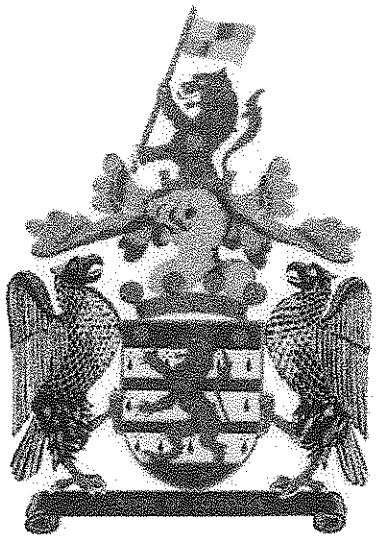
TOWN OF COTTESLOE



Works and Corporate Services Committee

ATTACHMENT 10.2.4

Meeting Date: 16 April 2013

Table of Revised Costs

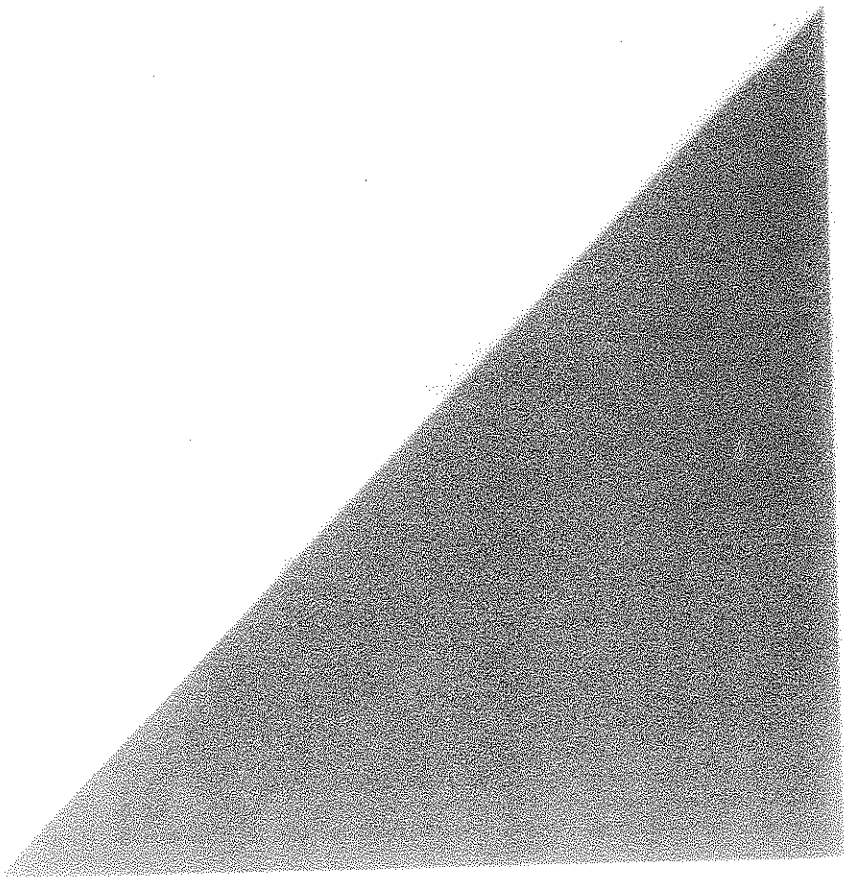
	Revised cost ESTIMATE ONLY	Comments	loss of trees
Widen CN side to 70m length	78000	current option. Revised cost to include additional drainage works. Sewer, ugp and telecom unknown Major Telstra observed	cn - 2x mature
Widen CN side to 130m length	141650	current option. Revised cost to include additional drainage works. Sewer, ugp and telecom unknown Major Telstra observed	cn - 2x mature, 1x small
Widen TOC side to 70m length	61500	current option	toc - 1x mature, 1x small
Widen TOC side to 100m length	87850	little-no service issues	toc - 3x mature, 2x small
Widen both sides to 70m length	118200	current option. Revised cost to include additional drainage works. Sewer, ugp and telecom unknown Major Telstra observed	cn - 2x mature toc - 1x mature, 1x small
Widen both sides to 100m length	174000	current option. Revised cost to include additional drainage works. Sewer, ugp and telecom unknown Major Telstra observed	cn - 2x mature, 1x small toc - 3x mature, 2x small

OPUS

City of Nedlands

West Coast Highway/ North Street Intersection

SIDRA Analysis



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City of Nedlands

West Coast Highway/ North Street Intersection

SIDRA Analysis

Prepared By

Tim Selby
Senior Transportation Engineer

Reviewed By

Tim Judd
Traffic and Transportation Manager

Approved for Release By

Kenneth McTiernan
Civil Engineering Work Group Manager

Opus International Consultants (PCA) Pty Ltd
Perth Office
Suite 2, 186 Main Street
P O Box 174, Osborne Park WA 6917
Australia

Telephone: +61 8 9440 1555
Facsimile: +61 8 9440 1255

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Reference: WP1423.00
Status: Final

Contents

Executive Summary

The City of Nedlands has received State black spot funding for the 2013/2014 financial year for improvements to the traffic signal controlled West Coast Highway/North Street/Servetus Street intersection. Specifically, the proposed upgrade includes the installation of overhead mast arms on the West Coast Highway and an extended left turn lane on North Street. As part of the enhancements, the City wishes to examine the potential to further improve the operational performance of the intersection through the provision of a separate right turn phase for North Street traffic turning into the West Coast Highway (south). As such, any change in the traffic signal phasing arrangement requires Approval in Principle from Main Roads WA.

An assessment of the existing intersection has been carried out along with a review of its forecast performance with the extended left turn lane and secondly with the extended left turn lane plus a right turn phase. For simplicity and to allow a meaningful comparison of the performance of the North Street approach to the intersection, existing traffic signal cycle and phase times have been used (with the exception of the additional right turn phase where the existing phase times for the West Coast Highway only have been retained).

The intersection modelling confirms that the North Street approach is currently operating at or over capacity. As part of this, queuing vehicles for the straight ahead and right turn movement typically block the heavy left turn movement even though this left turn movement has a relatively large amount of 'green time' provided. Similarly, the heavy left turn volumes limits the opportunity for straight ahead and right turning traffic to utilise the limited amount of 'green time' for these permitted movements. In addition, it was noted that vehicles on the West Coast Highway (south) currently queue back beyond the adjacent Claremont Crescent traffic signal controlled intersection to the south.

The provision of an extended left turn lane from 40m to 90m (as supplied by the City) typically allows two lanes of traffic for the left turn movement and the combined straight ahead/right turn movement to queue separately under the existing traffic volumes. A 10% increase in traffic volumes however results in the mixed queuing of vehicles with straight ahead and right turning vehicles potentially blocking left turning vehicles and vice versa. As such, increased intersection performance could be achieved by extending the left turn lane further than the 90m proposed to a length in the order of 120m to 150m if physically achievable.

Whilst the provision of an additional leading right turn phase for the North Street approach provides benefits to this arm of the intersection during the evening peak hour in terms of additional green time for the straight ahead and right turn movement without any opposing traffic, without changes to the phase times for the West Coast Highway traffic, this option will have a significant adverse impact on the performance of the Servetus Street approach.

In addition, the provision of a separate right turn phase for traffic exiting the North Street approach results in no improvement in road safety based on existing crash data. As such, the additional cost of installing the associated right turn signals will cause the benefit cost ratio to reduce and hence be less eligible for funding through the Black Spot project funding mechanism.

It is recommended that consideration be given to simply extending the length of the left turn lane on North Street. Ideally this should be beyond the 90m length originally envisaged by the City to cater for future demand. The provision of the right turn phase is not warranted on road safety grounds nor will it improve the overall performance of the intersection.

1 Introduction

1.1 Background

The City of Nedlands has received State black spot funding for the 2013/2014 financial year for improvements to the traffic signal controlled West Coast Highway/North Street/Servetus Street intersection. Specifically, the proposed upgrade includes the installation of overhead mast arms on the West Coast Highway and an extended left turn lane on North Street.

As part of the enhancements, the City along with the neighbouring Town of Cottesloe wish to examine the potential to further improve the operational performance of the intersection through the provision of a separate signal phase for North Street to assist traffic turning right onto the West Coast Highway (south). As such, any change in the traffic signal phasing arrangement requires Approval in Principle from Main Roads WA.

This report sets out the results of a SIDRA analysis (Version 5.1) of the operating performance of the West Coast Highway/North Street intersection during the morning (AM) and evening (PM) peak hours for both a Thursday and a Friday using existing traffic volumes and a 10% increase in movements. The following scenarios have been modelled in SIDRA:

- Existing intersection geometry and traffic signal phasing;
- Extended left turn lane on North Street with existing traffic signal phasing; and
- Extended left turn lane on North Street with revised traffic signal phasing to include a separate right turn phase for North Street traffic.

1.2 Site Location

The West Coast Highway/North Street/Servetus Street cross-road traffic signal controlled intersection is located in the suburb of Swanbourne on the border of the City of Nedlands, Town of Cottesloe and Town of Claremont. The West Coast Highway is classified as a Primary Distributor under the control of Main Roads WA in the Main Roads WA Road Information Mapping System with a 60km/h speed limit. Both North Street and Servetus Street are classed as Local Distributor roads with a 50km/h speed limit.

A locality plan along with a more detailed intersection layout diagram is shown in Figures 1.1 and 1.2 respectively.

Two through lanes in each direction have been provided along the West Coast Highway along with right turning lanes. A separate signalised left turn lane has also been provided on the northern approach whilst the left turn lane on the southern approach is separated from the straight ahead traffic by a splitter island and has a give way control. North Street and Servetus Street are single carriageway roads with one lane in each direction. On the approach to the intersection, North Street widens to two lanes with a dedicated left turn lane and a combined through/right turn lane. Similarly, Servetus Street widens to two lanes on the approach to the intersection, albeit with a short dedicated right turn lane and a mixed left turn/through lane. Pedestrian crossing phases have been provided across the West Coast Highway (north and south) and North Street approaches.

