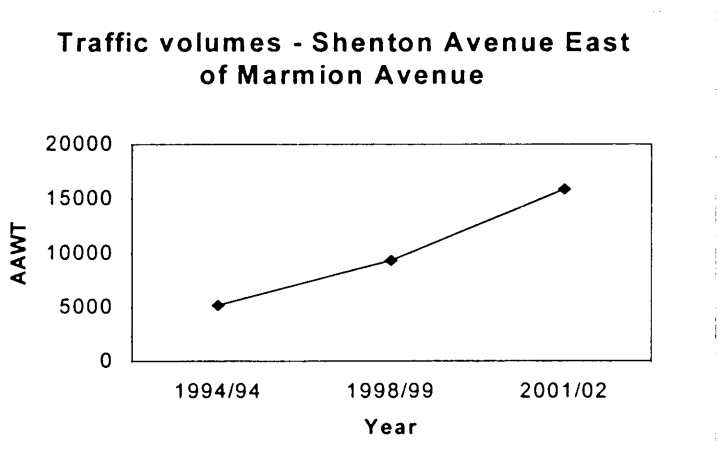
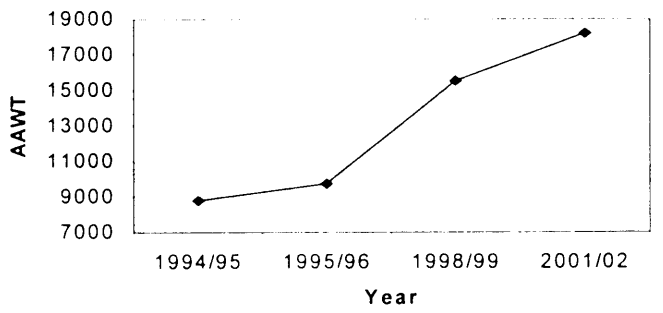


Figure 2.4: Traffic Volumes for Shenton Avenue west of Joondalup Drive



Based on the Main Roads WA Transport Modelling data that was sourced as part of this study, traffic volumes on Shenton Avenue in 2006 is projected to be approximately 15,000vpd. Main Roads WA has also assumed that Mitchell Freeway would be extended up to Shenton Avenue by 2011 and that Shenton Avenue would carry approximately 32,000 vehicles per day (vpd) west of the Mitchell Freeway intersection, and 20,000vpd east of the Freeway intersection.

2.4 Existing Traffic Volumes

City of Joondalup has recorded traffic volumes on both east and west legs of the Shenton Avenue / Pontiac Way intersection from Tuesday 19 March 2002 to Tuesday 26 March 2002. Turning traffic counts on the south approach of the intersection were also recorded. These volumes indicate that the general peak morning period is between 1100hrs to 1200hrs and the peak evening period is between 1700hrs to 1800hrs, with higher volumes evident on Friday. Table 2.1 below summarises these peak hour traffic volumes along Shenton Ave and Pontiac Way.

Table 2.1: Peak Traffic Volumes for Shenton Avenue / Pontiac Way Intersection

LOCATION	Direction of Traffic Flow	AM Peak hour Volume	PM Peak Hour Volume
Shenton Avenue west of Pontiac Way – Through Lane	East	520	447
	West	724	1,223
Shenton Avenue east of Pontiac Way – Through Lane	East	520*	447*
	West	611	910
Pontiac Way south of Shenton Avenue	North	367	631
	South	177	137

**Assumed that volume is consistent with recorded traffic counts taken for Shenton Avenue west of Pontiac Way eastbound lane.*

2.5 Pedestrian Movements

It was envisaged that the peak morning pedestrian movement would be between 0800hrs and 0900hrs with most of the pedestrians being students of Lake Joondalup Baptist College. Similarly, the peak afternoon or evening pedestrian movement would be between 1500hrs and 1600hrs when school closes. Pedestrian counts were therefore taken during these peak times on Thursday 21 March 2002 and are represented in Figures 2.5 (below) and 2.6 (overleaf).

The traffic counts during the morning drop-off period (0800hrs to 0900hrs) and afternoon pick-up period (1500hrs to 1600hrs) were also noted and tabulated in Table 2.2 below. The data indicates that higher traffic volumes were evident at the intersection during the Thursday drop-off morning period, and Friday pick-up afternoon period.

Table 2.2: Traffic Volumes for Shenton Avenue / Pontiac Way Intersection During School Drop-off and Pick-up Period

LOCATION	Direction of Traffic Flow	Drop-Off Period Volume (Thursday)	Pick-Up Period Volume (Friday)
Shenton Avenue west of Pontiac Way – Through Lane	East	954	680
	West	379	919
Shenton Avenue east of Pontiac Way – Through Lane	East	954*	680*
	West	471	790
Pontiac Way south of Shenton Avenue	North	135	399
	South	251	185

**Assumed that volume is consistent with recorded traffic counts taken for Shenton Avenue west of Pontiac Way eastbound lane.*

Figure 2.5: Morning Traffic Volumes for Pontiac Way / Winton Road intersection and Pedestrian Counts on Shenton Avenue

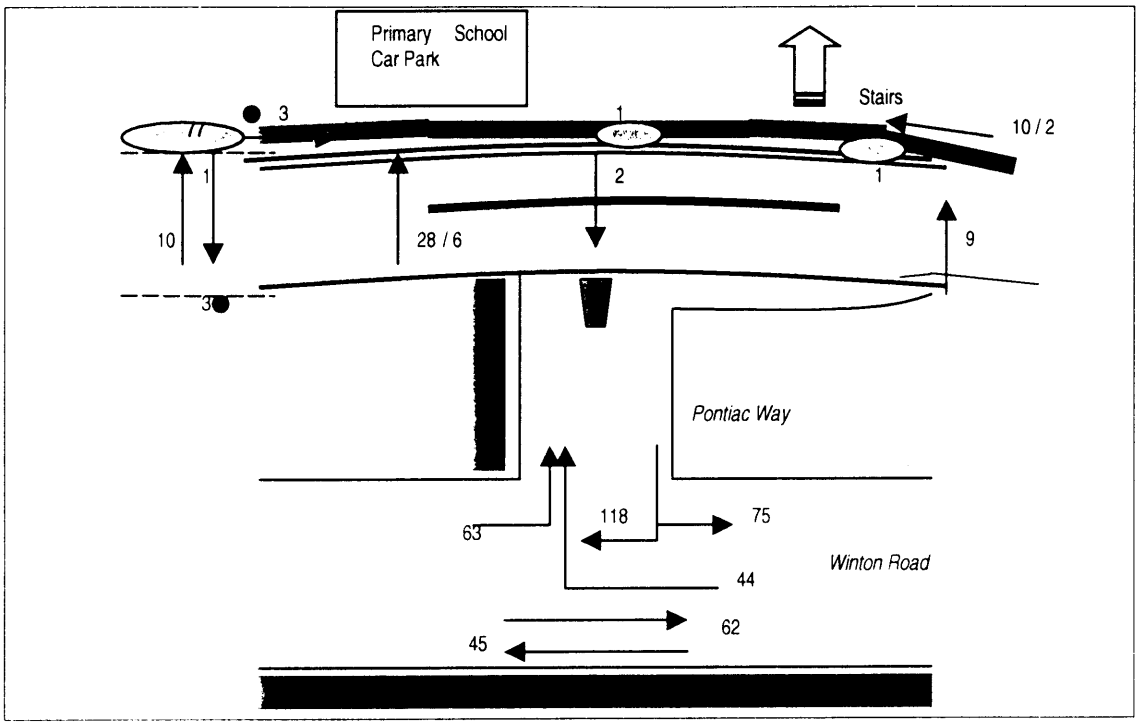
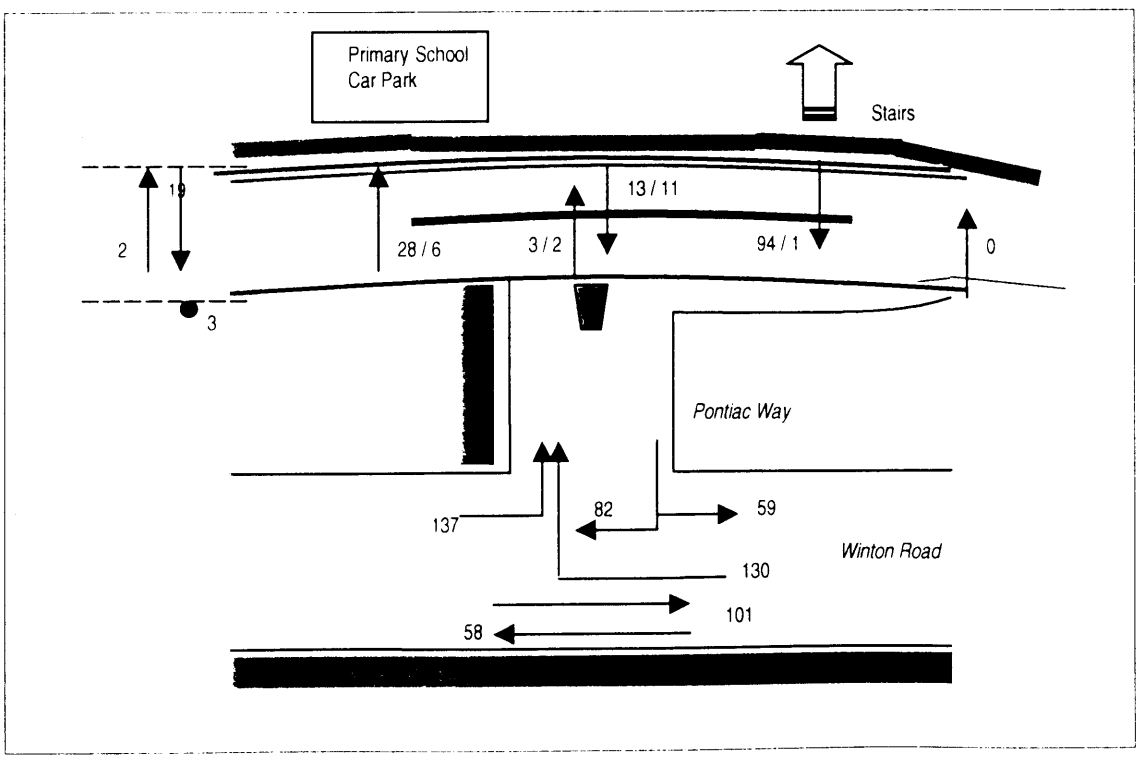


Figure 2.6: Afternoon (Evening) Traffic Volumes for Pontiac Way / Winton Road intersection and Pedestrian Counts on Shenton Avenue



2.6 Traffic Speed

The existing speed limit on Pontiac Way is 50km/h as it is classified as a local road. The posted speed limit on both Joondalup Drive and Marmion Avenue is 70km/h. The designated speed limit along Shenton Ave is 70 km/h.

The City of Joondalup has provided 85th percentile speeds along Shenton Ave on both the east and west approach to the Pontiac Way intersection. The speed was recorded during the survey period from Tuesday 19 March 2002 to Tuesday 26 March 2002. It was found that during weekdays, the 85th percentile speed on Shenton Avenue west of Pontiac Way in both directions was approximately 71km/h, while the speed on the westbound lane of Shenton Avenue east of Pontiac Way was recorded at 61km/h. During the survey period, the traffic speed recorded along Shenton Avenue at the intersection ranged from 15km/h to 160km/h.

2.7 Crash History

Reported vehicle accident data was obtained from Main Roads WA along Shenton Avenue for the five-year period from 1 January 1996 to the 31 December 2000.

2.7.1 Shenton Avenue

A total of fifteen (15) reported vehicle accidents occurred along Shenton Avenue between Marmion Avenue and Joondalup Drive in the five-year period from 1 January 1996 to 31 December 2000. This corresponds to an average accident rate of three (3) accidents per year. The summary accident history for Shenton Avenue within 200 metres west and 20 metres east of Pontiac Way intersection during this period is as follows:

Rear End Crashes	10	(67 %)
Sideswipe Same Direction	3	(20 %)
Other Crashes	2	(13 %)
TOTAL	**15**	**(100%)**

Eight (8) of these crashes occurred at the intersection, whilst six (6) occurred west of the intersection, and one (1) occurred east of the intersection.

Out of the reported 15 crashes, one (1) resulted in medical attention being required, while eight (8) resulted in major property damage, and seven (7) resulted in minor property damage. Most of these crashes occurred in daylight under dry pavement conditions. Forty percent of these accidents occurred on a horizontally curved section of the road.

It was unknown in eighty percent of the accidents whether speed was a contributing factor. In the remaining twenty percent, speed was not a factor.

2.7.2 Shenton Avenue and Joondalup Drive Intersection

Over the same five-year period, ninety-three (93) vehicle accidents at the intersection of Shenton Avenue and Joondalup Drive were reported, which corresponds to an average accident rate of 18.6 accidents per year.

The summary accident history for the intersection of Shenton Avenue and Joondalup Drive during this period is as follows:

Rear End Crashes	42	(45%)
Indirect Right Angle Crashes	39	(42%)
Right Angle Crashes	7	(8%)
Sideswipe Same Direction Crashes	3	(3%)
Other Crashes	2	(2%)
TOTAL	**0**	**(100%)**

Two (2%) of these crashes resulted in hospitalisation being required and 23 crashes (25%) resulted in medical attention. Fifty-one percent (51%) of the total reported crashes resulted in major property damage.

Most of the crashes occurred under dry pavement conditions on level straight road alignments and none of these crashes occurred during night time. Speed was known to be a factor in one of these 93 crashes. In addition, while speed is known to not be a factor in 41% if the crashes, It is unknown in the remaining 58% if speed was a contributing factor to the crash.

2.8 Other Traffic Issues

Pedestrian and Cyclist Safety:

- Due to existing curved alignment of Shenton Avenue, and existing speed limit of 70km/h, students have been observed to commence crossing activity on Shenton Avenue but stop and return back to footpath due to oncoming traffic.
- Students generally cross west of the median island.
- Some student cyclists were observed to approach from the west side of Pontiac Way intersection along Winton Road. Cyclists were also observed to stage their crossing across Shenton Avenue due to high traffic volumes. They were also observed to re-align their bicycles parallel to Shenton Avenue due to lack of storage space in the centre of Shenton Avenue. The existing median island has no refuge point, and is approximately 50 metres wide.
- Most students approaching from the southeast direction were observed to use cyclist ramp located on Winton Road (adjacent to Joondalup Drive) and the cycle lane on the south side of Shenton Avenue west of Joondalup Drive intersection. However, this cycle lane ends within fifty metres west of Joondalup Drive. Students were observed to cross at this location (end of cycle lane) to the north side of Shenton Avenue and use existing footpath.
- Primary school students have been observed to cross Shenton Avenue unassisted.

Pick-Up and Drop-off Facilities:

- Some pick-up/drop-off activities were observed along Pontiac Way in both directions as well as Winton Road.
- Some U-turn activities along Pontiac Way by parents who dropped-off students.
- Parents travelling eastbound along Shenton Avenue would stop and on some occasions park at the existing bus-bay to drop-off students in the morning.
- Some parents have been observed to park adjacent to the Pontiac Way median, obstructing both the cycle lane and parts of the Shenton Avenue eastbound lane.
- Parked vehicles were also noted along the bus bay and shoulder lane north of Shenton Avenue in the afternoon just prior to the pick-up period at 1500hrs.
- Some pick-up activities were also noted at the car park area located south of the Winton Road / Pontiac Way intersection.

Heavy Vehicle Movements:

- Four non-service buses noted to approach from the west and turn north at the Pontiac Way / Winton Road intersection. There is an existing bus depot at the corner of Buick Way and Winton Road (south of the Joondalup Business Park).
- Heavy commercial vehicles aside from buses were also evident along Shenton Avenue, Pontiac Way and Winton Road.

Existing Sight Distances:

- Limited intersection entering sight distance from Pontiac Way to Shenton Avenue. It is estimated that the sight distance available from Pontiac Way to westbound lane of Shenton Avenue east of Pontiac Way is approximately 90 metres. The required safe intersection sight distance for an 85th percentile speed of 60km/h is 105 metres minimum, and 130 metres minimum for the 85th percentile speed of 70km/h.

3. Intersection Options

3.1 Introduction

There are a number of intersection options that may be considered. Six different new intersection configurations are proposed and discussed in detail below. Refer to **Appendix B** of this report for option plans.

There are some constraints that must be considered as part of this study, one of which involves the carriageway width in the short-term scenario. The length of the railway tunnel that is located below the intersection governs the carriageway width at the intersection of Shenton Avenue and Pontiac Way. Therefore roundabout options are only feasible after the tunnel has been widened, and width constraints at the intersection are minimised.

3.2 Option 1 – Existing Intersection

The existing Friday peak morning and evening through traffic and turning traffic volumes for Shenton Avenue and Pontiac Way intersection were input into the intersection modelling software program SIDRA to ascertain the existing intersection level of service during the peak periods. Table 3.1 below summarises the SIDRA outputs. The output is also shown diagrammatically in **Appendix C**. Refer to Table 2.1 of this report for the traffic volumes used.

Table 3.1: SIDRA Outputs for Shenton Avenue / Pontiac Way Intersection based on Existing Friday Morning and Evening Peak Period

		AM				PM			
Location	**Movement Type**	**Degree of Saturation**	**Level of Service**	**Average Delay (sec)**	**95% Queue (m)**	**Degree of Saturation**	**Level of Service**	**Average Delay (sec)**	**95% Queue (m)**
Pontiac Way South Approach	Left	0.506	B	12.4	19	0.957	C	24.1	109
Shenton Avenue East Approach	Left	0.133	B	10.4	0	0.102	B	10.4	0
	Through	0.435	B	0.4	0	0.648	D	0.8	0
Shenton Avenue West Approach	Through	0.371	B	0.5	0	0.319	B	0.4	0
OVERALL		Level of Service: A				Level of Service: A			

The outputs indicate that the average delay is less than thirty seconds long during the morning and evening peak period, with queues on Pontiac Way South Approach estimated at less than twenty metres in the morning peak period, and less than 110 metres (equivalent to 18 vehicle queue) during the evening peak period. The outputs also indicate that the intersection overall level of service is currently A (very good) in both peak periods.

3.3 Option 2 – Right-Turn Slip Lane

An intersection treatment was explored to determine the effectiveness of routing traffic on Shenton Avenue as a dual carriageway through a single carriageway approximately 100 metres west of the intersection, which would then diverge into two lanes: a single through lane and a dedicated right-turn slip lane.