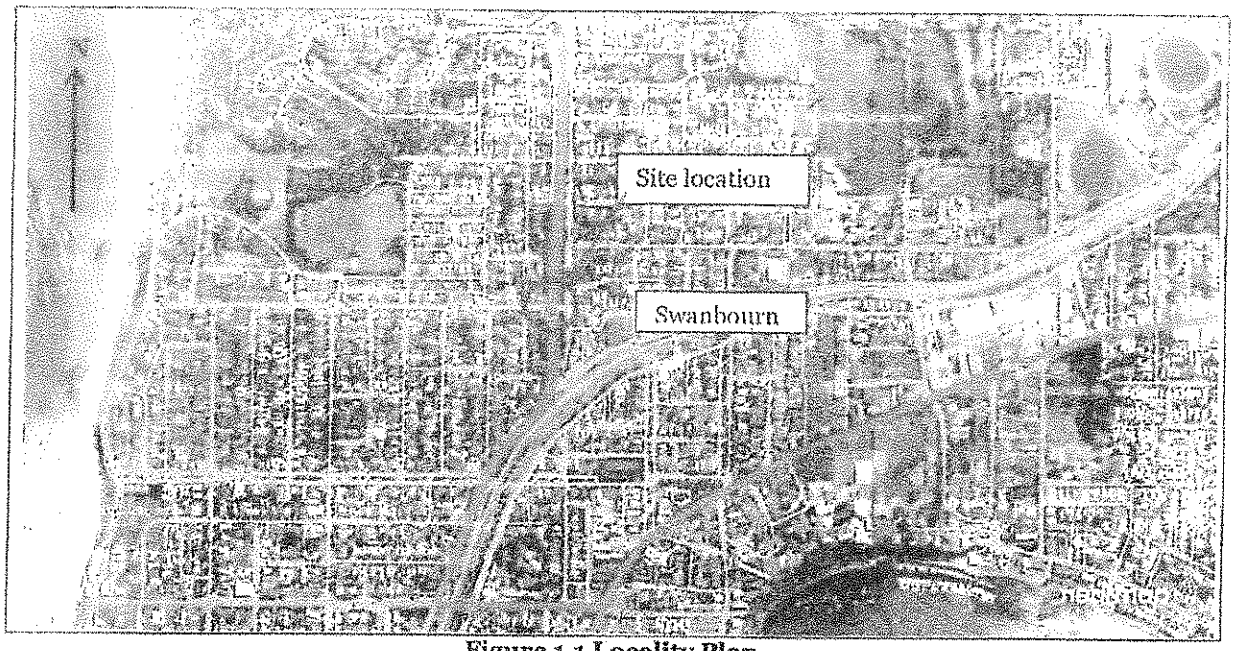


Figure 1.1 Locality Plan

Source:NearMaps

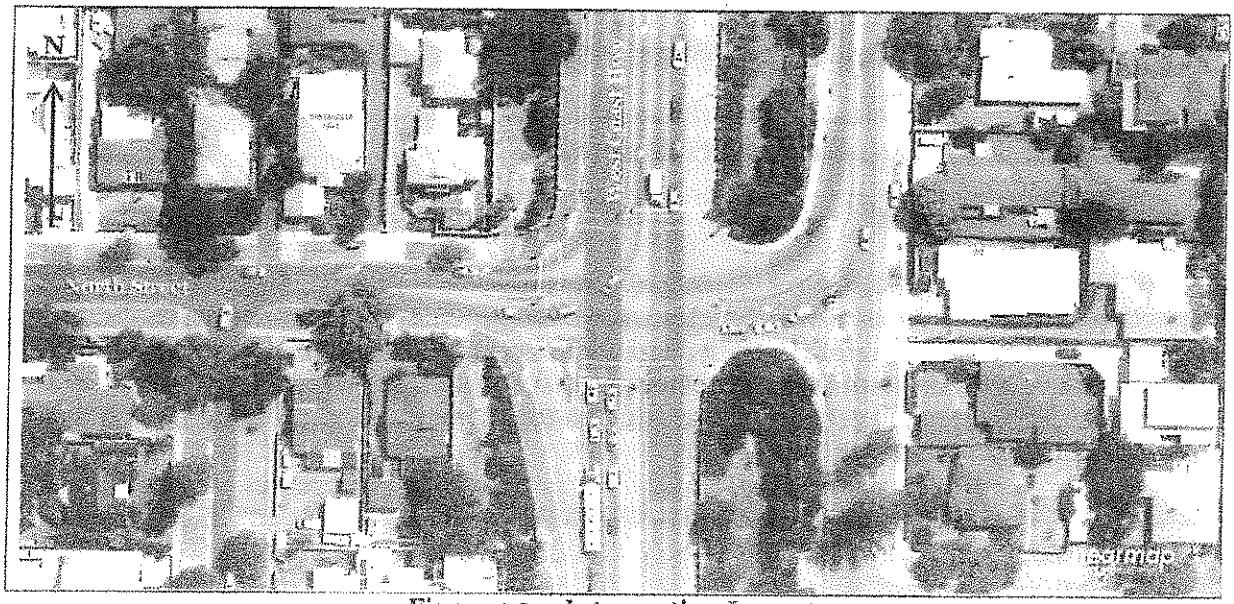


Figure 1.2m Intersection Layout

Source:NearMaps

2 Traffic Volumes

2.1 Existing Turning Movements

Traffic surveys were undertaken using video cameras between 7am and 9am and 4pm and 6pm on Thursday 28 February 2013 and Friday 1 March 2013. The results of the traffic counts are shown in Appendix A. As indicated, the survey data indicates that traffic volumes were approximately 10% higher on the Thursday than on the Friday during the peak hours.

As part of the traffic count survey, maximum queue lengths were also recorded. The results of the queue length surveys are shown in Appendix B. The data clearly shows that the additional traffic on the Thursday resulted in longer and more frequent queues, particularly along West Coast Highway (south) and North Street. Observations of the intersection operation and queues along West Coast Highway (south) indicate northbound vehicles queuing as far back as the Claremont Crescent traffic signal controlled intersection to the south of the site. Conversely, southbound vehicles at the Claremont Crescent intersection were also observed as queuing back as far as the North Street/Servetus Street intersection, thereby impacting upon the performance of the intersection under consideration as part of this analysis.

In terms of traffic movements from North Street, the left turn movement is the dominant turn for all peak hour periods with relatively low right turn movements.

Very few pedestrian crossing movements at the intersection were recorded during the peak hours (see Section 2.3).

2.2 Forecast Traffic Growth

In accordance with the City of Nedlands brief, the intersection has been tested using a future traffic growth of 10%.

2.3 Common SIDRA Input Assumptions

Pedestrian Movements
Given the extremely low numbers of pedestrian crossing movements, a maximum of five pedestrian movements per leg in the peak hour across the West Coast Highway (north and south) and North Street approaches has been assumed for the SIDRA modelling. Notwithstanding this, given the very limited number of times that the pedestrian phase is called to cross West Coast Highway and hence the high probability that no pedestrian phase is requested, no additional 'extra start loss' time to the left and right turning movements from North Street and Servetus Street has been provided, and hence, pedestrian movements have not been modelled as being opposed by the turning movements.

Traffic Bunching
The proximity (200m) of the Claremont Crescent traffic signal controlled intersection to the immediate south of the West Coast Highway/North Street/Servetus Street intersection has been taken into account within SIDRA in terms of a 'highly favourable' platoon arrival type for this approach in accordance with SIDRA guideline recommendations. It should also be noted that southbound traffic along the West Coast Highway also tend to arrive at the West Coast Highway/ North Street/Servetus Street in a platoon despite the next adjacent traffic signal controlled

intersection being more than 1km away. Typically, SIDRA requires such intersections to be within 1km of the downstream intersection to allow a 'favourable' progression to be modelled. As such, whilst the northern approach has been assumed to have random arrivals, it should be noted that modelled traffic queue lengths tend to be slightly longer than those observed. If this movement had been modelled as having a 'favourable' platoon, calculated queue lengths would have typically been in same order as those observed.

Gradients

A slight southbound downhill gradient exists along West Coast Highway through the intersection whilst a slight eastbound uphill gradient exists along North Street and Servetus Street. The approach gradient is used within SIDRA to help estimate saturation flows and for calculating fuel consumption, operating costs and emissions. Downhill gradients increase saturation flows but decrease fuel consumption, operating costs and emissions. As such, nominal gradients have been used within SIDRA when modelling the intersection.

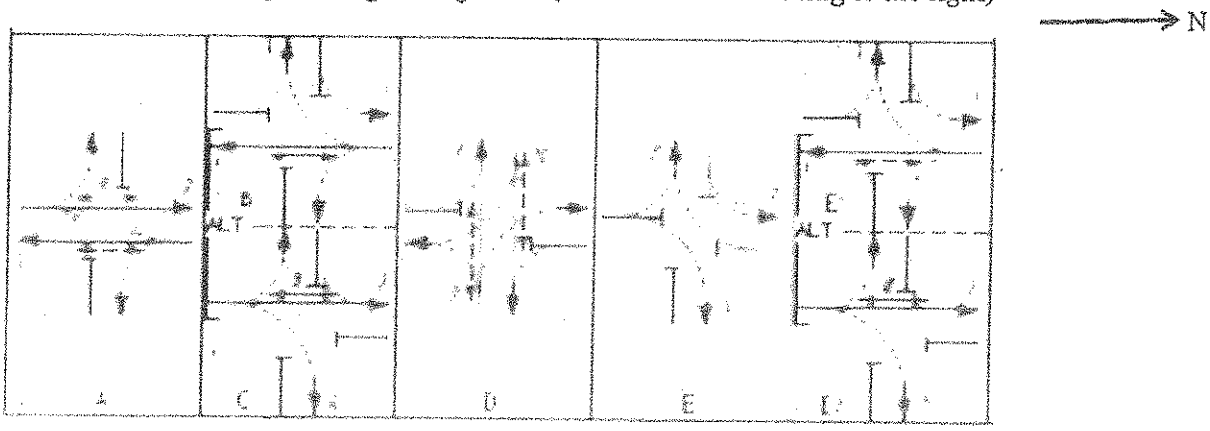
3 Existing Intersection

3.1 SIDRA Inputs

3.1.1 Cycle Times and Phasing

A copy of the existing phasing arrangements along with the existing intersection design is contained in Appendix C (with the phasing replicated below in Figure 3.1). As shown, a number of alternative phases can be called depending upon the traffic demand detected at the intersection stop lines.

Figure 3.1 Existing Phasing Arrangement (north is shown as being to the right)



A review of the actual operational phasing arrangements during the peak hours indicates that the Thursday morning peak hour typically operates with phases A, B, D and E or A, B, D, E and E1 being called during the signal cycle.

For the other peak periods, the intersection typically operates with phases A, B, D and E, albeit with Phase E being rarely called during the evening peak hours due to the low level of right turning traffic from the West Coast Highway south approach. However, in order to cater for this right turn movement from the West Coast Highway, it has been necessary to include this phase throughout the modelling process.

A review of the existing traffic signal cycle times indicate that during the morning (AM) peak hour for the Thursday, the cycle time was typically 2 minutes 20 seconds long, reducing to approximately 2 minutes 10 seconds in the evening (PM) peak hour. For both the morning and evening peak hour on the Friday, the cycle time was typically in the order of 2 minutes long. As part of the phase times, Phase D that currently provides green time to North Street (straight ahead and right turns) and Servetus Street typically has a 30 – 40 second phase time (including inter-green time) for all modelled periods.

The intersection has been modelled in SIDRA as a fixed time traffic signal with user given cycle and phase times based on the observed typical on site phase lengths during the traffic counting, albeit with some tweaks to better reflect the recorded queue lengths. It should be noted that a review of the cycle and phasing times using SIDRA to calculate the optimum cycle time in some instances suggest shorter cycle times than currently observed as occurring.

For simplicity and ease of comparison, the existing modelled phase and cycle times have been replicated when assessing the impact of the 10% increase in traffic volumes. In practice, additional green time may be provided to the West Coast Highway traffic volumes to accommodate the increase in traffic on this main through route, which would need to be at the expense of traffic on North Street and Servetus Street.

3.2 SIDRA Results

Details of the SIDRA results for the existing intersection arrangement are shown as a series of tables in Appendix D (Tables D1 to D10) with the results summarised below. In all instances, the intersection as a whole is shown to be currently operating at or over its theoretical capacity during the peak hours with particular issues in terms of delays and/or queue lengths at the North Street and the West Coast Highway (south) approaches.

3.2.1 AM Peak – 2013

Thursday

Due to the different phasing arrangements that typically operate throughout the morning peak hour, it has been necessary to model both sets of indicated phases separately to obtain indicative performance results. Table D1 shows the results for the four phase arrangement and Table D2 for the five phase arrangement.

In both instances, the left turn from North Street (highlighted in yellow in Tables D1 to D2) is shown as being constrained by the short left turn lane with queuing straight ahead and right turning traffic preventing left turning traffic reaching the intersection stop line and/or left turning traffic queuing back out of the left turn lane blocking straight ahead/right turning traffic. This occurs despite the permitted left turning movement occurring in all but one of the phases (Phase A).

In both the four and five phase arrangements, northbound vehicles on West Coast Highway are shown as queuing back beyond Claremont Crescent as currently occurs. 95th percentile queue lengths on the West Coast Highway (north) approach to the intersection however are slightly longer than those observed on site whilst the calculated queue lengths on North Street slightly exceed the maximum recorded queue length (Note: due to the length of the queue, the survey could only record a maximum queue length of 45 vehicles i.e. actual queue length distance exceeds that which was possible to measure from the video survey.) Depending upon the phasing arrangement

used, the intersection is calculated to operate at between Level of Service D and E at present with the main through movements on West Coast Highway operating between B and D. North Street is shown to operate at Level of Service F (i.e. the lowest possible level of service) regardless of the phasing arrangement.

Friday
The modelling indicates that the intersection operates similarly to the Thursday morning performance (for the same phasing arrangement) with large delays and low service levels on the North Street approach to the intersection given that queues from the straight through and right turning traffic block the left turning movement, with priority given to the major north-south traffic movements along West Coast Highway. Overall, the intersection performs at Level of Service D.

5.3.3 PM Peak – 2013

Thursday and Friday
The priority phasing for the West Coast Highway movements results in low levels of service for the straight through and right turning vehicles on North Street albeit with much shorter queue lengths. Overall, the intersection is calculated to operate at Level of Service C for both the Thursday and Friday evening peak hour, with the southern approach along the West Coast Highway approaching its theoretical capacity.

5.3.4 AM Peak – 2023 + 10% Traffic Growth

Thursday
For the four phase arrangement (using the same phase times as previously), the additional traffic results in the overall Level of Service for the intersection reducing from D to E primarily due to the doubling of delays to through and right turning traffic on North Street (with an associated increase in queue length) along with an increase in delays to right turning traffic from West Coast Highway (south). With the five phase arrangement incorporating the additional green time to southbound, in addition to the same impacts identified above for the four phases, delays for the northbound straight ahead traffic from West Coast Highway (south) also double with an increase in queue length well beyond the Claremont Crescent intersection.

Friday
Using the same phase and cycle times as previously, the additional traffic reduces the intersection performance from Level of Service D to E with the main problem manoeuvres being the straight through and right turn from North Street and the right turn from West Coast Highway (south). Improvements to the overall performance of the intersection can only be achieved by increasing the cycle time with a corresponding increase in green time to phases D and E, and a reduction for Phase B, thereby having a negative impact on southbound traffic on the West Coast Highway.

5.3.5 PM Peak – 2023 + 10% Traffic Growth

Thursday
Using the same cycle and phase times as previously modelled, the overall intersection is forecast to operate at Level of Service F due primarily to large delays on North Street to the straight ahead and right turning traffic. Delays and queues also increase on the West Coast Highway (south) approach for straight ahead traffic. Improvements to the overall performance of the intersection can best be achieved by increasing the cycle time with a corresponding increase in green time to North Street.

However, this would also result in the West Coast Highway approaches having lower levels of service.

Friday
Using the same phase and cycle times as previously, the additional traffic reduces the intersection performance from Level of Service C to D due to the impact on the straight ahead and right turning traffic on North Street.

4 Option 1 – Extended Left Turn Lane on North Street (existing phasing)

4.1 SIDRA Inputs

4.1.1 Intersection Arrangement

As part of this option, the left turn lane on North Street has been extended from 40m to 90m based on supplied plans provided by the City. The theory behind this approach to address capacity problems is that there is less chance of straight ahead and right turning traffic queuing back from the stop line blocking the left turning movement and vice versa.

4.1.2 Cycle Times and Phasing

The same phasing and cycle times adopted for the existing intersection have been utilised within the modelling to allow a like-for-like comparison. As such, priority is primarily given to the heavy through movement along West Coast Highway, rather than providing additional green time to the side road movements.

4.2 SIDRA Results

It should be noted that no change occurs to the performance of the West Coast Highway and Servetus Street approaches using this Option. As such, no comment on their performance has been provided in the following sections. Detailed results of the SIDRA modelling are contained in Appendix E (Tables E1 to E10).

4.2.1 AM Peak – 2013

Thursday
For both the four and five phase arrangements, the North Street approach is forecast to operate at Level of Service D with much improved average delay for the through and right turn lanes. Notwithstanding this, the left turn movement is forecast to operate at or close to its theoretical capacity.

Friday
All movements at the North Street approach to the intersection improve with the overall Level of Service on this arm changing from E to D, with average delays for the straight ahead and right turn manoeuvres being more than halved and queue lengths being significantly shortened. The North Street approach is shown to operate well within its theoretical capacity for this Option unlike in the existing situation.

Thursday
The extended two approach lanes along North Street minimise the impact that straight ahead and right turning traffic has on the left turning movement with the result that the average delay for the left turning movement decreases and the Level of Service improves from D to C. However, no change occurs to the straight ahead and right turning movement which still operate at Level of Service F and above its theoretical capacity, albeit with queues of 17 vehicles. Any improvements to these manoeuvres using this phasing arrangement can best be achieved with a reduction in cycle time, primarily at the expense of Phases A and E, which will have an impact on the West Coast Highway approaches.

Friday
As with the Thursday traffic movements, the left turn movement from North Street is forecast to have a high level of service and reduced average delays with the extended left turn lane. No change is forecast to occur with the straight ahead and right turn movements.

4.8.3 AM Peak – 2013 + 10% Traffic Growth

Thursday
For both the four and five phase traffic signal controlled intersection arrangements with the additional traffic volumes, the Level of Service on the North Street approach is forecast to improve from F to D compared to the existing design due to reduced delays to the straight ahead and through traffic. However, left turning vehicles are forecast to queue back beyond the length of the left turn lane resulting in the approach not performing as well as it could do if the left hand turning lane approach length was extended further beyond the modelled 90m distance.

Friday
The straight ahead and right turn movements at the North Street approach improve with the overall Level of Service on this arm changing from F to D, with delays and queue lengths being significantly shortened. The North Street approach is shown to operate well within its theoretical capacity unlike in the existing situation.

4.8.4 PM Peak – 2013 + 10% Traffic Growth

Thursday
Whilst minor improvements to the left turning traffic in terms of reduced delay occur with the extended left turn lane, the average delay and queue lengths for the straight ahead and right turning movement improve significantly. However, delays for these movements still being high with the Level of Service for this approach remaining at F.