The potential traffic volumes that would turn right at Shenton Way into Pontiac Way was determined based on the turning traffic movements at the Shenton Avenue and Joondalup Drive intersection (sourced from Main Roads WA), and the landuse activity in the vicinity of the Study Area. In the weekday morning peak of 0800hrs to 0900hrs on Thursday 21 March 2002, approximately 420 vehicles were recorded to turn right at from Shenton Avenue into Joondalup Drive. Assuming that a similar turning volume would be experienced in the morning peak period of a Friday, and that 50% of these volumes would turn right from Shenton Avenue into Pontiac Way, approximately 210 vehicles would use the proposed right-turn slip lane.

Similarly, in the evening peak period of 1700hrs to 1800hrs, the potential volumes on the proposed right-turn slip lane would be approximately 50% of the recorded (21 March 2002) Shenton Avenue evening peak period right-turn volumes into Joondalup Drive. The recorded turning volume was 274 vehicles therefore the potential evening peak right-turn volume on Shenton Avenue into Pontiac Way would be approximately 140 vehicles.

Option 2 was analysed using the intersection modeling software program SIDRA with the existing and projected volumes as discussed above. The output for Option 2 is summarised in Table 3.2 below and shown diagrammatically in **Appendix C**.

Table 3.2: Peak Period SIDRA Outputs for Shenton Avenue / Pontiac Way Intersection with Right-Turn Slip Lane

Location	Movement Type	AM				PM			
		Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)	Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)
Pontiac Way South Approach	Left	0.141	A	9.2	3	0.957	C	23.3	109
Shenton Avenue East Approach	Left	0.209	A	6.6	0	0.375	A	2.7	0
	Through	0.209	A	0.0	0	0.375	A	0	0
Shenton Avenue West Approach	Through	0.677	A	0.0	0	0.319	A	0	0
	Right	0.210	B	12.3	7	0.249	C	16	8
OVERALL		Level of Service: A				Level of Service: A			

The morning peak period is likely to experience an overall level of service A (very good). A level of service A has been assigned to all lanes except the right-turn lane of the Shenton Avenue West Approach, which is likely to experience a level of service B (good). This indicates that SIDRA is estimating that during the morning peak period Option 1 (with a right-turn slip lane) will operate well.

An overall level of service A (very good) is also estimated by SIDRA for Option 1 in the evening peak period. All lanes of the Shenton Avenue East Approach and the through lane of the Shenton Avenue West Approach are all likely to operate at a level of service A (very good). The right-turn lane of the Shenton Avenue West Approach and the westbound lane of the Pontiac Way South Approach are both likely to experience a level of service C (acceptable). The queue length and delays, estimated during the evening peak, at the Pontiac Way South Approach are likely to be the same as the queues and delays experienced in the existing evening peak scenario.

3.4 Option 3 – Signalised Intersection (no dedicated Pedestrian Crossing signals) with Right-Turn Slip Lane on Pontiac Way

Another intersection can be achieved by dualising Shenton Avenue and signalising the intersection (three-phase system). The Pontiac Way South Approach would be re-aligned to provide a single left-turn lane and a slip lane for right-turn traffic. Converse to the previous option (Option 2), this would allow full vehicular access around the intersection.

The morning peak right-turn traffic volumes from Shenton Avenue into Pontiac Way would potentially be 210 vehicles as derived in Section 3.1 of this report.)

The traffic counts recorded in April 2002 for the other access/egress crossovers into the Joondalup Business Park were sourced from City of Joondalup. The evening volumes on these crossovers during the Friday morning period of 0800hrs to 0900hrs, and Friday evening period of 1700hrs to 1800hrs are summarised below in Table 3.2. Refer to locality plan in **Appendix A** of this report for the crossover locations.

Table 3.3: Existing Traffic Counts on Crossovers into Joondalup Business Park

Location	Friday 0800-0900hrs	Friday 1700-1800hrs
Cord Street Eastbound	177	209
Cord Street Westbound	222	82
Aston Street Eastbound	112	539
Aston Street Westbound	128	219
Buick Way Northbound	389	355
Buick Way Southbound	18	54

Given the relatively large egress volumes on Aston Street and Cord Street during the morning peak period, it is assumed that a significant percentage of the northbound traffic on Buick Way is through-traffic bypassing the signalised intersection along Joondalup Drive. For conservative purposes, it was assumed that twenty percent (25%) of the northbound Buick Way intersection would egress and turn right out from Pontiac Way into Shenton Avenue. Therefore, approximately 100 vehicles may turn right out from Pontiac Way.

During the evening peak period, it is assumed that 25% of traffic accessing the Joondalup Business Park from Buick Way would bypass Joondalup Drive and turn right at the Shenton Avenue/Pontiac Way intersection. It is further assumed that 25% of the egressing traffic on Cord Street and Aston Street would divert and turn right out of Pontiac Way onto Shenton Avenue. Therefore, the total number of vehicles turning right out of Pontiac Way during the evening peak period would be approximately 275 vehicles.

The evening peak right-turn traffic volumes from Shenton Avenue into Pontiac Way would potentially be 140 vehicles as derived in Section 3.1 of this report.)

The intersection modeling software SIDRA was used to determine the likely level of service of Option 3 with the existing and projected traffic volumes in the peak periods. The output for the SIDRA analysis is summarised in Table 3.4 overleaf. The output is also shown diagrammatically in **Appendix C**.

Table 3.4: Peak Period SIDRA Outputs for Shenton Avenue / Pontiac Way Signalised Intersection with Right-Turn Slip Lane on Pontiac Way

Location	Movement Type	AM				PM			
		Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)	Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)
Pontiac Way South Approach	Left	0.239	B	12.3	13	1.06	F	108.5	302
	Right	0.623	C	34.1	25	1.00	C	30.3	42
Shenton Avenue East Approach	Left / Through	0.723	C	24.4	61	0.97	D	51.2	155
	Through	0.723	C	21.2	54	0.97	D	48.4	149
Shenton Avenue West Approach	Through	0.738	A	7.1	89	0.51	A	6.3	52
	Through / Right	0.738	B	15.7	62	0.51	B	19.8	19
OVERALL		Level of Service: B				Level of Service: D			

The overall level of service estimated for the signalised intersection in the morning peak period is B (good). The level of service for the morning peak period ranges from A (very good) for the through lane of the Shenton Avenue West Approach to C (acceptable) for the right-turn lane at the Pontiac Way South Approach and for all lanes at the Shenton Avenue East Approach. Vehicles at the Pontiac Way South Approach are estimated to undergo average delays of less than 40 seconds. The longest queue length of approximately 90 metres (equivalent to 15 cars) is projected to occur at the through lane of the Shenton Avenue West Approach.

In the evening peak period, the signalised intersection is likely to operate of an overall level of service D (acceptable). Although the through lane of the Shenton Avenue West Approach is likely to operate at a level of service A (very good), the left-turn lane on Pontiac Way South Approach is projected to perform at a level of service F (very poor) with an average delay exceeding 100 seconds, and a queue length of more than 300 metres (equivalent to 50 vehicles).

3.5 Option 4 – Dual Lane Roundabout

Similarly with Option 3, Option 4 assumes a dual carriageway at Shenton Avenue on both approaches to the intersection. Pontiac Way South Approach remains similar to the existing lane configuration of single lane entry and exit. This option is applicable in the long-term timeframe, after the tunnel widening process is completed.

Traffic volumes estimated for the Option 3 intersection are applicable and are used to analyse Option 4 in the intersection modeling software SIDRA and the output is summarised in Table 3.5 overleaf and shown diagrammatically in **Appendix C**.

The outputs indicate that the roundabout option overall level of service is B (good) for the morning peak period. Each movement type at each approach was also estimated to perform at level of service B. However, the overall level of service is F (very poor) for the evening peak period, with Pontiac Way South Approach left / right-turn lane performing at level of service F (very poor). Traffic on Pontiac Way South Approach will experience delays of more than 500 seconds, and queue length of more than 1,400 metres.

Table 3.5: Peak Period SIDRA Outputs for Shenton Avenue / Pontiac Way Roundabout Intersection

Location	Movement Type	AM				PM			
		Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)	Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)
Pontiac Way South Approach	Left / Right	0.279	B	13.1	9	1.551	F	517.6	1424
Shenton Avenue East Approach	Left / Through	0.257	B	10.7	9	0.377	B	10.9	15
	Through	0.257	B	11.9	9	0.377	B	11.5	15
Shenton Avenue West Approach	Through	0.404	B	11.3	16	0.262	B	11.7	9
	Through / Right	0.404	B	12.0	16	0.262	B	12.6	9
OVERALL		Level of Service: B				Level of Service: F			

3.6 Option 5 – Dual Lane Roundabout with North Approach

Option 5 explores the scenario where a new northern local road is provided at the intersection to allow access and egress from Shenton Avenue to the Lake Joondalup Baptist College and Joondalup Arena located north of the intersection. For the purposes of this Study, this new road is identified as Pontiac Way North Approach. The intersection is configured with dual carriageway on Shenton Avenue at each approach, and a single lane carriageway on Pontiac Way North and South Approach. Again, this option is applicable in the long-term timeframe, after the tunnel widening process is completed.

The provision of a northern access/egress point to the school and arena is likely to generate more traffic through the intersection. From consultation and liaison with both the school approximately 1,050 students currently attend the primary school and college. At the college section of the school, there are four formalised drop-off bays, and approximately 42 staff parking bays. No visitor or parent car parking facilities are provided. At the primary school section of the school, there are approximately twenty bays for parent parking, and twenty bays for staff parking. The school church is equipped with five parking bays.

The Joondalup Arena has also informed that it opens between 0500hours and 2400hrs. The number of visitors during the weekday morning peak period of 0800hours to 0900 hours, and evening peak period of 1700hrs to 1800hrs has been recorded to be an average of 110 visitors in the morning, and 920 in the evening.

Based on this information, it is assumed that there will be approximately 230 vehicles and 200 vehicles respectively on the entry lane and exit lane of Pontiac Way North Approach during the morning peak period. Conversely, there will be 100 vehicles on each lane at the Pontiac Way North Approach during the evening peak period. These additional generated traffic volumes are augmented with the volumes assumed for the previous options, and distributed to the other approaches of the intersection. The overall morning and evening peak traffic volumes are as shown in Figure 3.1 (refer below) and Figure 3.2 (refer overleaf).

Figure 3.1: AM Peak Period Volumes for Shenton Avenue / Pontiac Way Roundabout Intersection

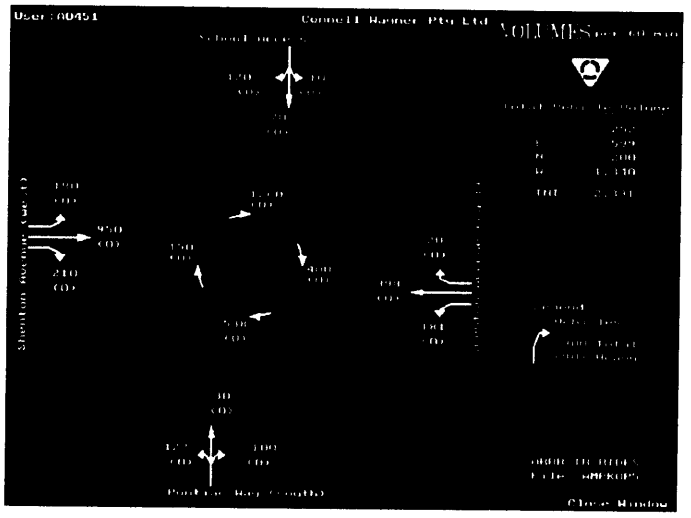
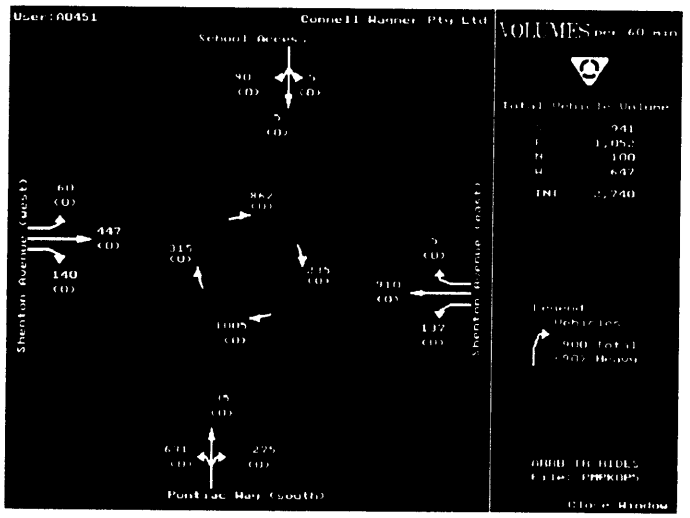


Figure 3.2: PM Peak Period Volumes for Shenton Avenue / Pontiac Way Roundabout Intersection



The SIDRA outputs are summarised in Table 3.6 below and illustrated in **Appendix C**.

Table 3.6: Peak Period SIDRA Outputs for Shenton Avenue / Pontiac Way Roundabout Intersection with North Approach

Location	Movement Type	AM				PM			
		Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)	Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)
Pontiac Way South Approach	Left / Through / Right	0.357	B	14.2	12	1.787	F	731.5	1813
Shenton Avenue East Approach	Left / Through	0.331	B	12.0	13	0.445	B	11.5	19
	Through / Right	0.331	B	13.4	13	0.445	B	12.3	19
Shenton Avenue West Approach	Left / Through	0.494	B	11.1	21	0.284	B	11.3	10
	Through / Right	0.494	B	12.2	22	0.284	B	12.5	10
Pontiac Way North Approach	Left / Through / Right	0.468	C	22.3	19	0.162	B	16.7	5
OVERALL		Level of Service: B				Level of Service: F			

The outputs indicate that the roundabout option with the north approach has an overall level of service B (good) for the morning peak period. The level of service for each movement type at each approach was also estimated to perform at level of services B, with the exception of the new north approach. The left/through/right-turn lane at this approach is projected to have a level of service C (acceptable) with an average delay of less than 25 seconds, and a queue length of 20 metres.

As per Option 4, the Pontiac Way South Approach left/through/right-turn lane and the left/through lane of the Shenton Avenue East Approach are both likely to perform at a level of service F (very poor) in the evening peak period, and the intersection performs at the overall level of service is F (very poor). Traffic on Pontiac Way South Approach will experience delays of more than 700 seconds, and queue length of more than 1,800 metres.

3.7 Option 6 – Signalised Intersection (no dedicated Pedestrian Crossing signals) with North Approach and Right-Turn Slip Lane on Pontiac Way South Approach

Option 6 is similar to Option 3 with the inclusion of the new Pontiac Way North Approach. The north approach is controlled by a traffic signals with the phase being the same as that for Pontiac Way South Approach. The volumes derived in Section 3.6 of this report are applied to this option analysis. The outputs are summarised in Table 3.7 overleaf, and presented diagrammatically in **Appendix C** of this report.

The overall level of service estimated for the signalised intersection in the morning peak period is C (acceptable). The longest average delay, which is at the Pontiac Way North Approach, is estimated to be less than 45 seconds. The longest queue is projected to be on the left lane of the Shenton Avenue West Approach with approximately 160 metres (equivalent to 26 vehicles).

In the evening peak period, the signalised intersection is likely to operate of an overall level of service E (poor). The Pontiac Way South Approach left-turn lane has a level of service F (very poor) with average delay exceeding 90 seconds, and queues more than 400 metres long. Furthermore, both lanes of the Shenton Avenue East Approach are expected to perform at level of service E (poor) with average delays more than 75 seconds, and queues of more than 240 metres on each lane.

Table 3.7: Peak Period SIDRA Outputs for Shenton Avenue / Pontiac Way Signalised Intersection with North Approach Right-Turn Slip Lane on Pontiac Way South Approach

Location	Movement Type	AM				PM			
		Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)	Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)
Pontiac Way South Approach	Left	0.131	B	10.5	11	1.042	F	93.8	419
	Through / Right	0.808	D	39.2	38	1.231	D	44.4	52
Shenton Avenue East Approach	Left / Through	0.849	D	38.1	78	0.988	E	78.7	242
	Through	0.849	C	32.3	73	0.988	E	76.0	242
Shenton Avenue West Approach	Left / Through	0.852	D	19.3	157	0.677	C	17.8	113
	Through / Right	0.852	B	25.1	111	0.677	B	32.7	34
Pontiac Way North Approach	Left / Through / Right	0.585	D	42.1	57	0.111	C	30.1	15
OVERALL		Level of Service: C				Level of Service: E			

3.8 Option 7 – Right-turn Slip Lane and Left-turn Slip Lane on Shenton Avenue West Approach

Option 7 is similar to Option 2 where traffic west of the intersection is directed to merge from a dual carriageway through single carriageway approximately 100 metres west of the intersection. However, in Option 7, this lane would then diverge into three (instead of two) lanes: a left-turn slip lane, a single through lane and a dedicated right-turn slip lane. East of the intersection the through lane of Shenton Avenue diverges into a dual carriageway. Pontiac Way North Approach is controlled by a GIVE WAY sign with single lane entry and exit.

The traffic volumes derived in Section 3.6 are applied to this intersection option and the resulting SIDRA outputs are summarised in Table 3.8 below.

Table 3.8: Peak Period SIDRA Outputs for Shenton Avenue / Pontiac Way Intersection with Right-turn Slip Lane and Left-turn Slip Lane

Location	Movement Type	AM				PM			
		Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)	Degree of Saturation	Level of Service	Average Delay (sec)	95% Queue (m)
Pontiac Way South Approach	Left	0.141	A	10.2	3	1.134	F	141.8	394
Shenton Avenue East Approach	Left / Through	0.167	A	6.1	0	0.3	A	2.5	0
	Through	0.167	A	0	0	0.3	A	0	0
Shenton Avenue West Approach	Left	0.138	A	8.6	0	0.060	A	8.6	0
	Through	0.542	A	0	0	0.255	A	0	0
	Right	0.255	A	12.7	8	0.294	A	17	10
Pontiac Way North Approach	Left	0.387	B	14.3	11	0.116	B	10.2	3
OVERALL		Level of Service: A				Level of Service: E			

The morning peak period is likely to experience an overall level of service A (very good) with all lanes performing at a level of service A except for the Pontiac Way North Approach left-turn lane. This lane is estimated to perform at a level of service B (good). Converse to the morning peak period, the

overall level of service for the intersection in the evening peak period is E (poor). Although all the lanes perform at level of services A or B, the Pontiac Way South Approach is estimated to perform poorly with level of service F (very poor) due to the anticipated significant average delays of more than 140 seconds, and queue lengths of approximately 400 metres.

3.9 Comparison of Proposed Option Intersection Capacity

With the exception of Option 2 (right-turn slip lane on Shenton Avenue West Approach only), Pontiac Way South Approach performs relatively poorly with level of service F (very poor) in all the proposed options (refer to Table 3.9 below).

Table 3.9: Comparison of Peak Period SIDRA Outputs for Shenton Avenue / Pontiac Way Intersection Options

OPTION	AM Level of Service	PM Level of Service	Worst Approach	Delays / Queues
Right-Turn Slip Lane on Shenton Avenue West Approach	A	A	Pontiac Way South Approach Left-Turn Lane – Level of Service C in PM Peak Period	23.3 seconds; 109 metres
Signalised Intersection with Right-Turn Slip Lane on Pontiac Way	B	D	Pontiac Way South Approach Left-Turn Lane – Level of Service F in PM Peak Period	108.5 seconds; 302 metres
Dual Lane Roundabout	B	F	Pontiac Way South Approach Left/Right-Turn Lane – Level of Service F in PM Peak Period	517.6 seconds; 1,424 metres
Dual Lane Roundabout with North Approach	B	F	Pontiac Way South Approach Left/Through/Right-Turn Lane – Level of Service F in PM Peak Period	731.5 seconds; 1,813 metres
Signalised Intersection with North Approach and Right-Turn Slip Lane on Pontiac Way South Approach	C	E	Pontiac Way South Approach Left-Turn Lane – Level of Service F in PM Peak Period	93.8 seconds; 419 metres
Right-turn Slip Lane and Left-turn Slip Lane on Shenton Avenue West Approach	A	E	Pontiac Way South Approach Left-Turn Lane – Level of Service F in PM Peak Period	142 seconds; 394 metres

The roundabout options create the longest average delays and queues on this approach. As Pontiac Way South Approach has a leg of less than 200 metres, the estimated queues of more than 1,400 metres in these options would adversely affect the intersection of Pontiac Way and Winton Road.

The options that involve the provision of a new access road north of the intersection (Pontiac Way North Approach) will also result in significant queuing on Pontiac Way South Approach and will affect the intersection of Pontiac Way and Winton Road.

According to the SIDRA outputs, the best performing option is Option 2 however this option does not serve the existing demand for direct access into the school and arena from Shenton Avenue. Furthermore, this option also infers the merging of traffic from a dual carriageway into a single lane at the intersection and this may have some adverse impacts on the traffic flow on Shenton Avenue further west and east of the intersection.

The options that do not provide direct access into the school and arena do not address the pedestrian and cyclist safety issue.

There are other advantages and disadvantages related to each of the presented options and are summarised in Table 3.10 (refer overleaf).

Table 3.10: Advantages and Disadvantages of Shenton Avenue / Pontiac Way Intersection

OPTION	Advantages	Disadvantages
Right-Turn Slip Lane on Shenton Avenue West Approach	▪ Provides right-turn movement from Shenton Avenue into Pontiac Way ▪ Relatively inexpensive	▪ Does not allow right-turn movement from Pontiac Way into Shenton Avenue ▪ Requires eastbound Shenton Avenue carriageway to be reduced to one lane ▪ Requires relocation of bus bay on eastbound Shenton Avenue carriageway ▪ Does not provide access to the north of Shenton Avenue
Signalised Intersection with Right-Turn Slip Lane on Pontiac Way	▪ Maintains Shenton Avenue eastbound carriageway with two through lanes ▪ Allows full access into and out of Pontiac Way ▪ Safer exit from Pontiac Way onto Shenton Avenue ▪ Provides signalised pedestrian crossing facilities across Shenton Avenue	▪ Tend to encourage more traffic into Pontiac Way ▪ Additional delays to Shenton Avenue due to extra traffic signals ▪ For eastbound Shenton Avenue there is no right-turn slip lane which could result in an increase in rear-end crashes ▪ With extension of Mitchell Freeway it would result in 4 sets of signals in approximately 600 metres which would impact on the effectiveness of Shenton Avenue ▪ Coordination of these signals with Joondalup Drive / Shenton Avenue Intersection will result in increased delays due to increased cycle time. ▪ The short length of the right-turn slip lane for Pontiac Way right-turn could result in the right-turn traffic interfering with the left-turn traffic ▪ More expensive option and ongoing intersection costs ▪ Could encourage drop off / pick up of students at the intersection
Dual Lane Roundabout	▪ Provides full and safe access from Pontiac Way ▪ Can become an entry statement for the City Centre ▪ Shenton Avenue maintains 2 lanes in each direction ▪ Provides an opportunity to slow traffic approaching Joondalup from the west	▪ Tend to encourage more traffic into Pontiac Way ▪ Requires lengthening of the railway tunnel ▪ Pedestrian crossing points at the intersection less safe that the signalised intersection ▪ More difficult for cyclists to negotiate on road than traffic signals ▪ Could cause delays for Shenton Avenue or Pontiac Way if traffic is very heavy on one leg of roundabout
Dual Lane Roundabout with North Approach	▪ Provides full and safe access from Pontiac Way ▪ Can become an entry statement for the City Centre ▪ Shenton Avenue maintains 2 lanes in each direction ▪ Provides an opportunity to slow traffic approaching Joondalup from the west ▪ Provides an alternative access into the school	▪ Tend to encourage more traffic into Pontiac Way ▪ Requires lengthening of the railway tunnel ▪ Pedestrian crossing points at the intersection less safe that the signalised intersection ▪ More difficult for cyclists to negotiate on road than traffic signals ▪ Could cause delays for Shenton Avenue or Pontiac Way if traffic is very heavy on one leg of roundabout ▪ Vehicles exiting the school have right of way over westbound Shenton Avenue traffic ▪ Could encourage more traffic to use the intersection due to the increased access to the school
Signalised Intersection with North Approach and Right-Turn Slip Lane on Pontiac Way South Approach	▪ Maintains Shenton Avenue eastbound carriageway with two through lanes ▪ Allows full access into and out of Pontiac Way ▪ Safer exit from Pontiac Way onto Shenton Avenue ▪ Provides pedestrian crossing facilities across Shenton Avenue ▪ Provides an alternative access for the school	▪ Tend to encourage more traffic into Pontiac Way ▪ Addition delays to Shenton Avenue due to extra traffic signals ▪ Eastbound Shenton Avenue there is no right-turn slip lane and could results in an increase in rear-end crashes ▪ With extension of Mitchell Freeway it would result in 4 sets of signals in approximately 600 metres ▪ Coordination of these signals with Joondalup Drive / Shenton Avenue Intersection will results in increased delays due to increased cycle time. ▪ The short length of the right-turn slip lane for Pontiac Way right-turn could result in the right-turn traffic interfering with the left-turn traffic ▪ Requires moving Pontiac Way to the west to line up north and south legs of the intersection ▪ Will increase delays to Shenton Avenue traffic to cater for green time required for school exiting traffic
Right-turn Slip Lane and Left-turn Slip Lane on Shenton Avenue West Approach	▪ Provides right-turn movement from Shenton Avenue into Pontiac Way ▪ Relatively Inexpensive ▪ Provides alternative access for the school	▪ Does not allow right-turn movement from Pontiac Way into Shenton Avenue ▪ Does not allow right-turn movements in and out of school access ▪ Does not allow through movement between Pontiac Way and school access ▪ Requires eastbound Shenton Avenue carriageway to be reduced to one lane ▪ Requires relocation of bus bay on eastbound Shenton Avenue carriageway ▪ Does not provide access to the north of Shenton Avenue ▪ Right –turn slip lane for access into school provides no room for paths or services

4. Recommendations

City of Joondalup has expressed the existing demand for a right-turn access into the Joondalup Business Park from Shenton Avenue. Six intersection options were explored which includes the short-term options with signalised and non-signalised configurations and the long-term option of a roundabout intersection configuration. The Joondalup Business Association, Lake Joondalup Baptist College and the Joondalup Arena have requested access to Shenton Avenue from the south opposite Pontiac Way.

4.1 Intersection Level of Service

While each of the intersection options performs well in the morning peak period, the roundabout options, and options with the new North Approach at the intersection perform unsatisfactorily during the evening peak period. The best performing option is the three-way unsignalised intersection with a right-turn slip lane on Shenton Avenue West Approach.

4.2 Safety of Intersection

The existing horizontal and vertical alignment of Shenton Avenue at the intersection limits the intersection sight distances to less than a hundred metres on the west and east approach of the road. AUSTROADS recommend a minimum safe intersection distance of 130 metres for a design speed of 70km/h, 105 metres for 60km/h and 80 metres for 50km/h. Due to the vertical incline of Shenton Avenue from the Joondalup Drive signalised intersection located approximately 250 metres east of the Pontiac Way intersection, vehicle speeds would be controlled to some extent. The proposed re-alignment of Shenton Avenue west leg further to the north would decrease the horizontal curvature at the intersection, hence improving intersection visibility.

The options that require the merging of traffic on Shenton Avenue from a dual carriageway to a single lane provide the most control over vehicle speed through the intersection, particularly on Shenton Avenue West Approach.

The signalised options will also control the average speed through the intersection. They also provide greater intersection safety than the unsignalised intersection options as the signals are able to control and direct traffic through the intersection more effectively than an unsignalised option.

The roundabout options may be able to restrain speed but this is dependent on both the intersection geometry and the amount of circulating traffic around the roundabout. If the circulating lanes are restricted in width or the approaches are offset from each other, drivers would be required to slow down to negotiate the roundabout. Also, if there is a significant volume of circulating traffic, drivers would be more inclined to slow down and stop if necessary at each approach to the intersection.

4.3 Pedestrian Movements

Due to the limited intersection visibility, and high traffic volumes on Shenton Avenue, pedestrian movements should be completely discouraged for Shenton Avenue in the vicinity of the Pontiac Way intersection. This can be achieved through a combination of deterrents including:

- Providing direct access/egress for drop-off/pick up traffic from Shenton Avenue to the school and arena;
- Installing a safety fence on the road shoulder to prevent pedestrians crossing Shenton Avenue. This would also discourage pick-up and drop-off activities along the verge of Shenton Avenue;
- Removing existing pedestrian access/egress points between the Lake Joondalup Baptist College and the north side of Shenton Avenue; and
- Diverting, if necessary, school bus services along Shenton Avenue to the Lake Joondalup Baptist College entrance.

Liaison between the City of Joondalup and Lake Joondalup Baptist College will also be required to ensure the school population is educated about alternative pedestrian access. Transperth may also need to be consulted if school bus service routes are affected.

4.4 Movement of Bus Bay

It is recommended that the existing bus bay on the north side of Shenton Avenue be relocated approximately further east to a location approximately 150 metres east of the intersection. This will minimise the conflicts between the merging traffic and the bus movements for both the signalised and unsignalised options. The bus bay relocation is not necessary for the roundabout option.

4.5 Traffic Management

If the selected option allows full access at the intersection of Pontiac Way and Shenton Avenue, traffic may be encouraged to bypass Joondalup Drive and use Winton Road, through the Joondalup Business Park, as an alternative route. This may necessitate the City of Joondalup to administer traffic management on the road network within the Joondalup Business Park area.

4.6 Long-Term Feasibility of Intersection

The future connection of the Mitchell Freeway to Shenton Avenue will necessitate a signalised intersection to be installed approximately 400 metres west of the Pontiac Way / Shenton Avenue intersection. This will place the Pontiac Way / Shenton Avenue intersection between two sets of signalised intersections along Shenton Avenue (the Mitchell Freeway connection and Joondalup Drive / Shenton Avenue intersection). Therefore if a signalised intersection option is placed at the Shenton Avenue / Pontiac Way intersection, there will be 3 sets of signals within 700 metres which may minimise the efficiency of Shenton Avenue. The installation of a signalised intersection as a short-term option is also more costly than an unsignalised option.

The options that provide for direct access/egress from Shenton Avenue to the school and arena will also address pedestrian and cyclist safety issues in both the short-term and long-term.

While the feasibility of a roundabout intersection in the long-term may be beneficial for traffic flow along Shenton Avenue, it would adversely impact on Pontiac Way and Winton Road. The installation of the roundabout would therefore require an extensive review of the traffic access/egress volume between Pontiac Way to Shenton Avenue.

4.7 Final Recommendation

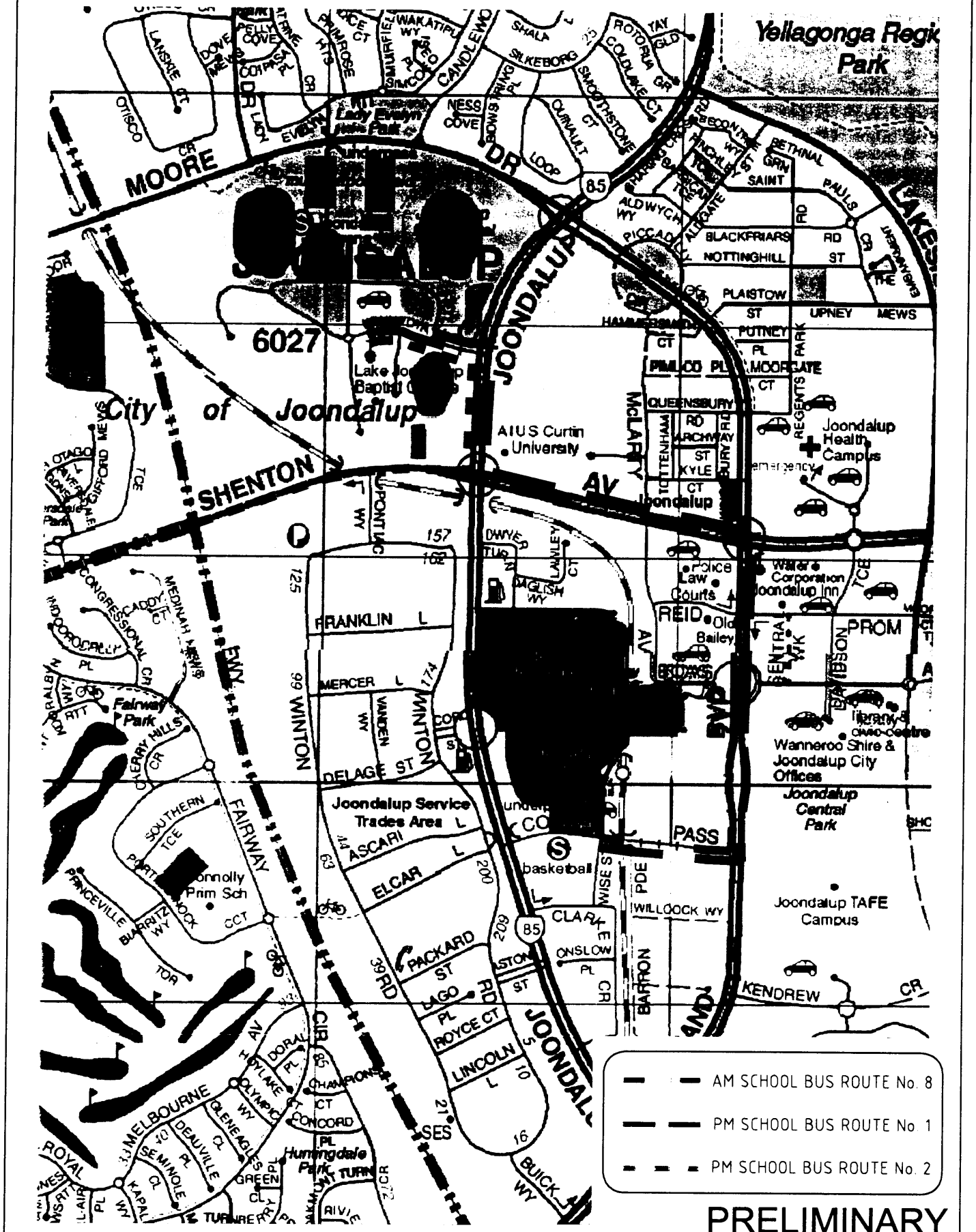
Based on the findings of this Study and through extensive consultation with stakeholders including the Lake Joondalup Baptist College, the Joondalup Arena and the Joondalup Business Association, it is recommended that the four-way signalised intersection option be adopted in the short-term, with the potential to re-configure the intersection in the long-term as a dual lane four-way roundabout.

This recommendation is based on the stakeholders' preference to allowing full access at the intersection and to improve traffic circulation options in the area whilst ensuring pedestrian, cyclist and motorist safety. Traffic flows and volumes at Pontiac Way during the evening peak period will need to be controlled in the short-term and long-term by improving the intersection capacity at the other access/egress points along Winton Road so that egress traffic volumes are well distributed around the Joondalup Business Park.