Friday
The additional left turn lane length provides benefits for all three turning movements at the North Street approach with the Level of Service improving from F to D with improved average delays and queue lengths forecast.

5 Option 2 – Extended Left Turn Lane on North Street and Right Turn Phase

5.1 SIDRA Inputs

5.1.1 Intersection Arrangement

As part of this option (as with the previous arrangement), the left turn lane on North Street has been extended from 40m to 90m. In addition, a separate right turn phase has been provided for the North Street approach (see below and Figure 5.1).

5.1.2 Phasing Arrangements

A separate right turn phase for North Street movements can be incorporated into the traffic signal controlled intersection arrangement in a number of ways:

- As a leading right turn phase preceding the opposing movement from Servetus Street. Following the leading right turn phase, full movements from both North Street and Servetus Street are permitted (as currently exists) with right turning movements from both approaches allowed to filter through the opposing straight ahead movements. As part of this, for safety reasons, it is necessary to temporarily terminate the right turn movement from North Street between the phases. It should be noted that the sharing of the through and right turn lane on North Street makes the intersection operation inefficient as right turning vehicles stopped by the red arrow will also block straight ahead traffic; or a straight through vehicle calls the right turn phase but no right turning vehicles exist.

- Using a split approach phasing arrangement for the North Street and Servetus Street approaches, whereby separate phases are allocated to the various turning movements with right turns from each approach un-opposed. Such an approach is typically used where heavy right turn movements are opposed by a very light movement or where turning proportions vary significantly during the day requiring flexible shared lane arrangements[1]. Whilst this arrangement improves road safety, it is highly inefficient and Austroads recommends examining other phasing options prior to adopting this arrangement. Such an option also limits the amount of available phase time to make the relatively heavy left turn movement from North Street.

- As a lagging right turn phase following the full set of movements from both North Street and Servetus Street (as currently exists). Due to road safety concerns, this arrangement is only permitted if the right turn movement from the direction opposing the lagging right turn (i.e. from Servetus Street) is banned; or all the movements from North Street are stopped, before then starting up again – which is extremely inefficient.

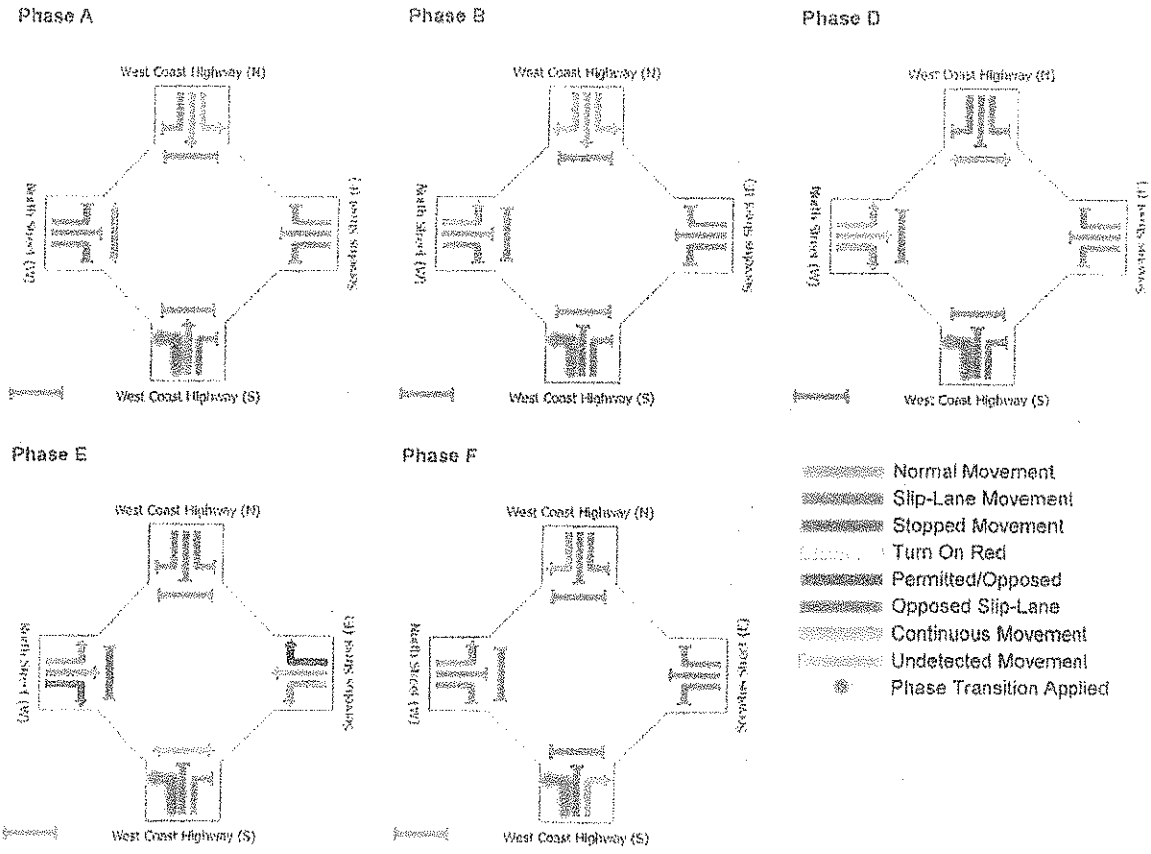
In addition to the above, an alternative arrangement such as providing a combined through and left turn lane together with a separate right turn lane on North Street has been considered but is considered as inappropriate given that the current lane configuration and phasing allows left turning traffic to make this movement in all phases except Phase A. By combining the left and

[1] Austroads Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings. 2007

through traffic into a single lane, the straight ahead movement would need to be halted during Phase B and E1, thereby reducing the overall green time available to the left turn movement.

Given the above, a leading right turn phase arrangement as shown in Figure 5.1 (for the existing four phase arrangement) has been adopted for testing in SIDRA as the least likely to cause inefficiency problems. (The existing five phase arrangement would simply have Phase B replicated following Phase F.)

Figure 5.1 Proposed Leading Right Turn Phasing Arrangement



It should be noted that in order to maintain the same level of performance along West Coast Highway as at present, phase times associated with such movements (Phases A, B and E/E1) have been kept the same as currently experienced. Applying such an approach results in the existing Phase D (30 - 40 second phase time) to be split into the North Street lead right turn phase followed by full movements from both the North Street and Servetus Street approaches. This can be expected to have greatest impact on Servetus Street performance.

5.2 SIDRA Results

Given the above noted typical approach to retain the same phase times for A, B and E/E1, no change in the performance of the West Coast Highway occurs and as such, the performance of these approaches have not been reported upon below, with focus being given to North Street and Servetus Street. Detailed results of the SIDRA modelling are contained in Appendix F.

5.2.2 AM Peak – 2013

Thursday and Friday
The provision of the right turn phase for North Street has negligible effect on the performance of North Street for both the four and five phase arrangement for both the Thursday and Friday morning peak hours in terms of average delay and queue lengths, but results in a much decreased Level of Service for the Servetus Street approach with increased delays and a small increase in forecast queue lengths.

5.2.3 PM Peak – 2013

Thursday and Friday
The provision of a right turn phase at North Street significantly improves the straight through and right turn movements on North Street with improvements in average delay and queue lengths. However, the reduced amount of green time provided to Servetus Street in order to cater for this additional phase results in the left and straight ahead movements on Servetus Street operating well over capacity at Level of Service F (previously Level of Service D) and with long resulting queue lengths.

It should be noted that in order to accommodate the additional phase and provide minimum green times for the pedestrian movement whilst retaining the same cycle time, in this instance, it has been necessary to reduce the Phase A time by four seconds. This in turn results in an adverse impact on the West Coast Highway (south) approach for straight through traffic movements.

5.2.4 AM Peak – 2013 + 10% Traffic Growth

Thursday and Friday
The additional traffic with the leading right turn phase provided in addition to the existing five phases (A, B, D, E and E1)results in the North Street approach operating beyond its theoretical capacity on the Thursday morning with increased delays and queues forecast. When modelled in addition to the four phase arrangement, the North Street approach performance varies little from that with only the extended left turn lane provided.

On the Friday morning, very little change for the North Street approach performance occurs compared to simply providing the extended left turn lane. The difference between the Thursday six phase (existing five phases plus leading right turn) arrangement and the other modelled results is due to the loss of the available 'green time' due to the additional phase but the same cycle length being run.

As with the existing traffic volumes, the Servetus Street approach performance on both Thursday and Friday declines with the installation of the additional leading right turn phase for North Street compared to simply providing the extended left turn lane.

5.2.5 PM Peak – 2013 + 10% Traffic Growth

Thursday and Friday
The provision of a right turn phase at North Street significantly improves the straight through and right turn movements on North Street with improvements in average delay and queue lengths. However, as with the existing traffic volumes, the reduced amount of green time provided to Servetus Street in order to cater for this additional phase results in the left and straight ahead

movements on Servetus Street operating well over capacity at Level of Service F (previously Level of Service D) and with long resulting queue lengths.

6 Benefit Cost Ratio

A review of the crash data indicates zero crashes involving vehicles turning right from North Street colliding with straight ahead or left turn movements from Servetus Street – the type of collisions that the installation of a separate right turn phase would typically address. As such, the road safety benefits generated by the installation of the right turn traffic signal aspects needed to permit this phase arrangement will be zero. Accordingly, the Benefit Cost Ratio (BCR) as a result of the additional costs to install the right turn traffic signal aspects will be lower than that calculated for the original black spot submission – as indicated below. (Zero benefits but additional cost.)