Appendix A

Locality Plan

A4



PRELIMINARY

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Project: SCHOOL BUS ROUTES

Drawing Title: SITE PLAN

No	Date	Revision Details	By
A	10.04.02	ISSUE FOR INFORMATION	AW

Drawn	A.W.	Date	11.04.02
Designed		Scale	N.T.S.
Verified			
Approved			
CW Project No		Drawing No	Rev

17.06.00

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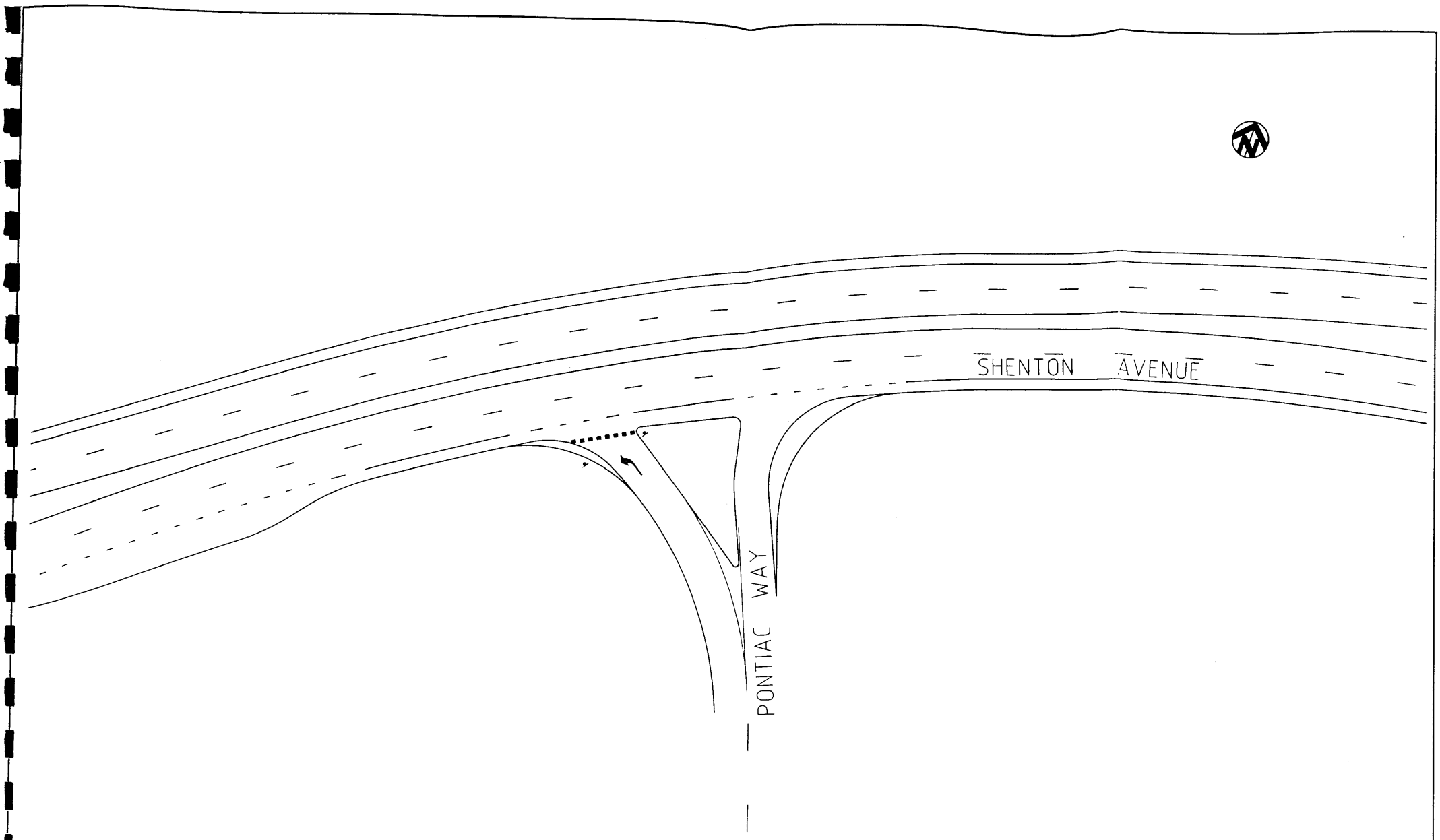
Appendix B

Option Plans



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ISSUED FOR CONSTRUCTION	S.M	17/12/01		

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FILE No. C869	DRAWN No.	
DESIGNED	S. MATULOVIC	15/6/01
VERIFIED	P. WOODS	7/10/01
APPROVED		

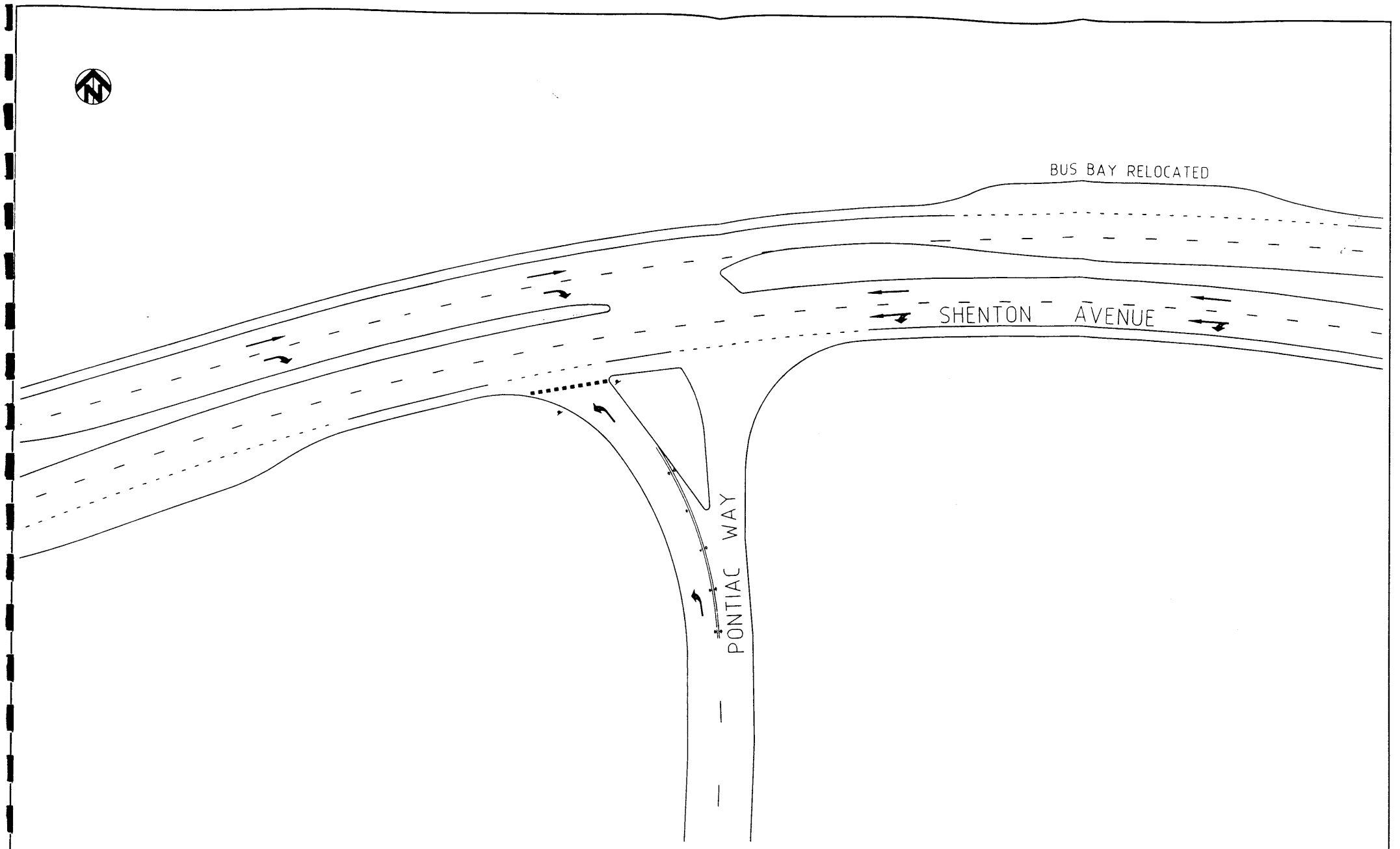
APPROVED / /
CO-ORDINATED DESIGN SERVICES
APPROVED / /
SENIOR INFRASTRUCTURE DESIGNER SERVICES
APPROVED FOR CONSTRUCTION / /
SENIOR INFRASTRUCTURE DESIGNER (CIVIL)

SHENTON AVENUE/PONTIAC WAY
INTERSECTION
OPTION 1

LOCALITY: JOONDALUP

CITY OF JOONDALUP
INFRASTRUCTURE MANAGEMENT SERVICES
CIVIL DESIGN SERVICES

FILE No. - | DRAWING No. E 1436-SK-01 | SHEET | REVISION | ORIGINAL SHEET SIZE A1



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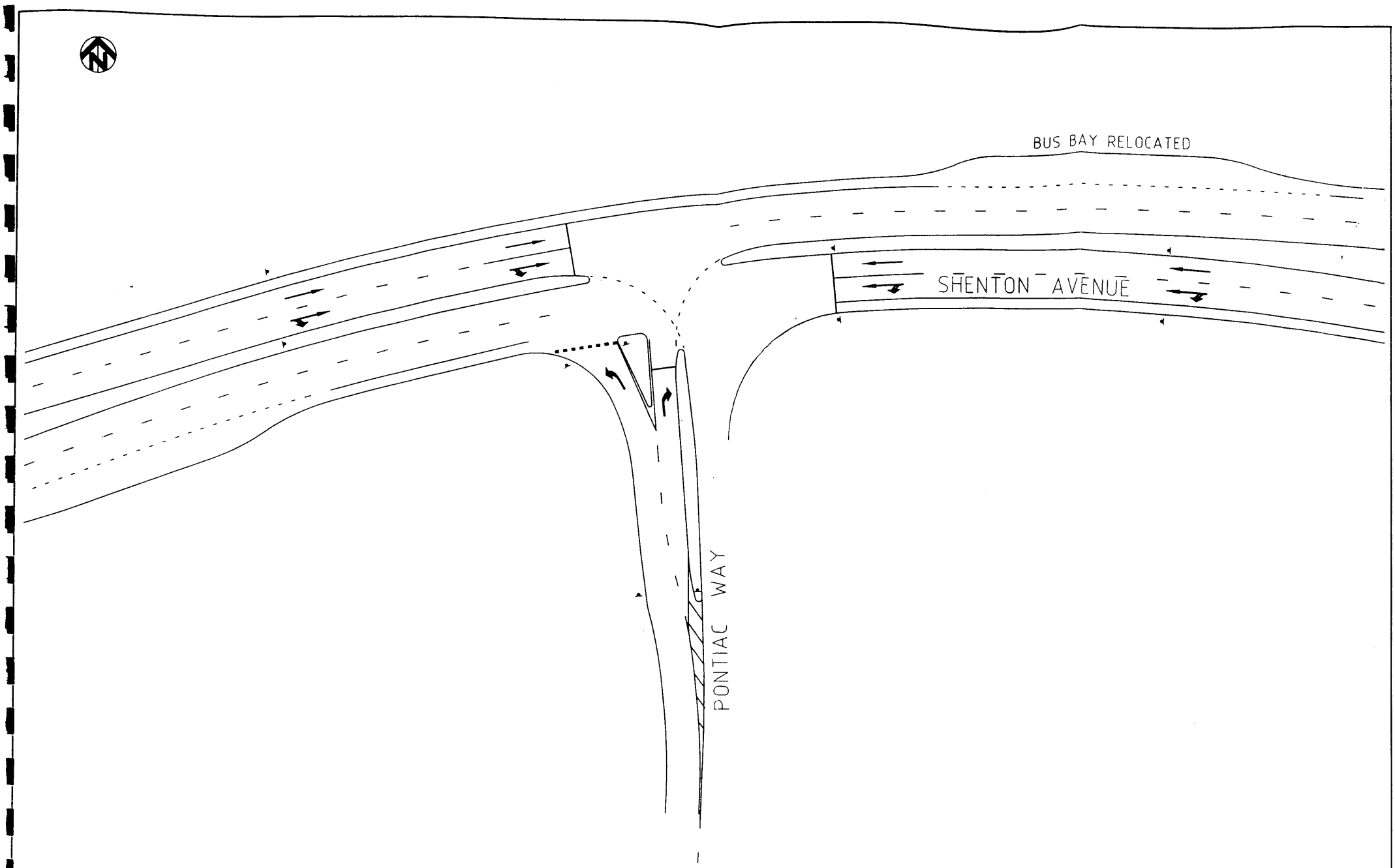
SHENTON AVENUE/PONTIAC WAY
INTERSECTION
OPTION 2

CONNOLLY/JOONDALUP

CITY OF JOONDALUP
INFRASTRUCTURE MANAGEMENT SERVICES
CIVIL DESIGN SERVICES

E 1436-SK-02 A1



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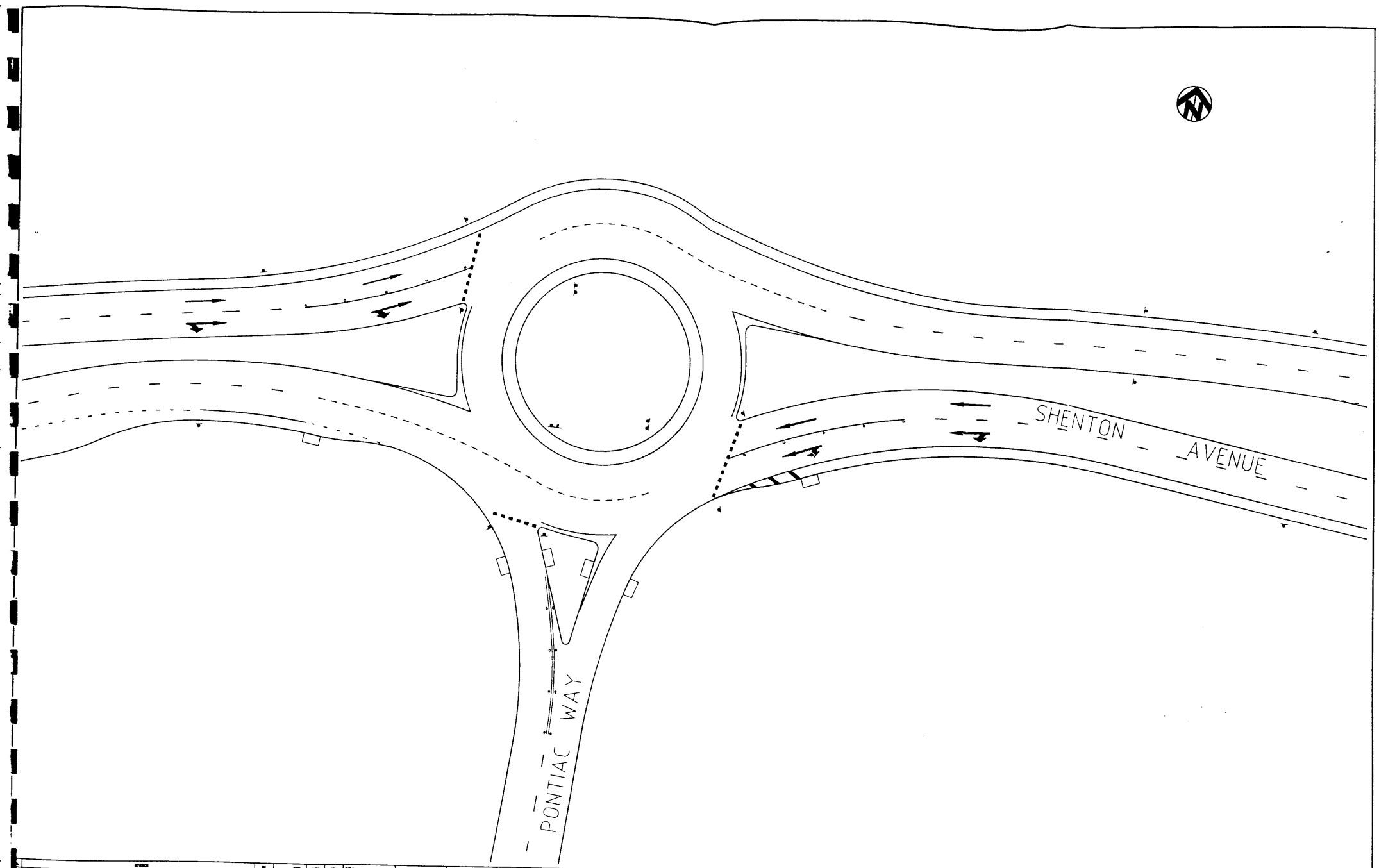