The original black spot submission for the left turn lane on North Street and overhead mast arms indicated a BCR of 3.75. When re-run using Main Roads WA Crash Analysis Reporting System (CARS) using the same crash data, construction date (2012), discount rate (5%), countermeasures and costs, a revised BCR of 2.08 is obtained. Notwithstanding this, the additional countermeasure of new right turn arrows as part of the signal modification results in the BCR decreasing further to1.76 given the lack of crash savings.

7 Conclusions

7.1 Comparison of Options to Existing Arrangement

The SIDRA modelling for the existing intersection arrangement confirms that the North Street and West Coast Highway (south) approaches are operating at or over capacity with queued straight ahead and right turning vehicles blocking left turning traffic along North Street; and vehicles on West Coast Highway queuing beyond the Claremont Crescent traffic signal controlled intersection to the south.

The provision of the extended left turn lane up to 90m in length as indicated by the City typically allows two lanes of traffic for the left turn movement and the combined straight ahead/right turn movement to queue separately under the existing traffic volumes. A 10% increase in traffic volumes however results in the mixed queuing of vehicles with straight ahead and right turning vehicles potentially blocking left turning vehicles and vice versa. As such, increased intersection performance could be achieved by extending the left turn lane further than the 90m proposed to a length in the order of 120m to 150m if physically achievable.

Whilst the provision of an additional leading right turn phase for the North Street approach provides benefits to this arm of the intersection during the evening peak hour in terms of additional green time for the straight ahead and right turn movement, without changes to the phase times for the West Coast Highway traffic, it will have a significant adverse impact on the performance of the Servetus Street approach.

7.2 Benefit Cost Ratio

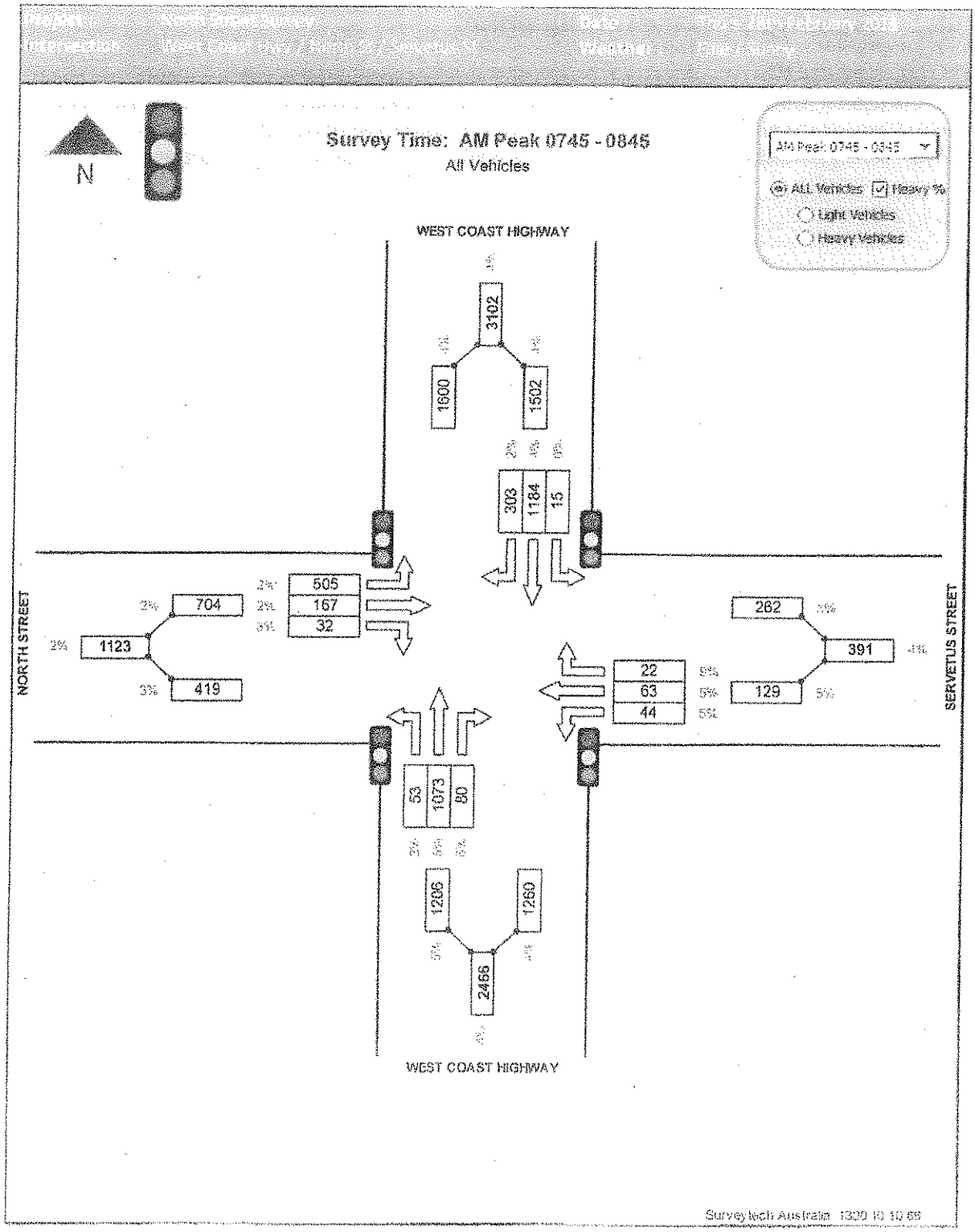
The provision of a separate right turn phase for traffic exiting the North Street approach has no impact from a road safety perspective in terms of the historical crash records. As such, as indicated in Section 6, the additional cost of installing the associated right turn signals will cause the BCR to

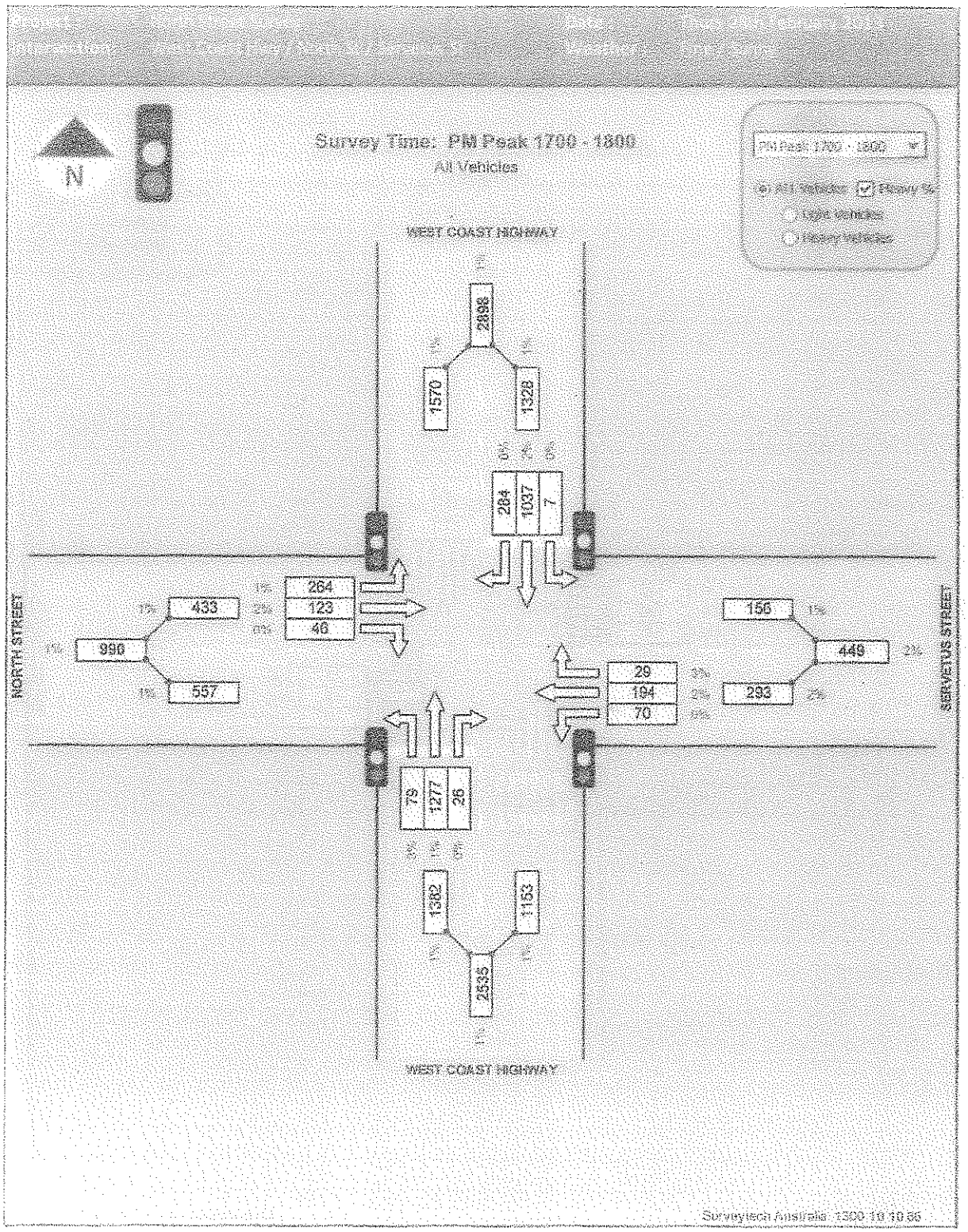
reduce and hence would not be eligible for funding through the black spot project funding mechanism.