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VERTICAL			

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SHENTON AVENUE/PONTIAC WAY
INTERSECTION
OPTION 4

LOCALITY JOONDALUP

CITY OF JOONDALUP
INFRASTRUCTURE MANAGEMENT SERVICES
CIVIL DESIGN SERVICES

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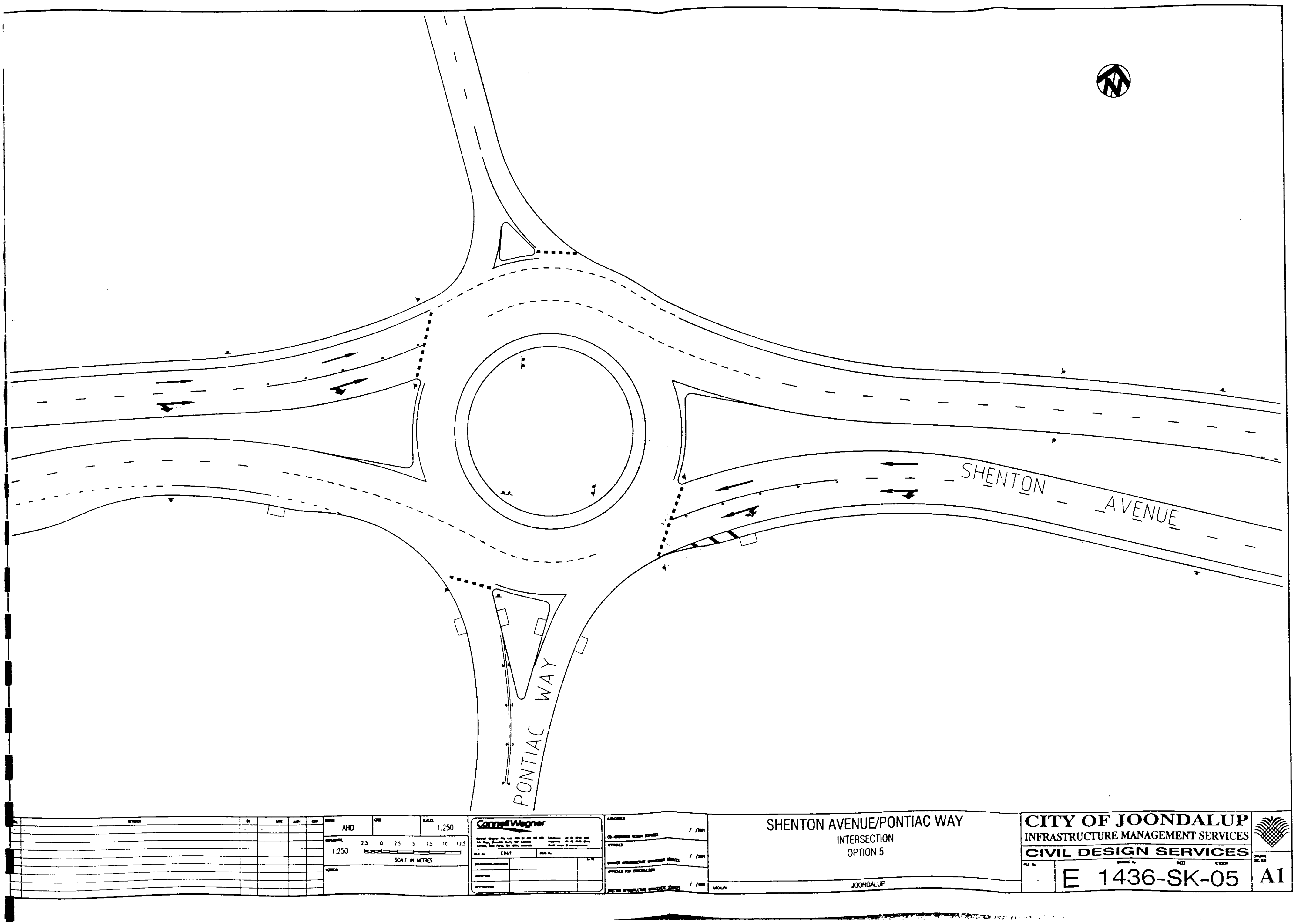
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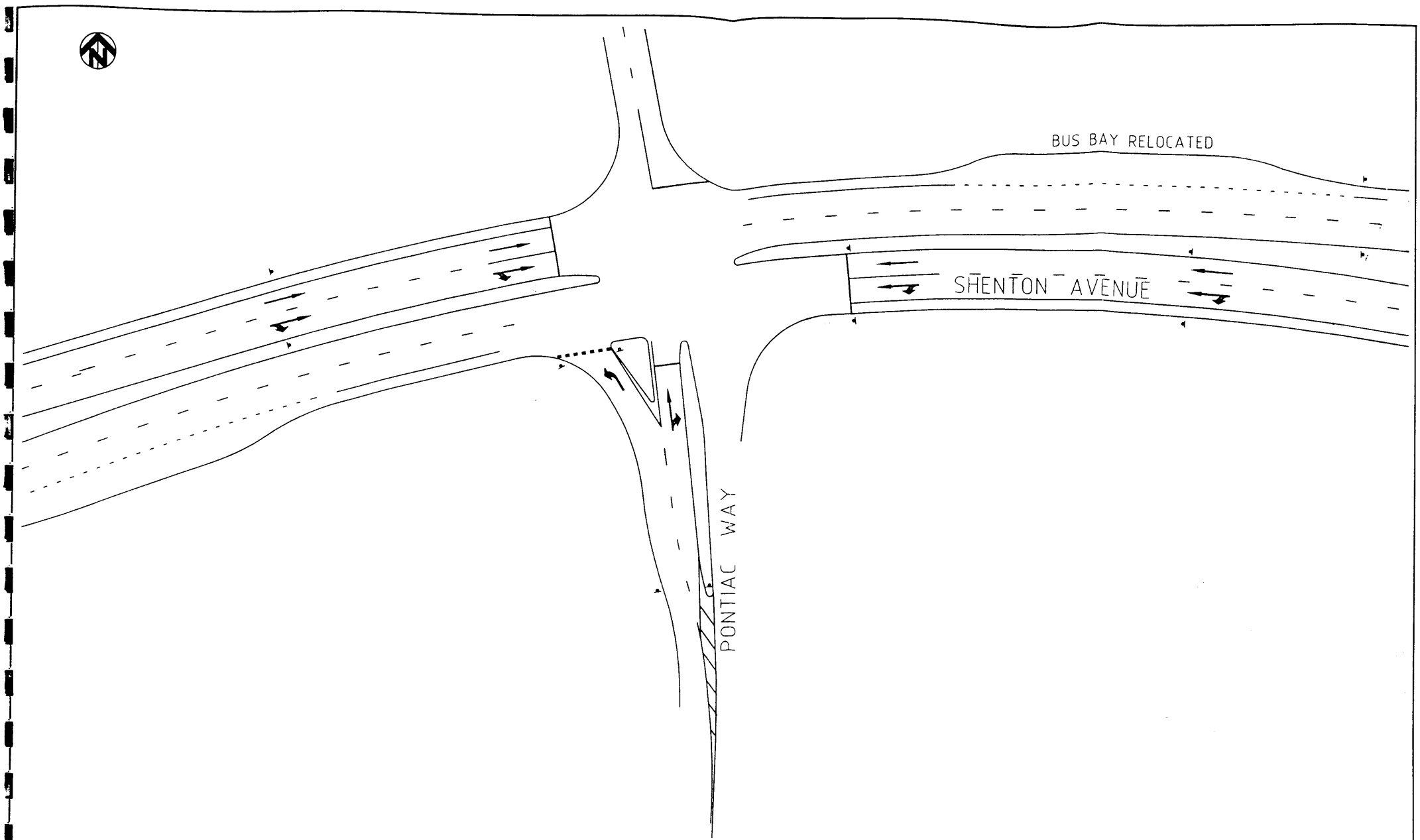
SCALE IN METRES
Connell Wagner
C069
SHENTON AVENUE/PONTIAC WAY
INTERSECTION
OPTION 5
JOONDALUP
CITY OF JOONDALUP
INFRASTRUCTURE MANAGEMENT SERVICES
CIVIL DESIGN SERVICES
E 1436-SK-05
A1



AHO	PCG94	1:250	
1:250	2.5 0 2.5 5 7.5 10 12.5 SCALE IN METRES		

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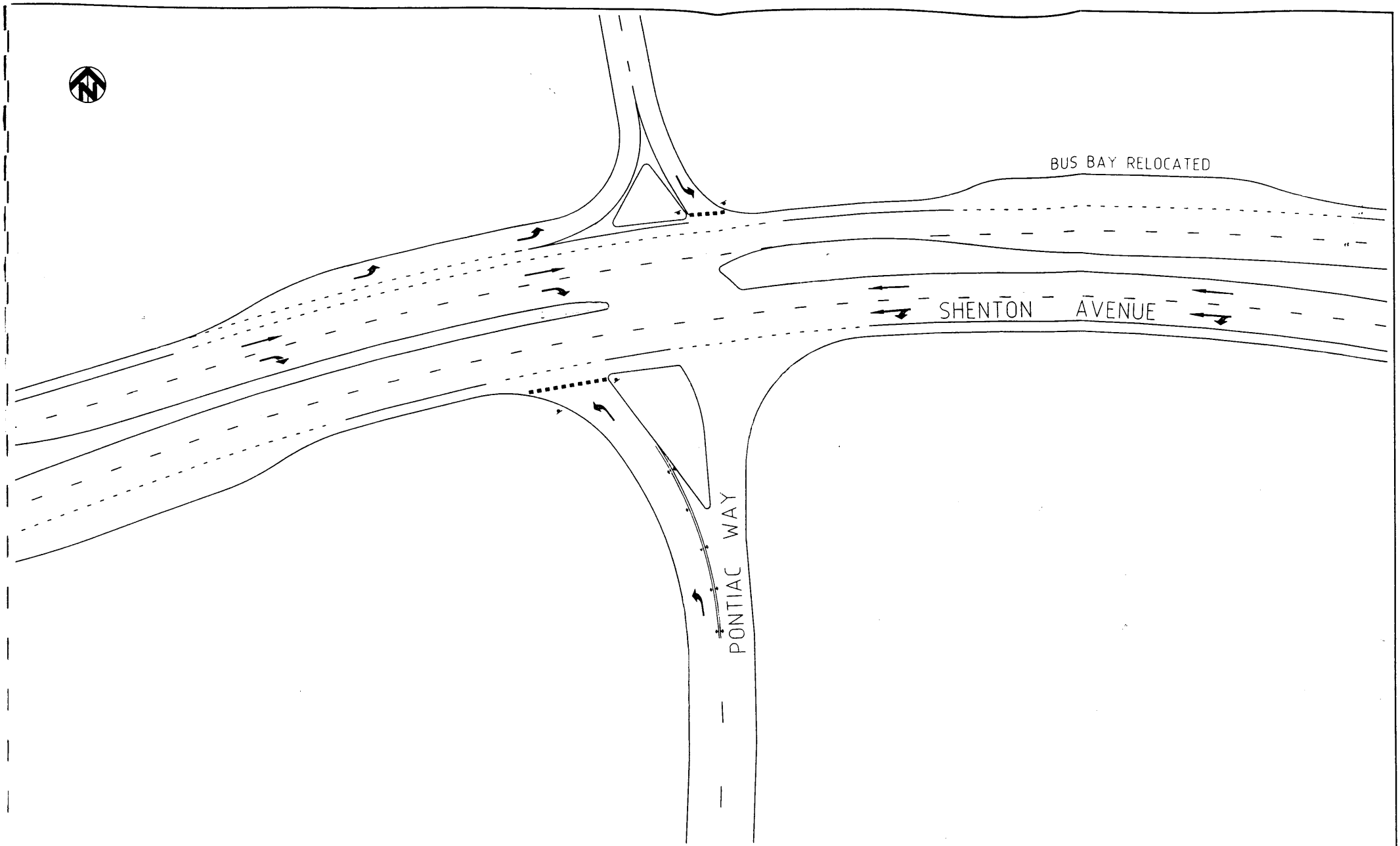
SHENTON AVENUE/PONTIAC WAY
INTERSECTION
OPTION 6

CONNOLLY/JOONDALUP

CITY OF JOONDALUP
INFRASTRUCTURE MANAGEMENT SERVICES
CIVIL DESIGN SERVICES

E 1436-SK-06 A1



DRAWN	AHD	DATUM	PCG94	SCALES	1:250		
HORIZONTAL	1:250	7.5 0 7.5 5 7.5 10 12.5 SCALE IN METRES					
VERTICAL							

Connell Wagner

SHENTON AVENUE/PONTIAC WAY
INTERSECTION
OPTION 7

CONNOLLY/JOONDALUP

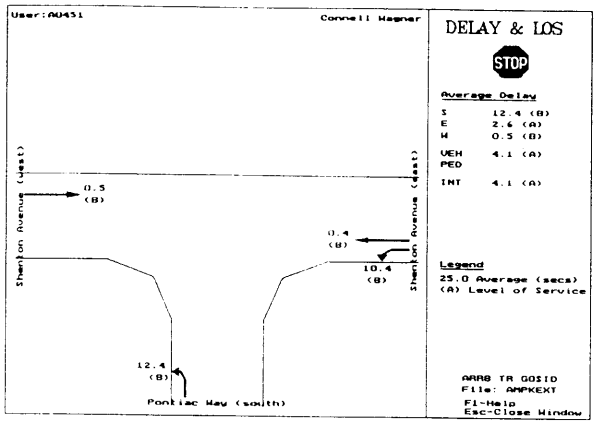
CITY OF JOONDALUP
INFRASTRUCTURE MANAGEMENT SERVICES
CIVIL DESIGN SERVICES

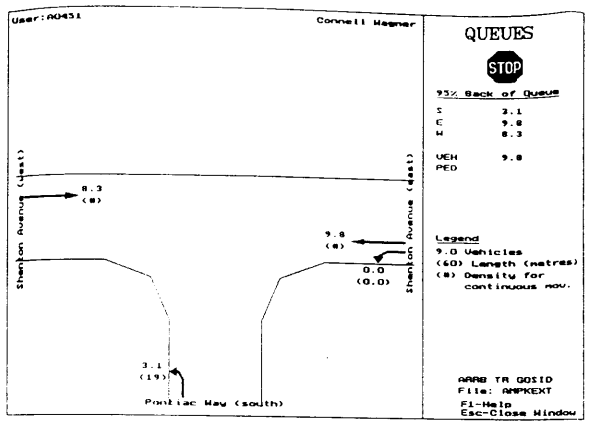
E 1436-SK-07 A1

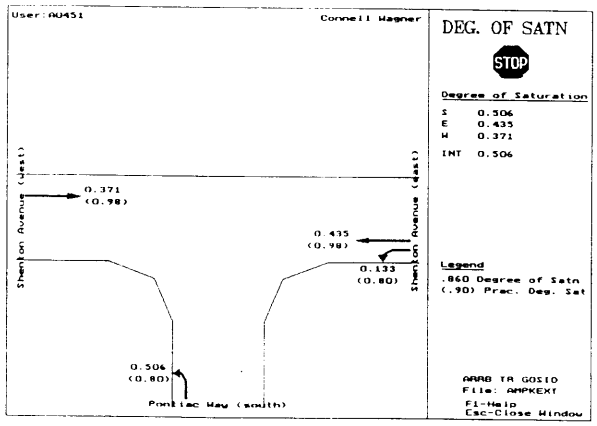
Appendix C

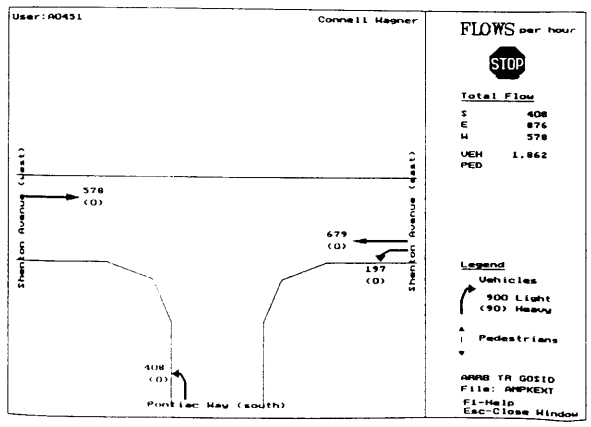
SIDRA Outputs

Intersection of Pontiac Way and Shenton Avenue
Option 1 AM Peak Traffic Hour Performance









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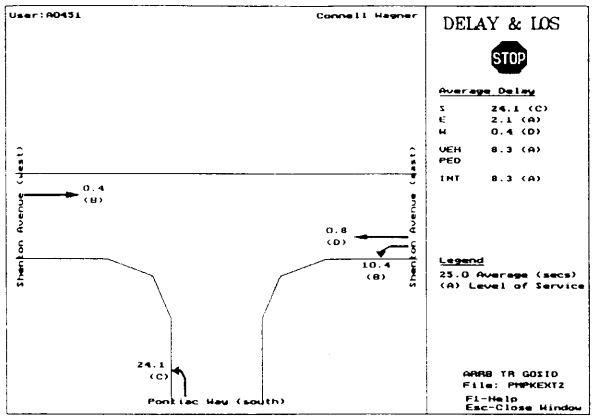
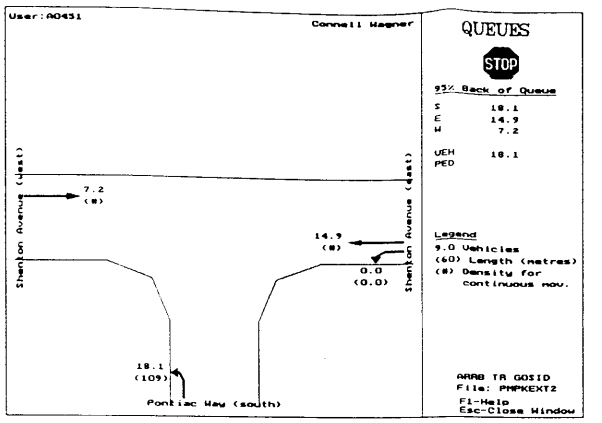
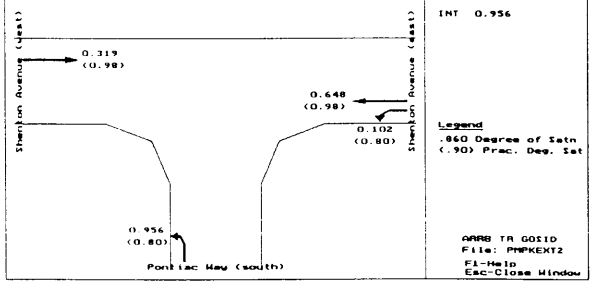
		Drawn	JP	3.4.02
		Checked	GM	
Project	Traffic and Pedestrian Study at Pontiac Way	**Approved**	KH	
			Init.	**Date**
		Scale	N/A	

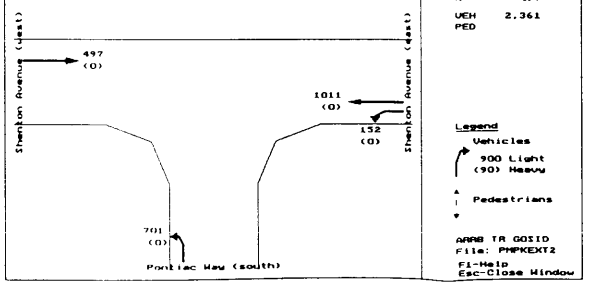
Job No.	C069.05
Drawing No.	Option 1 Peak AM Flow

Intersection of Pontiac Way and Shenton Avenue
Option 1 PM Peak Traffic Hour Performance