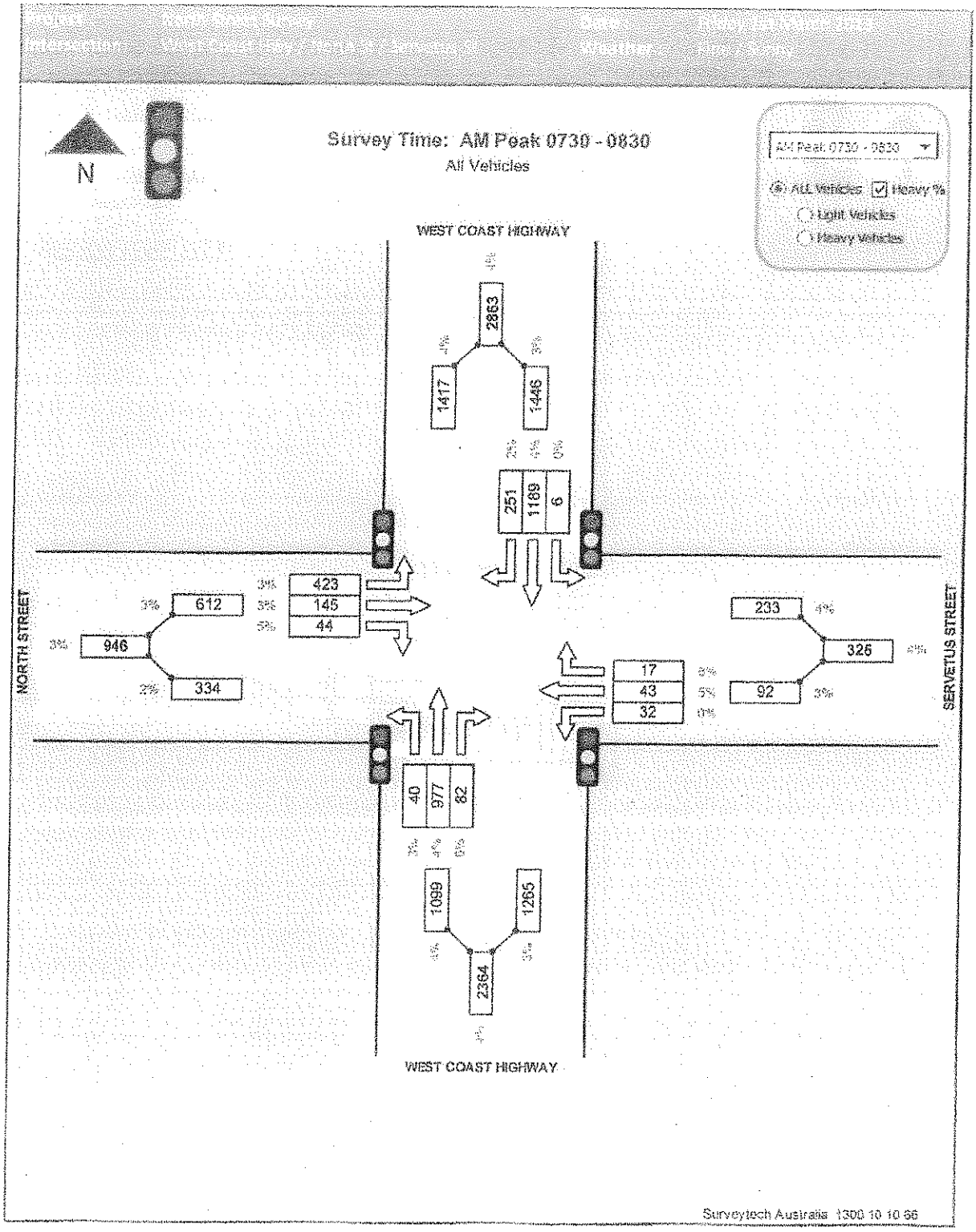
7.3 Recommended Arrangement

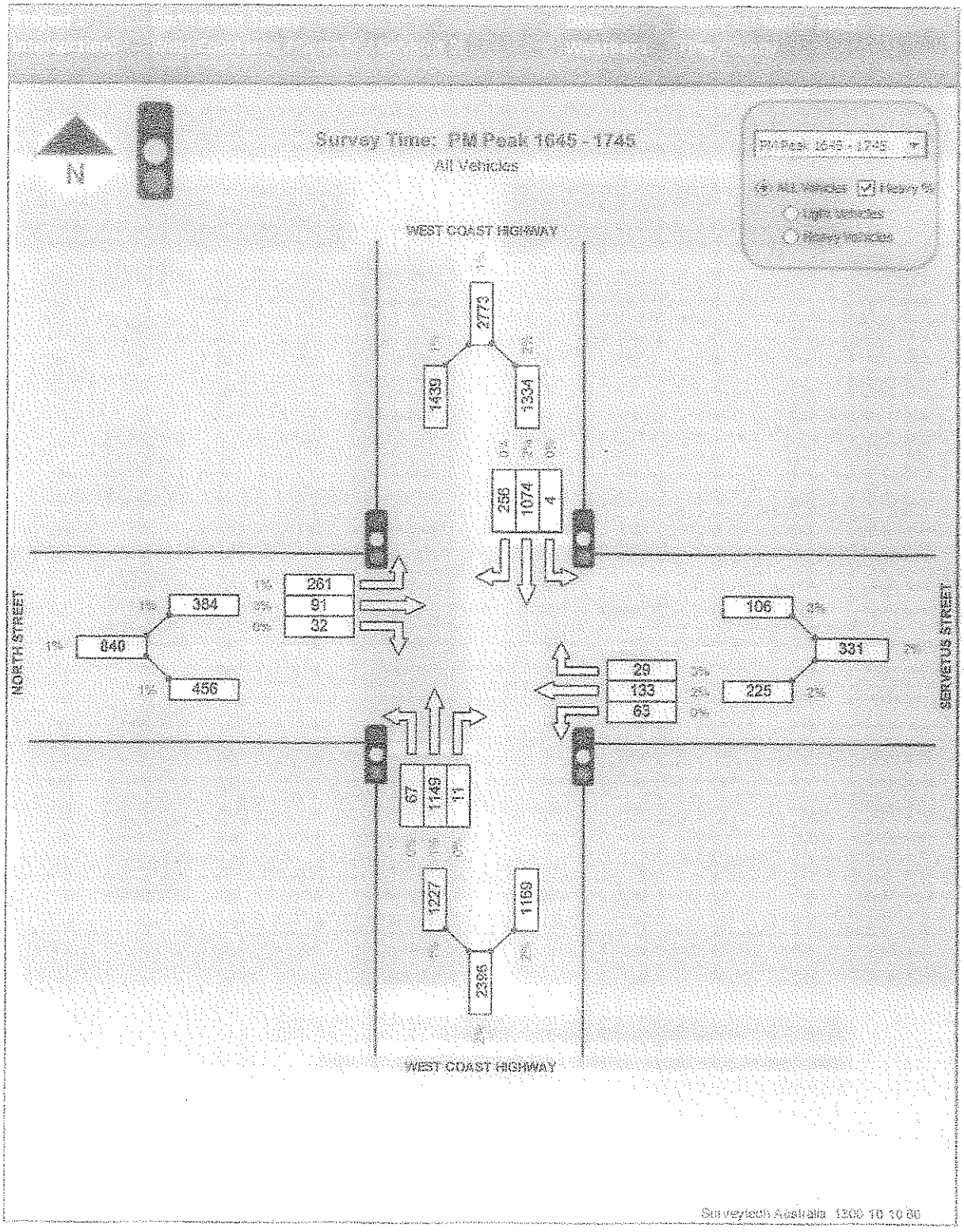
It is recommended that consideration be given to simply extending the length of the left turn lane on North Street. Ideally this should be beyond the 90m length envisaged by the City in the supplied design drawings to cater for future demand. The provision of the right turn phase is not warranted on road safety grounds nor will it improve the overall performance of the intersection.

Appendix A Traffic Counts




Survey Time: PM Peak 1700 - 1800
All Vehicles
N
WEST COAST HIGHWAY
NORTH STREET
SERVETUS STREET
WEST COAST HIGHWAY
2898
1570
1328
284
1037
7
264
123
46
433
990
557
156
449
293
29
194
70
79
1277
26
1382
1163
2535
Surveytech Australia 1300 10 10 35


N
Survey Time: AM Peak 0730 - 0830
All Vehicles
AM Peak 0730 - 0830
ALL Vehicles
Heavy %
Light Vehicles
Heavy Vehicles
WEST COAST HIGHWAY
2863
1417
1446
251
1189
6
NORTH STREET
612
946
334
423
145
44
SERVETUS STREET
233
326
92
17
43
32
40
977
82
1099
1265
2364
WEST COAST HIGHWAY
Surveytech Australia 1300 10 10 66


Survey Time: PM Peak 1645 - 1745
All Vehicles
N
WEST COAST HIGHWAY
NORTH STREET
SERVETUS STREET
2773
1439
1334
256
1074
4
261
91
32
384
840
456
106
331
225
29
133
63
67
1149
11
1227
1169
2395
Surveytech Australia 1300 10 10 80

Appendix B Queue Length Surveys

	Northbound		Southbound	
	Left	Right	Left	Right
0700-0705	6	5	13	8
0705-0710	8	8	8	7
0710-0715	9	8	8	12
0715-0720	11	8	11	9
0720-0725	8	2	9	5
0725-0730	7	4	7	9
0730-0735	11	8	7	10
0735-0740	7	2	15	11
0740-0745	10	2	17	8
0745-0750	11	8	15	17
0750-0755	7	5	18	28
0755-0800	12	8	18	25
0800-0805	12	6	23	16
0805-0810	8	11	20	34
0810-0815	12	7	25	22
0815-0820	15	8	25	45
0820-0825	10	5	18	45
0825-0830	11	8	28	15
0830-0835	7	8	23	17
0835-0840	12	4	14	25
0840-0845	5	5	17	27
0845-0850	6	6	20	9
0850-0855	6	5	10	25
0855-0900	8	4	15	21
[illegible]	9	4	16	18
[illegible]	15	11	23	45