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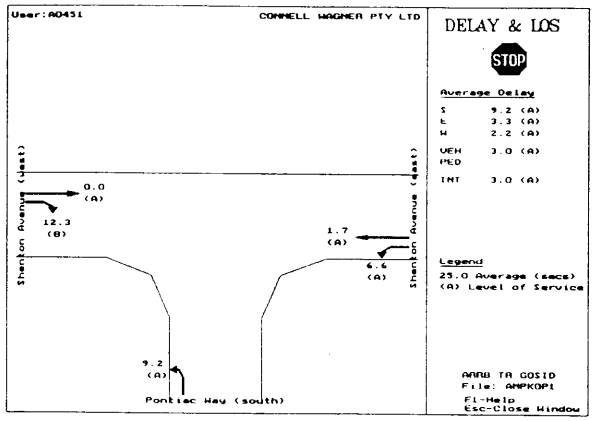
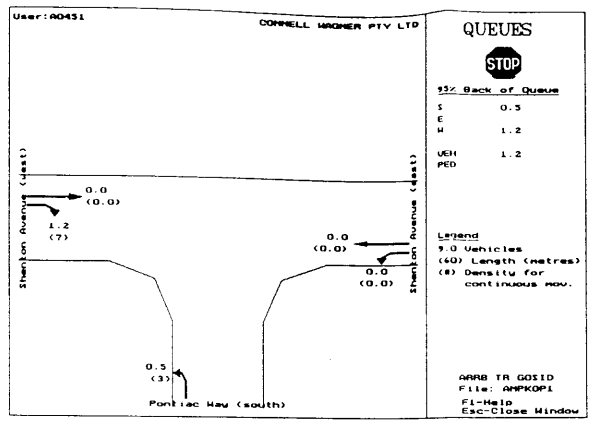
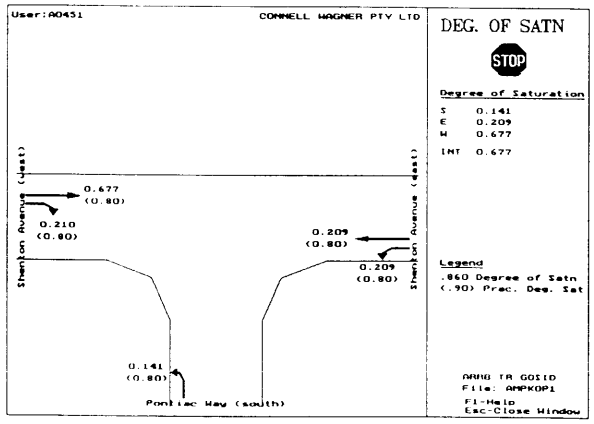
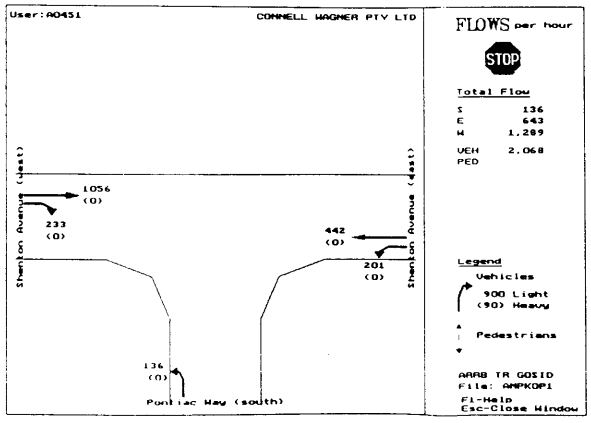
Project	Traffic and Pedestrian Study at Pontiac Way		
Designed	JP	3.4.02	**Job No.** C069.05
Drawn	JP	3.4.02	
Checked	GM		**Drawing No.** Option 1 Peak PM Flow
Approved	KH		
	Init.	**Date**	
Scale	N/A		

Intersection of Pontiac Way and Shenton Avenue
Proposed Option 2 - AM Peak Traffic Hour Performance









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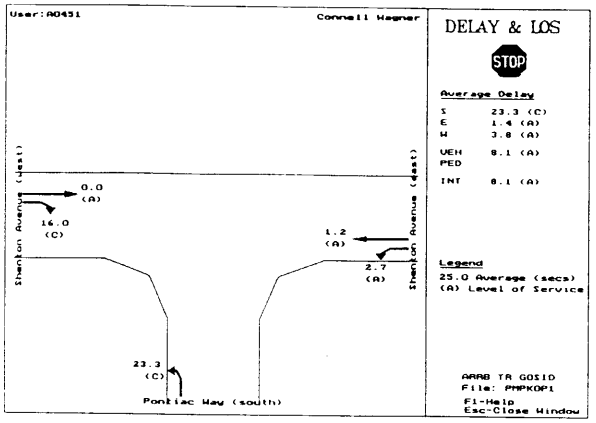
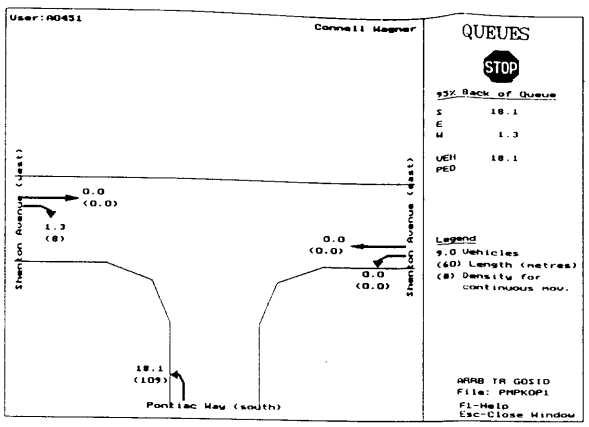
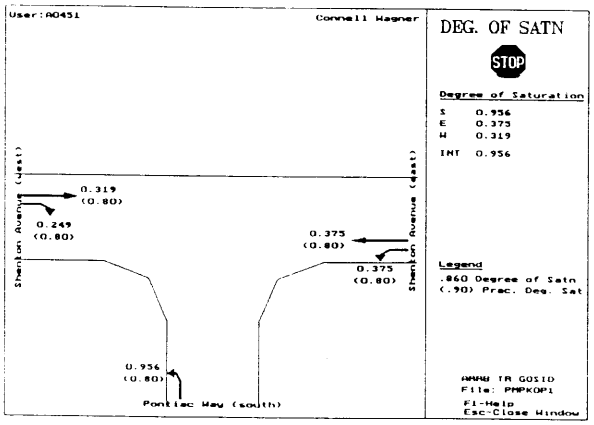
Client	The City of Joondalup		
Project	Traffic and Pedestrian Study at Pontiac Way		

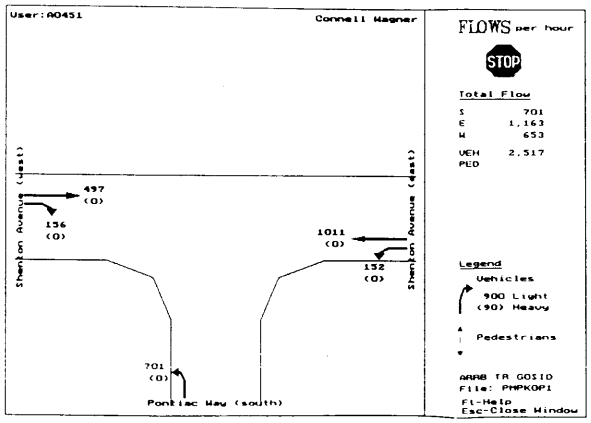
Designed	JP	23.4.02	**Job No.** C069.05
Drawn	JP	23.4.03	
Checked	GM		**Drawing No.** Option 2 Peak AM Flow
Approved	KH		
	Init.	**Date**	
Scale	N/A		

Intersection of Pontiac Way and Shenton Avenue
Proposed Option 2 - PM Peak Traffic Hour Performance









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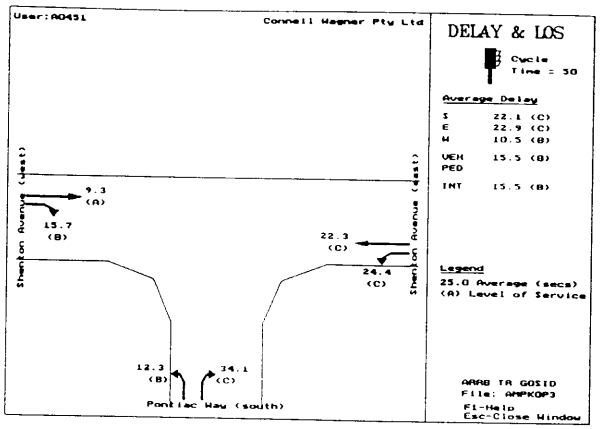
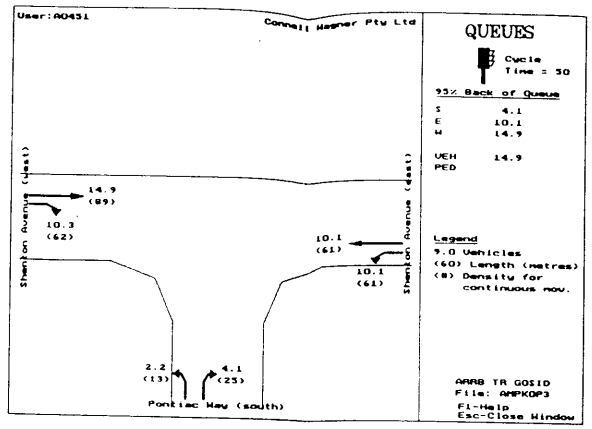
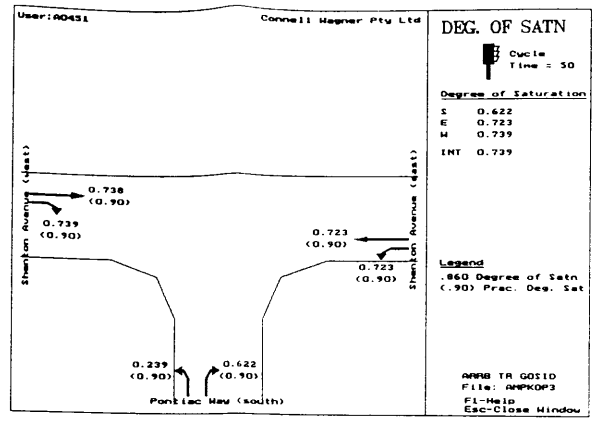
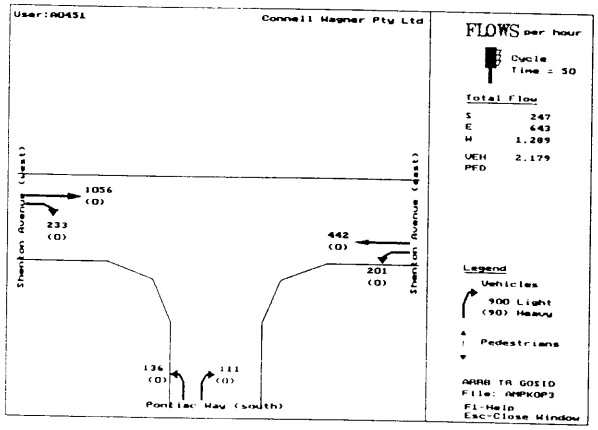
Checked	GM		
Approved	KH		**Drawing No.** Option 2 Peak PM Flow
	Init.	**Date**	
Scale	N/A		

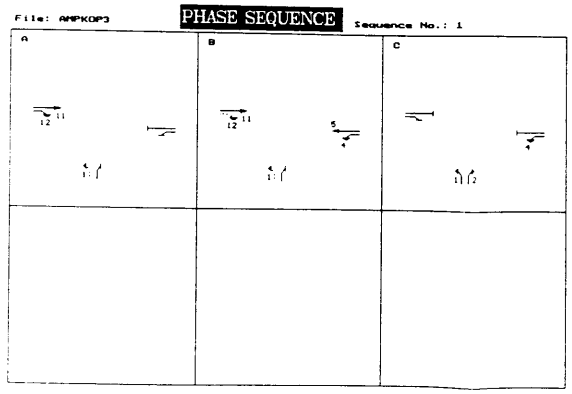
Intersection of Pontiac Way and Shenton Avenue
Proposed Option 3 - AM Peak Traffic Hour Performance











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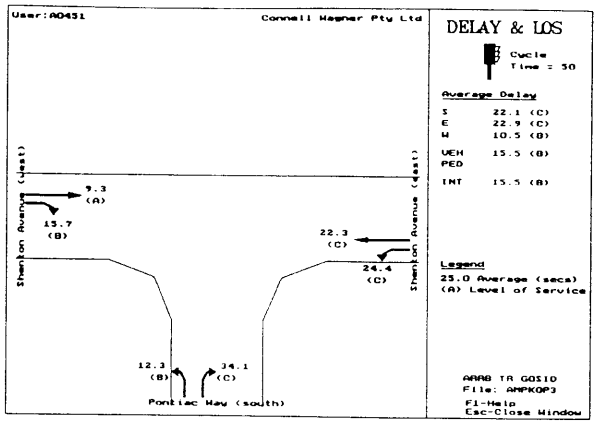
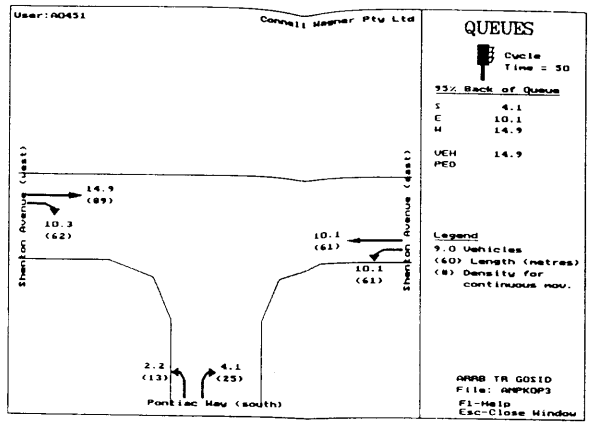
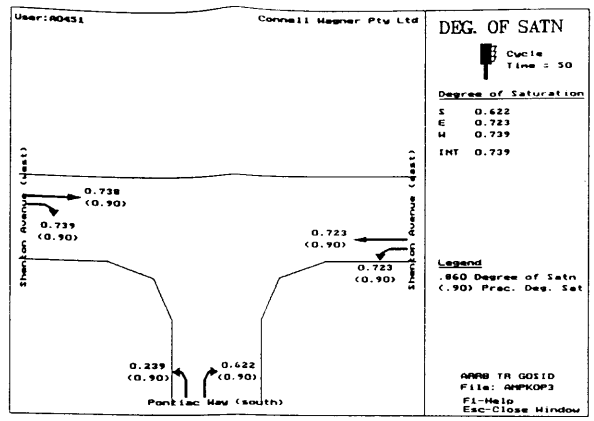
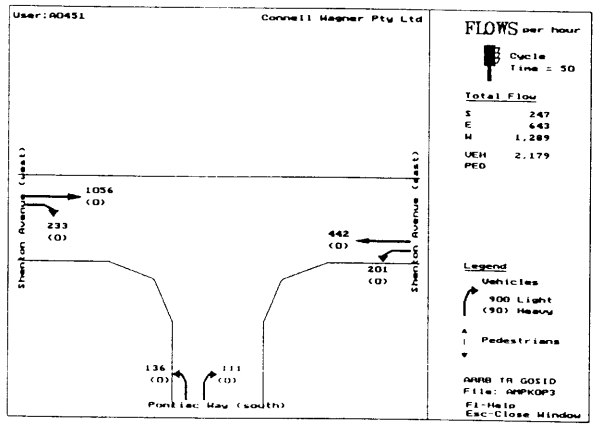
Drawn	JP	23.4.03	
Checked	GM		
Approved	KH		**Drawing No.** Option 3 Peak AM Flow
	Init.	**Date**	
Scale	N/A		

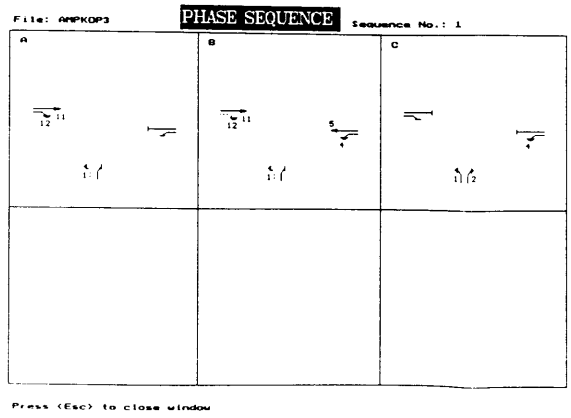
Intersection of Pontiac Way and Shenton Avenue
Proposed Option 3 - AM Peak Traffic Hour Performance











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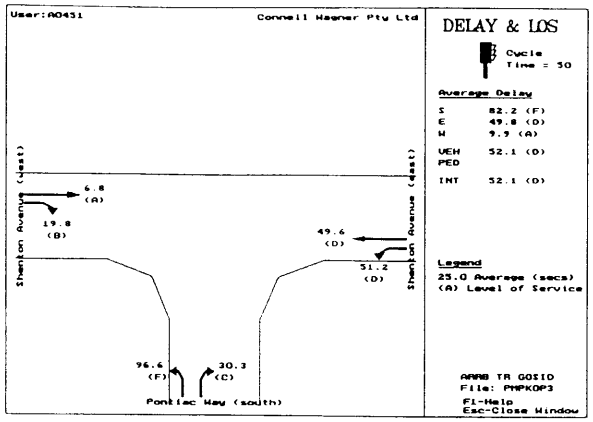
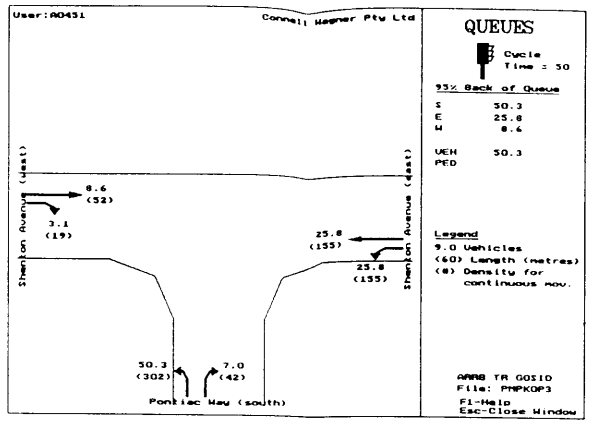
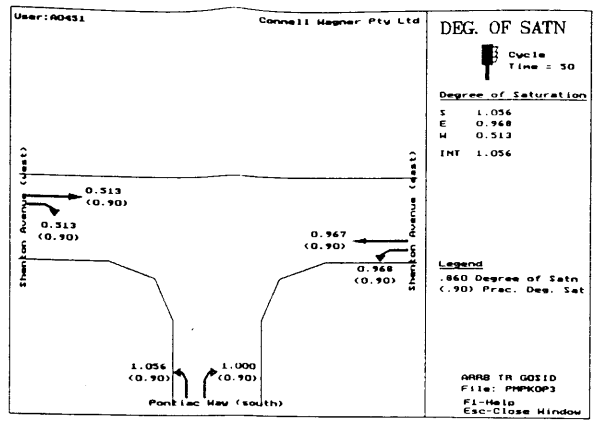
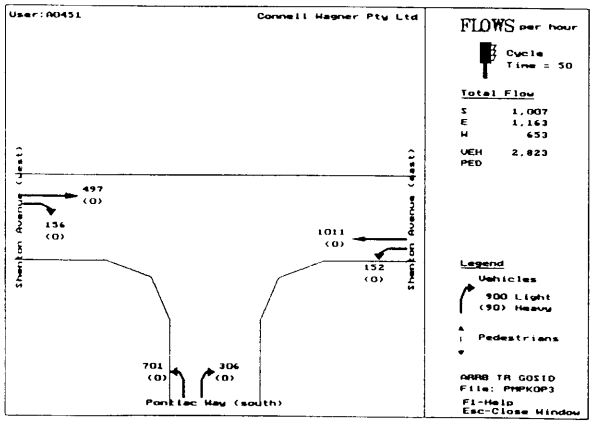
Checked	GM		
Approved	KH		**Drawing No.** Option 3 Peak AM Flow
	Init.	**Date**	
Scale	N/A		