	Northbound		Southbound	
	Left	Right	Left	Right
1600-1605	8	6	25	6
1605-1610	4	9	18	11
1610-1615	7	8	23	7
1615-1620	4	8	18	12
1620-1625	7	4	15	16
1625-1630	4	7	14	7
1630-1635	10	11	27	5
1635-1640	7	6	25	5
1640-1645	8	7	27	9
1645-1650	13	8	18	12
1650-1655	5	7	20	9
1655-1700	6	11	25	7
1700-1705	8	8	23	14
1705-1710	5	12	23	12
1710-1715	8	10	18	8
1715-1720	4	10	23	7
1720-1725	9	15	25	16
1725-1730	7	22	25	4
1730-1735	6	22	27	15
1735-1740	6	12	25	13
1740-1745	8	16	25	6
1745-1750	6	10	23	8
1750-1755	6	11	25	5
1755-1800	8	9	20	6
[illegible]	7	10	21	9
[illegible]	13	22	23	16

Queue length exceeds distance to next signalised intersection

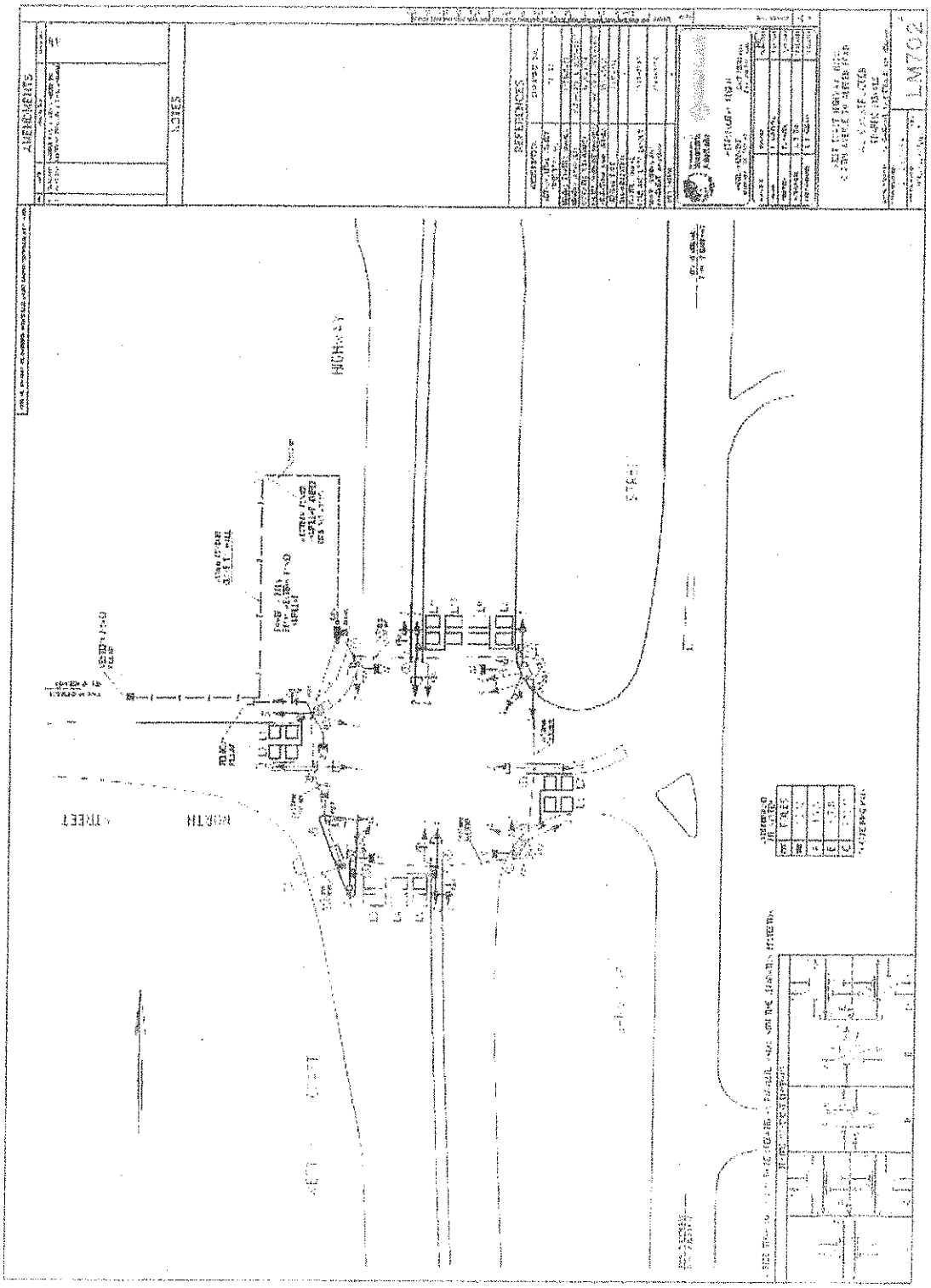
Queue length exceeds distance possible to measure due to geometry and length

	North	East	South	West
0700-0705	7	2	12	6
0705-0710	4	3	7	6
0710-0715	11	4	7	5
0715-0720	10	2	12	5
0720-0725	8	3	7	12
0725-0730	7	4	10	11
0730-0735	6	3	19	7
0735-0740	8	2	10	11
0740-0745	9	2	13	10
0745-0750	10	3	17	12
0750-0755	9	5	15	24
0755-0800	5	2	12	17
0800-0805	6	2	22	15
0805-0810	7	2	23	17
0810-0815	9	2	16	27
0815-0820	8	4	17	12
0820-0825	4	2	14	15
0825-0830	7	4	13	13
0830-0835	9	3	14	12
0835-0840	5	3	19	11
0840-0845	4	5	15	11
0845-0850	11	2	9	13
0850-0855	8	5	13	6
0855-0900	4	3	8	9
[illegible]	7	3	14	12
[illegible]	11	5	23	27

	North	East	South	West
1600-1605	5	5	19	8
1605-1610	8	5	20	4
1610-1615	6	3	16	8
1615-1620	6	6	7	11
1620-1625	8	5	9	6
1625-1630	5	7	11	12
1630-1635	7	7	8	9
1635-1640	8	8	11	9
1640-1645	10	2	12	6
1645-1650	8	7	13	8
1650-1655	6	9	15	8
1655-1700	6	6	8	9
1700-1705	6	10	11	7
1705-1710	7	6	15	9
1710-1715	5	11	18	6
1715-1720	8	7	16	6
1720-1725	11	9	29	3
1725-1730	8	8	20	4
1730-1735	7	9	18	7
1735-1740	8	4	14	5
1740-1745	7	6	12	7
1745-1750	7	7	15	7
1750-1755	5	4	11	6
1755-1800	6	7	8	6
[illegible]	7	7	13	7
[illegible]	11	11	29	12

Queue length exceeds distance to next signalised intersection

Appendix C Existing Traffic Signal Design



11.2.6 NORTH STREET / WEST COAST HIGHWAY LEFT TURN LANE EXTENSION

File No:	SUB/486
Attachments:	City of Nedlands Letter Plans of Options for Left Turn Lane Extension Aerial Photo of Affected Area
Responsible Officer:	Carl Askew Chief Executive Officer
Author:	Geoff Trigg Manager Engineering Services
Proposed Meeting Date:	19 June 2012
Author Disclosure of Interest	Nil

SUMMARY

The City of Nedlands has requested the Town of Cottesloe's approval *in principle* to create an extension of the existing left turning lane on North Street, at West Coast Highway, to address the traffic problems experienced through the Swanbourne area. There are three options regarding this proposal. The City of Nedlands would fund the works, in 2012/2013.

The recommendation is that Council:

1. Gives approval *in principle* to the City of Nedlands for the extension of the left turn lane of North Street onto West Coast Highway during the 2012/2013 financial year.

2. Gives support *in principle* to the North Street widening required for the increased left turn lane capacity to include an impact on the south side of North Street, in the Town of Cottesloe, with the requirements that impact on verge trees be kept to a minimum and that public consultation takes place with all potentially affected properties.

BACKGROUND

North Street is the boundary street between the City of Nedlands and the Town of Cottesloe, with the street centre line being the boundary.

The current works of resurfacing North Street has been a joint exercise between the two municipalities, with the eastern end of the work ending at approximately the start of the proposed left turn lane extension.

It has become obvious in recent years that the traffic lined up on North Street, wanting to turn left into West Coast Highway, has steadily increased, particularly at the peak times around 8.00am and 5.00pm. Vehicles are driving over the north side kerb line and the section built and marked for two lanes has been informally extended by increased vehicle use.

This proposal is aimed at creating a lengthened section of left turn lane which will also allow a lengthened 'through' lane from North Street across the highway or for a right turn.

STRATEGIC IMPLICATIONS

Nil

POLICY IMPLICATIONS

Nil

STATUTORY ENVIRONMENT

The City of Nedlands will have to obtain Main Roads WA approval for the extra line marking and signage required for this work. This will include approval of the design. Main Roads WA is the only authority with the power to approve such line marking and signage.

FINANCIAL IMPLICATIONS

The City of Nedlands will fund all works involved with this proposal, including survey, design, construction, lighting and any impact on services.

SUSTAINABILITY IMPLICATIONS

One or two street trees will have to be removed, depending on the design option chosen, either from the north or the south side of North Street.

CONSULTATION

Apart from this contact from the City of Nedlands, no other consultation has occurred.

STAFF COMMENT

The problem is obvious to anyone using North Street trying to get onto West Coast Highway around 8.00am and 5.00pm. The solution is to increase the holding capacity of the left turn lane and with it, the through / right turn lane. The City of Nedlands will fund all works and arrange the construction.

The issue is which side is to be affected. The three options are:

Option 1 - all works on the north (Nedlands) side;
Option 2 - all works on the south (Cottesloe) side; or
Option 3 - partial widening on both sides.

Option 3, with almost double the cost, up to 5 street trees lost and drainage pits on both sides being affected, would be the easiest option to discount.