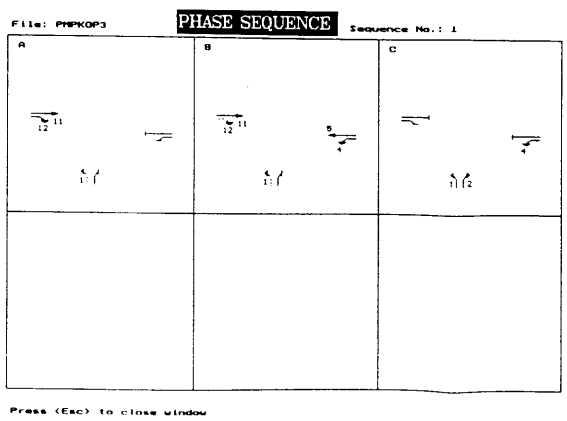
Intersection of Pontiac Way and Shenton Avenue
Proposed Option 3 - PM Peak Traffic Hour Performance











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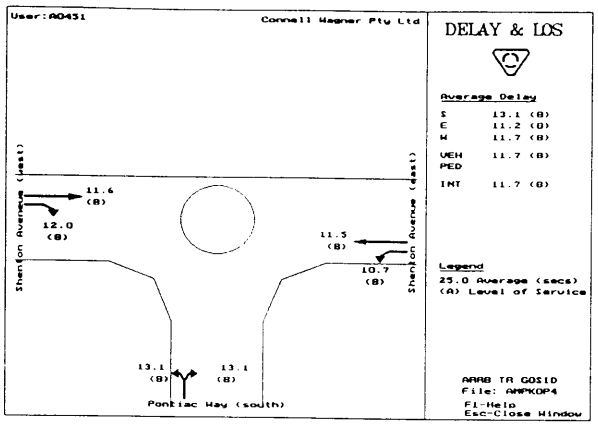
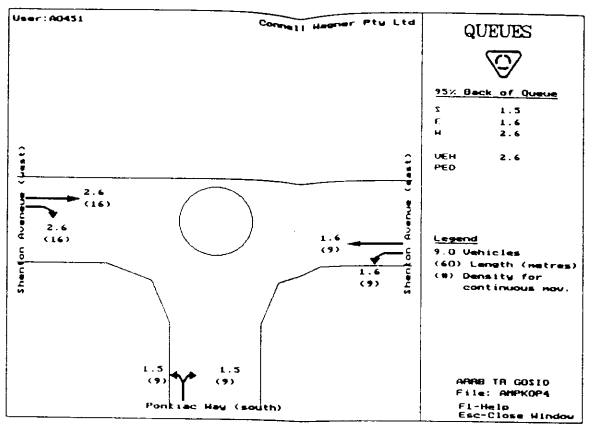
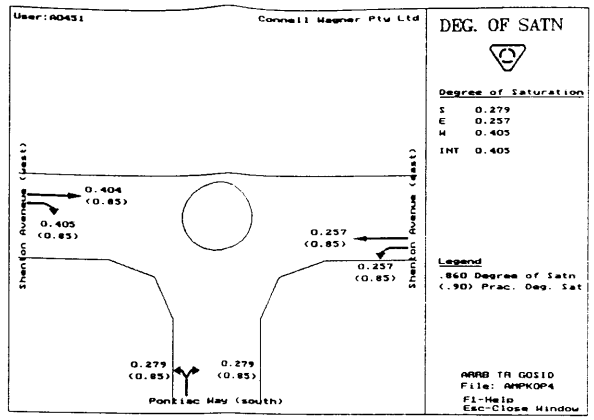
Client	The City of Joondalup
Project	Traffic and Pedestrian Study at Pontiac Way

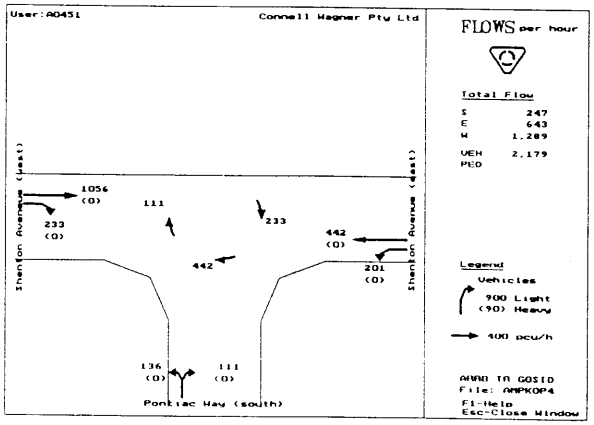
Designed	JP	23.4.02	Job No. C069.05
Drawn	JP	23.4.03	
Checked	GM		Drawing No. Option 3 Peak PM Flow
Approved	KH		
	Init.	Date	
Scale	N/A		

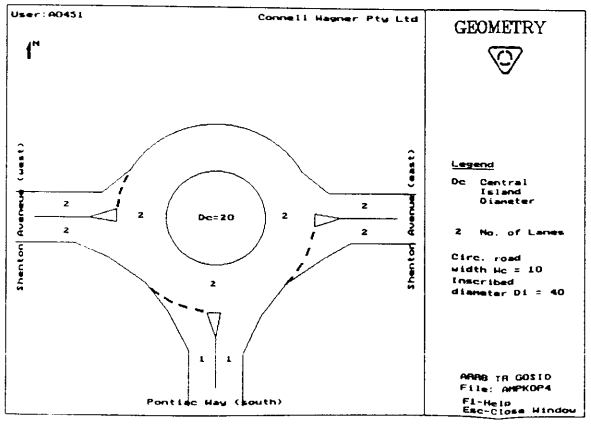
Intersection of Pontiac Way and Shenton Avenue
Proposed Option 4 - AM Peak Traffic Hour Performance











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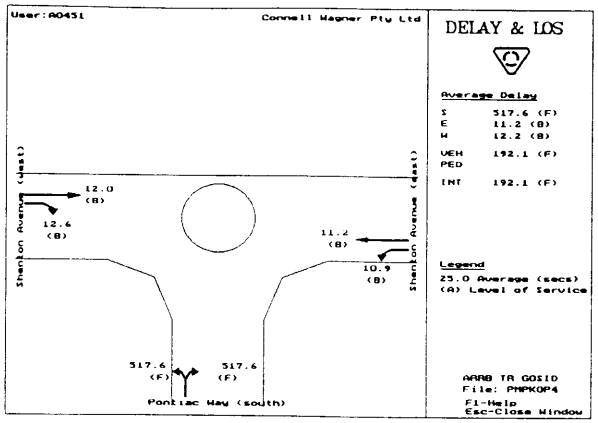
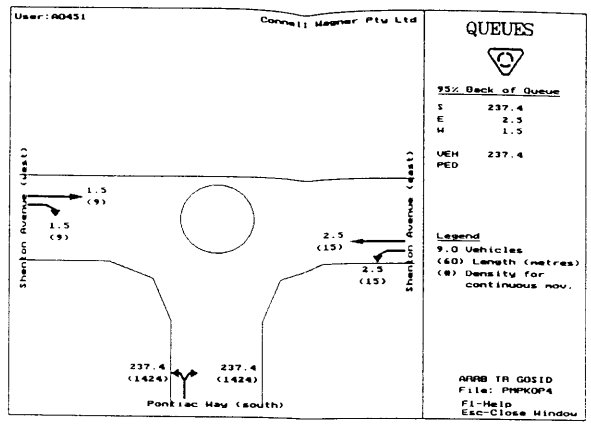
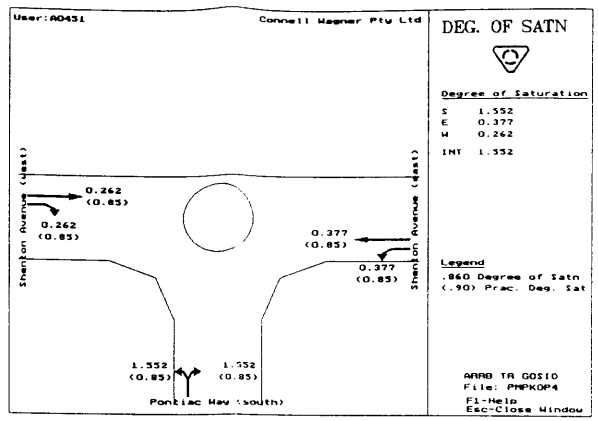
Client	The City of Joondalup
Project	Traffic and Pedestrian Study at Pontiac Way

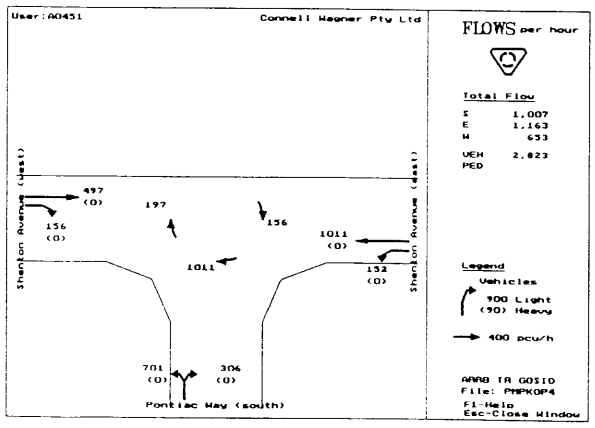
Designed	JP	14.5.02	**Job No.** C069.05
Drawn	JP	14.5.02	
Checked	GM		
Approved	KH		**Drawing No.** Option 4 Peak AM Flow
	Init.	**Date**	
Scale	N/A		

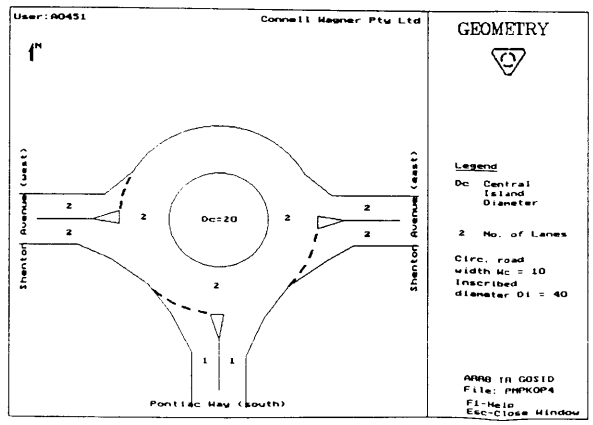
Intersection of Pontiac Way and Shenton Avenue
Proposed Option 4 - PM Peak Traffic Hour Performance











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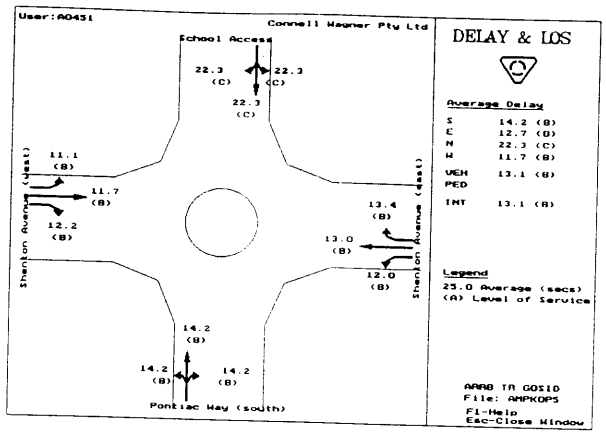
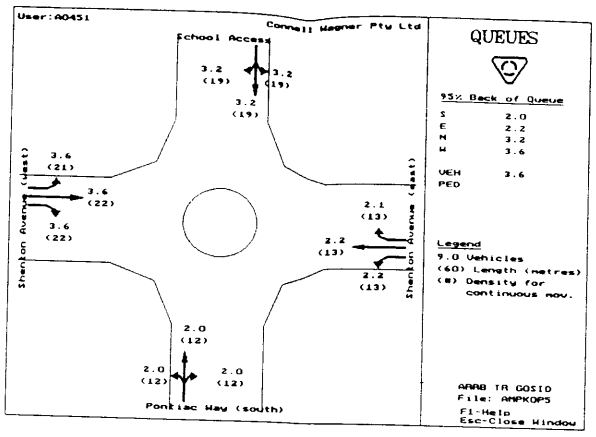
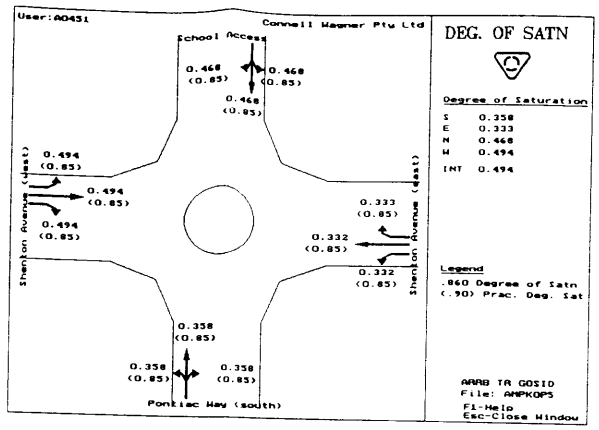
Client	The City of Joondalup
Project	Traffic and Pedestrian Study at Pontiac Way

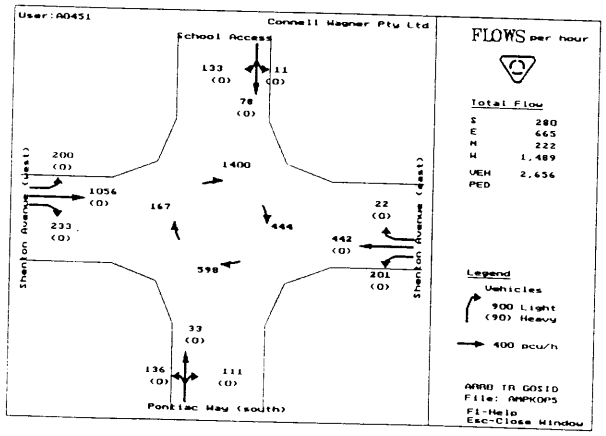
Designed	JP	14.5.02	Job No. C069.05
Drawn	JP	14.5.02	
Checked	GM		
Approved	KH		Drawing No. Option 4 Peak PM Flow
	Init.	Date	
Scale	N/A		

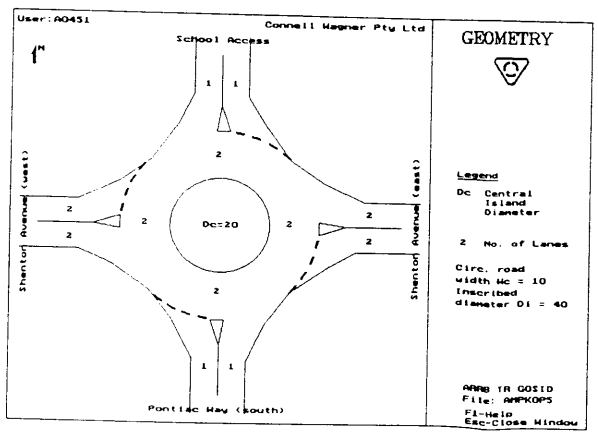
Intersection of Pontiac Way and Shenton Avenue
Proposed Option 5 - AM Peak Traffic Hour Performance











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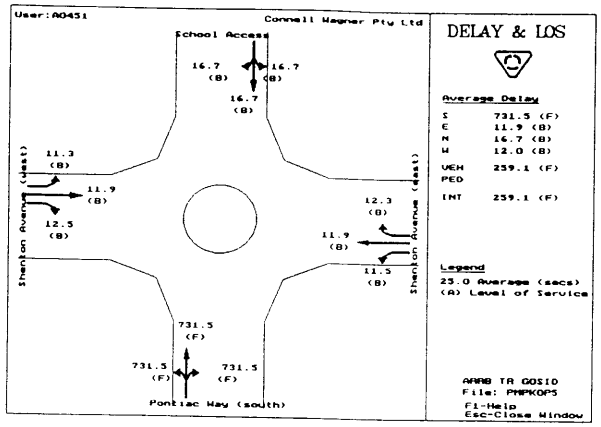
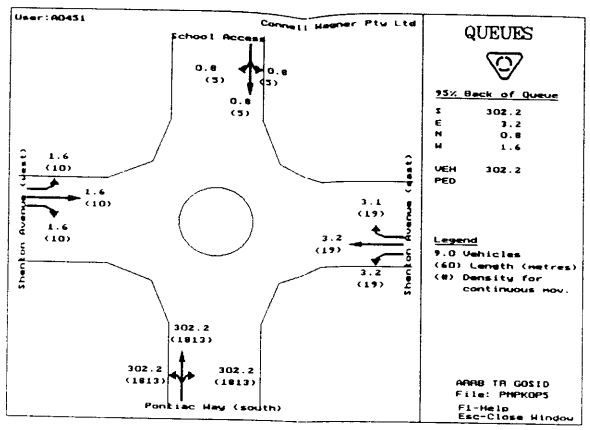
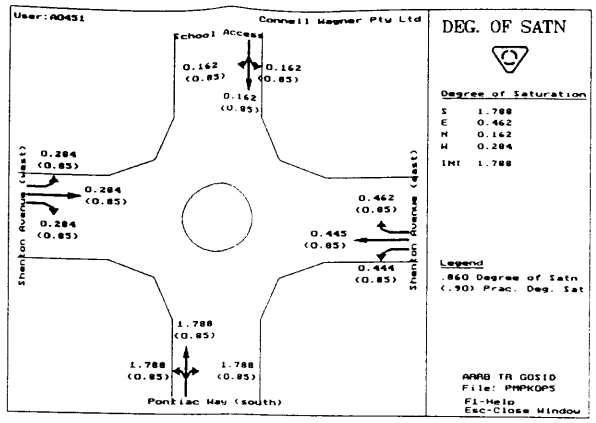
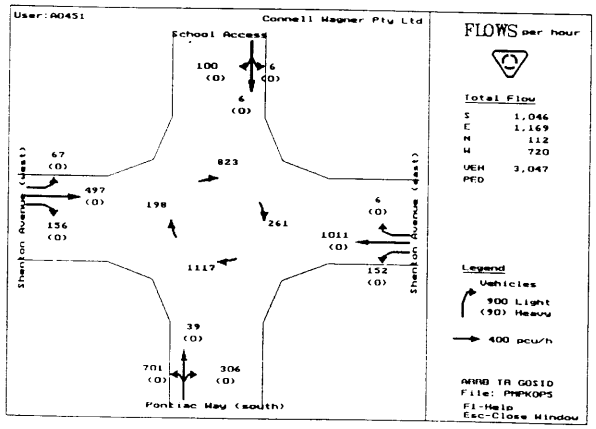
Client	The City of Joondalup		
Project	Traffic and Pedestrian Study at Pontiac Way		
Designed	JP	14.5.02	**Job No.** C069.05
Drawn	JP	14.5.02	
Checked	GM		**Drawing No.** Option 5 Peak AM Flow
Approved	KH		
	Init.	**Date**	
Scale	N/A		

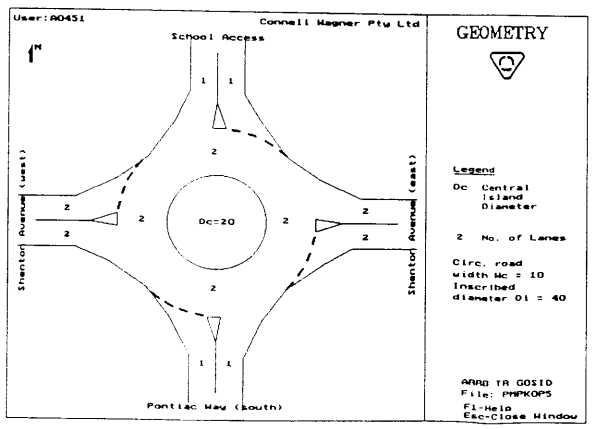
Intersection of Pontiac Way and Shenton Avenue
Proposed Option 5 - PM Peak Traffic Hour Performance











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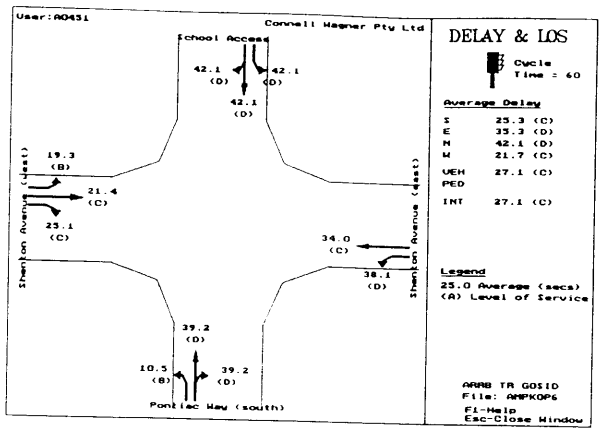
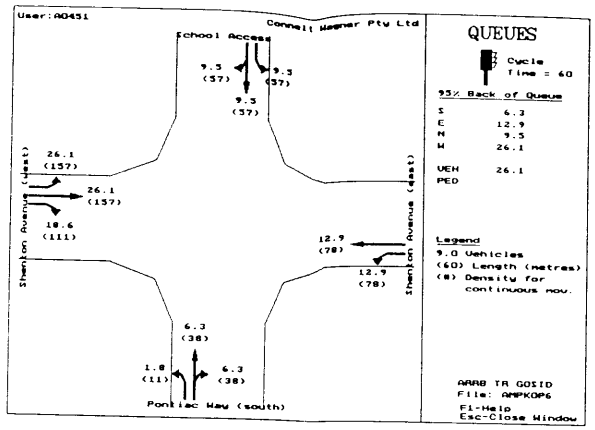
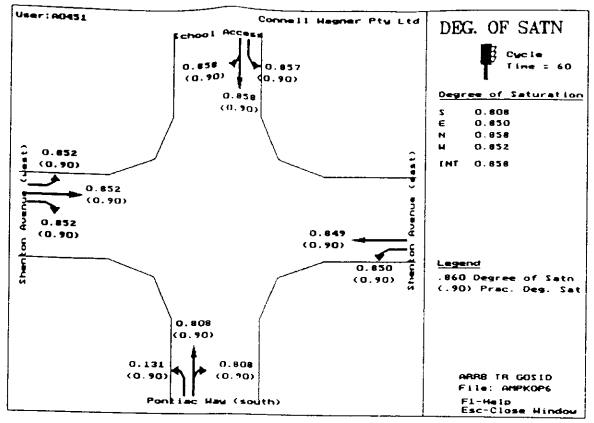
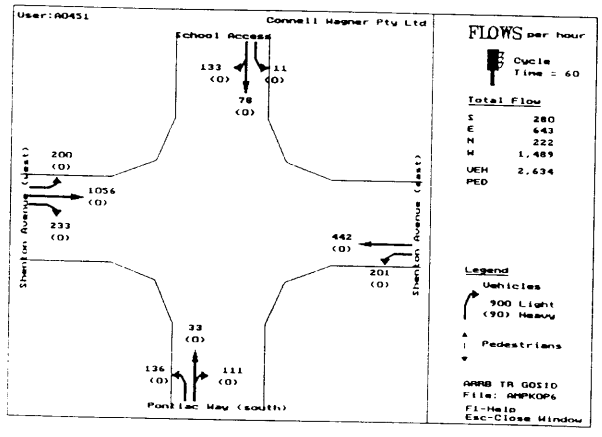
Approved	KH		Drawing No.
	Init.	Date	
Scale	N/A		Option 5 Peak PM Flow

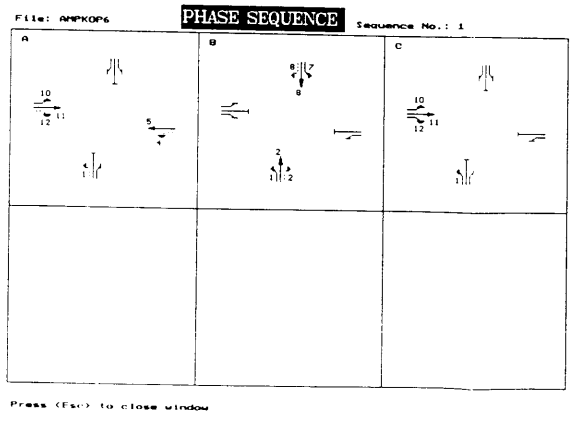
Intersection of Pontiac Way and Shenton Avenue
Proposed Option 6 - AM Peak Traffic Hour Performance











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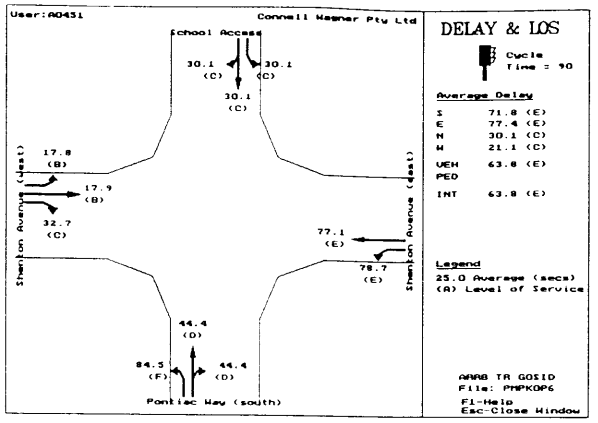
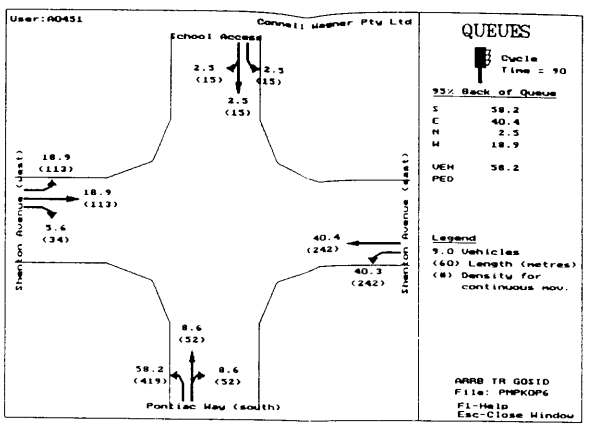
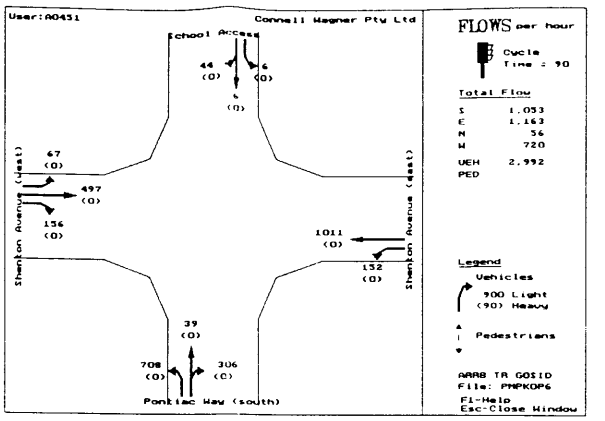
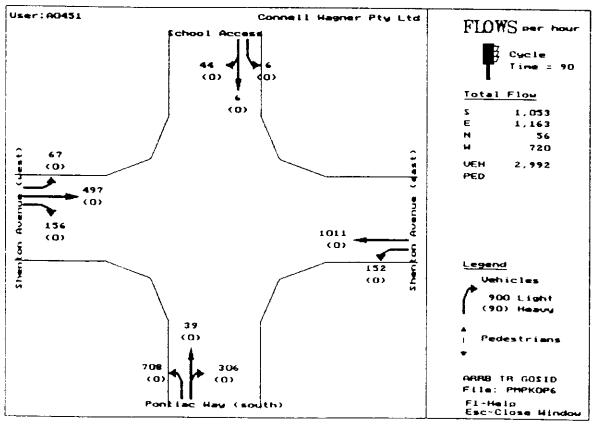
Approved	KH		
	Init.	Date	
Scale	N/A		

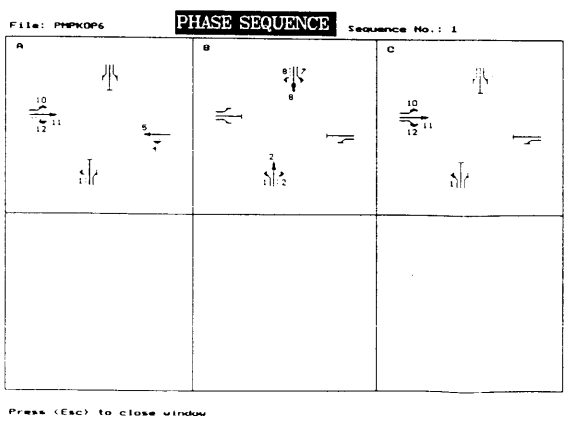
Intersection of Pontiac Way and Shenton Avenue
Proposed Option 6 - PM Peak Traffic Hour Performance











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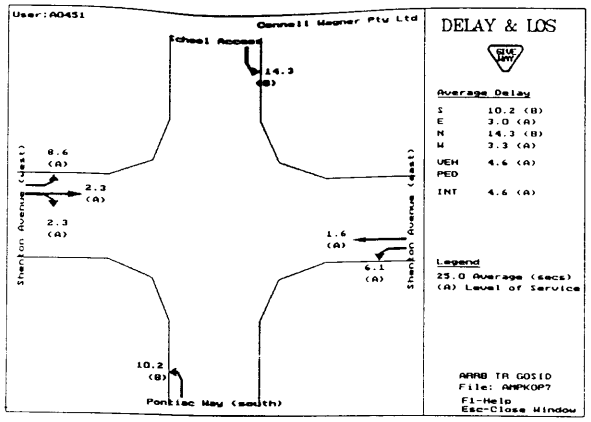
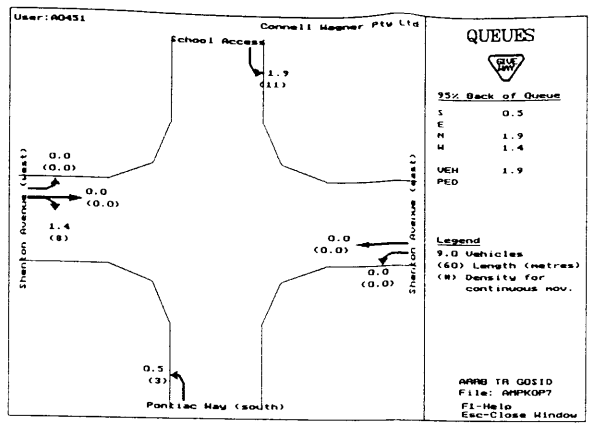
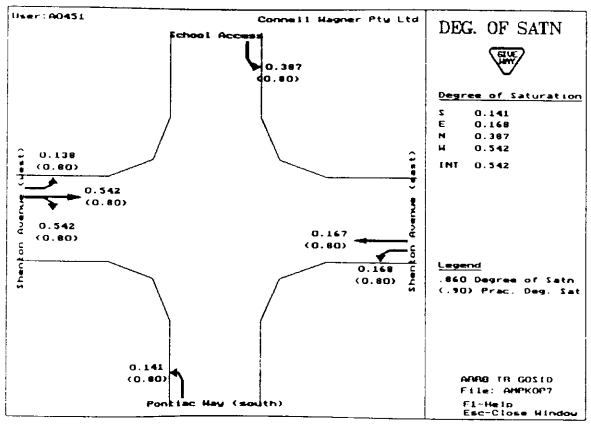
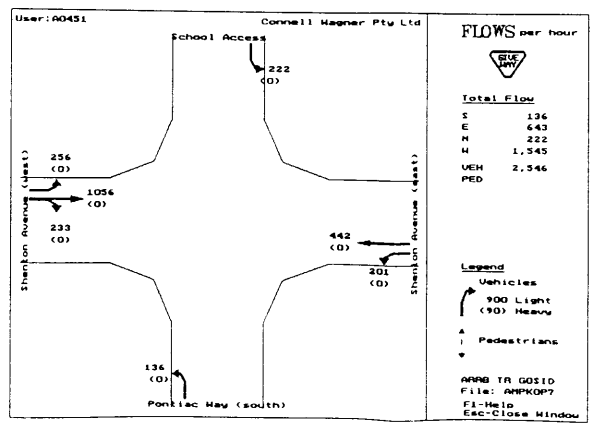
Approved	KH		
	Init.	**Date**	
Scale	N/A		

Intersection of Pontiac Way and Shenton Avenue
Proposed Option 7 - AM Peak Traffic Hour Performance









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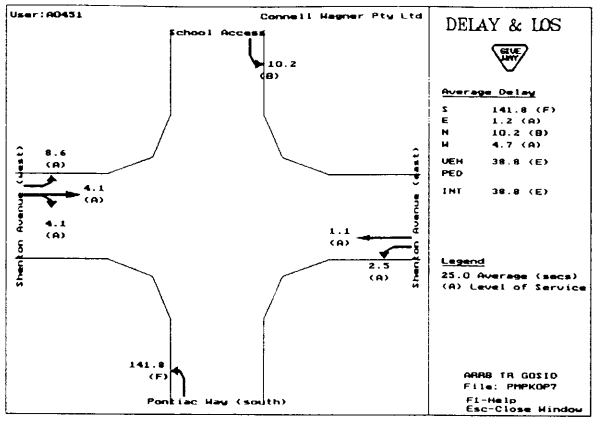
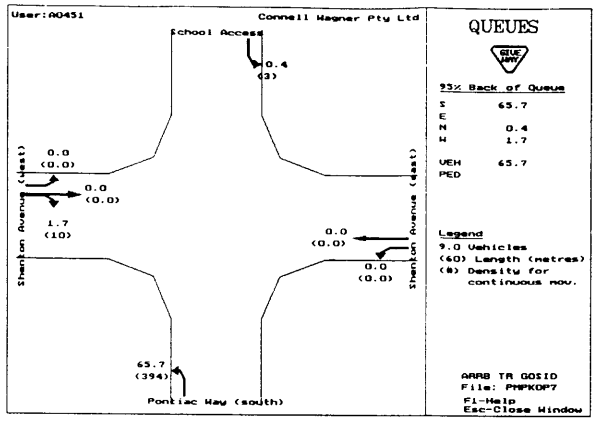
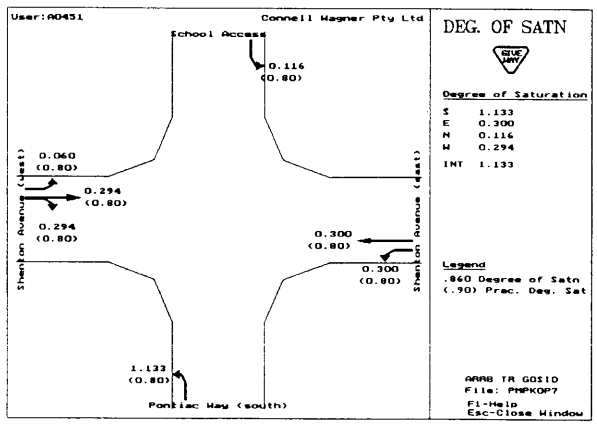
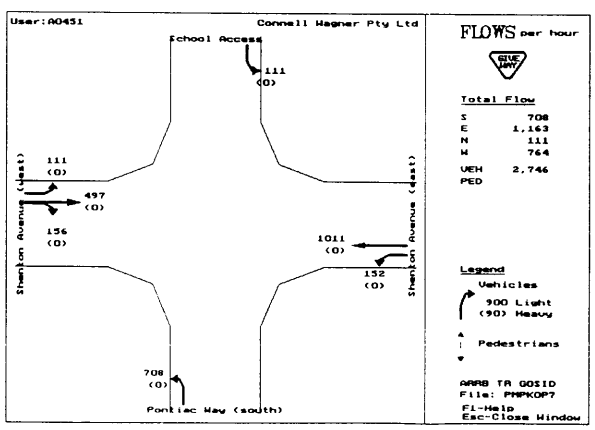
Approved	KH		Drawing No. Option 7 Peak AM Flow
	Init.	Date	
Scale	N/A		

Intersection of Pontiac Way and Shenton Avenue
Option 7 PM Peak Traffic Hour Performance









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	Init.	Date	
Scale	N/A		