There is a fourth option - Do nothing. With Nedlands funding the work and the obviousness of improvements being urgently required, this option should also be discounted.

Option 1 on the Nedlands side, affects 7 property accesses compared to Option 2 on the south side affecting 2 accesses. The majority of services are also on the Nedlands street verge, along with one street light required to be relocated.

In regards to street trees, the northern option removes 2 trees, with the southern option removing one tree. There is a potential of two more trees to be impacted upon, on the south side, depending on final exact surveys.

Given the heavy use made of this intersection by vehicles originating from Cottesloe and the lesser impact of on the south side verge (Option 2) when compared with Option 1 (north side), this proposal is worthy of support, dependant on the minimum amount of tree removals from the verge. At this stage, the works are proposed mid 2012/2013 if the City of Nedlands budget process permits.

VOTING

Simple Majority

COMMITTEE DISCUSSION

Committee discussed the three options presented in the letter from the City of Nedlands and agreed that option 2 did not entirely solve the issue of people turning right onto West Coast Highway, which in turn holds up traffic wanting to either turn left or go straight on. Committee discussed options to promote traffic flow that included use of the sump land on the corner of West Coast Highway and North Street to create a slip road and requesting that Main Roads consider revising the traffic light sequencing and/or include a right turn green arrow.

Committee agreed that it could be beneficial to receive a presentation from Engineers from the City of Nedlands to discuss other possibilities for the road works, as the current three proposed options may not solve the traffic congestion problems.

OFFICER RECOMMENDATION

Moved Cr Boland, seconded Cr Rowell

THAT Council:

1. Gives approval *in principle* to the City of Nedlands for the extension of the left turn lane of North Street onto West Coast Highway during the 2012/2013 financial year.

2. Gives support *in principle* to the North Street widening required for the increased left turn lane capacity to include an impact on the south side of North Street, in the Town of Cottesloe, with the requirements that impact on verge trees be kept to a minimum and that public consultation takes place with all potentially affected properties.

Lost 0/5

NEW MOTION / COMMITTEE RECOMMENDATION & COUNCIL RESOLUTION

Moved Cr Rowell, seconded Cr Strzina

THAT Council defer the matter and request a presentation from officers from the City of Nedlands to discuss other possibilities for this traffic management issue.

Carried 9/0

Please tick the relevant programme submissions: (Nominations can be submitted for consideration in both programs)

Nation Building Black Spot Program:		State Black Spot Program:	✓

Non Staged Project: Y/N	Y	Staged Project Stage One: Y/N		Staged Project Stage Two: Y/N	

Nominee Details

Reference No: (Main Roads use only)

1. Title: Dr/Mr/Mrs/etc:	Mr
2. Surname:	Melville
3. Given Name:	Andrew
4. Organisation:	City of Nedlands
5. Position Title/ Occupation:	Acting Director Technical Services
6. Postal address:	PO Box 9
	Nedlands
7. State:	WA
8. Postcode:	6909
9. Telephone Number:	92733500
10.Fax Number:	92733670
11. Email address:	council@nedlands.wa.gov.au
12. Date of submission:	July 2012

Site Nomination

1. Local government in which site nomination is located: City of Nedlands

2. Suburb: Nedlands

3. Postcode (of site): 6009

4. Site Description: (e.g. intersection, 5km road length, 20kms west of Smithville)

Intersection

5. Road Name(s):

Primary Road: West Coast Highway

Intersecting Road: (if applicable) North Street

6. Nature of Concern: High percentage of rear end crashes

PLEASE FORWARD NOMINATION FORM TO YOUR LOCAL GOVERNMENT OR MAIN ROADS WESTERN AUSTRALIA FOR SITE ASSESSMENT AND TREATMENT PROPOSAL

ONLY TO BE COMPLETED BY STATE OR LOCAL GOVERNMENT ROAD AUTHORITIES

Site Assessment

1. Road Classification:

   National Land Transport Network: [ ] State Road: [✓] Local Road: [✓]

2. Geographic location (Geocode).

   1: X: [ ] Y: [ ]

   2: X: [ ] Y: [ ]

3. Intersection Number or Road No's & SLK's of intersection: (if applicable) [81673]

4. Road No & Section SLK Start and SLK End: (if applicable) [ ]

5. Problem Diagnosis: (e.g. right turn crashes, rear end crashes)

   [Rear end crashes]

6. Traffic Count Report attached : Y/N [n] Traffic Count Date: [/ /]

7. Summary of crash statistics attached (from Crash Factor Matrix in CARS): Y/N [y]

8. Measurement period of crashes (5 calendar years): [2007-2011]

9. Total number of crashes: [28]

10. Total number of casualties: [7]

11. Total number of property damage/other crashes: [21]

Treatment Proposal

1. Proposed Treatment: (eg install signs, modify signals, install roundabout)

   Install overhead mast arms on West Coast Highway
   Install left turn pocket in North Street

2. Treatment Code: (if applicable – from CARS) [ ] [ ] [ ] [ ] [ ] [ ]

Support of Nomination

1. This nomination is supported by:

   Roads Safety Audit (Y/N) [n] Benefit Cost Ratio (BCR) calculation (Y/N) [y]

Road Safety Audit Supported Nominations

2. Is a copy of the relevant report (or section of the report) attached? (Y/N) [n]

   Date of Road Safety Audit [/ /]

Multiple Measure Modelling (BCR calculation) Supported Nominations

For Staged Projects BCR is to be calculated for the total estimated project cost

3. BCR/NPV calculations attached? Y/N: y (Printout from CARS or manual calculation)
4. Benefit Cost Ratio (BCR) (Total Estimated Cost to be used in calculating BCR): 3.75
5. Net Present Value: $511995
   (This is the difference between the present value of benefits and the present value of costs.)

Estimated Cost

Nation Building Program (if applicable)

1. Nation Building Program Contribution: $
2. Contribution by others: $
   Total Estimated Project Cost: $

State Black Spot Program (if applicable)

Non-Staged Projects

4. State Black Spot Program contribution: $96667
5. Local Government 1/3 contribution (only applies to Local Government nominations): $24167
6. Contribution by others: $24167
7. Total Estimated Project cost: $145000

Staged Projects - total estimated cost of all stages:

8. State Black Spot Program contribution: $
9. Local Government 1/3 contribution (only applies to Local Government Nominations): $
10. Contribution by others (specify): $
    Total Estimated Project Cost: $

Estimated Cost of Stage One

12. State Black Spot Program contribution: $
13. Local Government 1/3 contribution (only applies to Local Government nominations): $
14. Contribution by others (specify): $
15. Total Estimated cost of Stage One: $

Estimated Cost of Stage Two

16. State Black Spot Program contribution: $
17. Local Government 1/3 contribution (only applies to Local Government nominations): $
18. Contribution by others (specify): $
19. Total Estimated cost of Stage Two: $

    Note: This cost may be different to the original estimate when applying for stage Two funds (refer to the Guidelines)

Clearances and Utility Providers

1.	Heritage clearances required? Y/N	n
2.	Heritage clearances already obtained? Y/N	n
3.	Environmental clearances required? Y/N	n
4.	Environmental clearances already obtained? Y/N	n
5.	Other clearances/permits required? Y/N	n
	(Specify)	
6.	Other clearances/permits already obtained? Y/N	n
7.	Works required by utility providers:	

Western Power/Horizon Power: Y/N		Telecommunications: Y/N	n
Gas: Y/N	n	Water Corporation: Y/N	
Others: Y/N			

Contact Details

Contact Person:	Wayne Mo
Organisation:	City of Nedlands
Telephone Number:	92733539
Facsimile Number:	92733670
Email Address:	wmo@nedlands.wa.gov.au
Print Name:	Wayne Mo
Position/Title:	Design Engineer
Signature:	Wayne Mo
Date:	27 July 2012

PLEASE FORWARD NOMINATION FORM TO YOUR REGIONAL ROAD GROUP OR MAIN ROADS WESTERN AUSTRALIA FOR ASSESSMENT

Sketch or Diagram
(Please indicate North)

See attached

Additional Comments

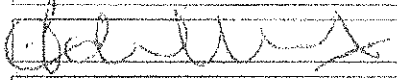
Agreement in principal for traffic signal modifications for installation of mast arms pending from MRWA

NOMINATION CHECKLIST
NON STAGED PROJECTS

All nominations for State and Nation Building Black Spot Programs must have this checklist completed and attached. Incomplete submissions will be returned.

1.	Completed nomination form	✓
	• Select/tick the appropriate Black Spot Program submission box: NBBS, STATE or both (nominations can be submitted for consideration in both programs).	
	• Nature of concern, problem diagnosis and proposed treatment must be filled in; do not leave blanks and refer to attachments.	
	• Estimated Cost.	
2.	Locality map (e.g. photocopy of street directory or regional map with location marked)	✓
3.	Drawing/sketch of proposal (for items such as shoulder sealing, skid resistant surface etc. Provide sketch showing extent of work)	✓
4.	Nomination Supplementary Form	✓
5.	CRASHtool Reports	
	• Crash Factor Matrix (for all nominations)	✓
	• Network Average Crash comparison	✓
	• Collision Diagram	✓
	AND	
5a	Road Safety Audit Report (by independent senior auditor) (Proposed treatments must follow from the recommendations of the report)	
	OR	
5b	Multiple Countermeasure Modelling (BCR/NPV calculations)	✓
6.	Evidence of MRWA approval (in principle) for regulatory devices (e.g. traffic signals, STOP or GIVE WAY control etc.)	
7.	Heritage/environmental clearances (where applicable)	
8.	Traffic count report (optional)	
9.	Both Forms have been signed (Nomination Form and Nomination Checklist)	✓

I confirm that the above items have been completed, checked and are attached to the submission, and that the contact person will be available during the submission evaluation period.

PRINT NAME:	Andrew Melville
POSITION:	Acting Director Technical Services
SIGNATURE:	
DATE:	27 July 2012

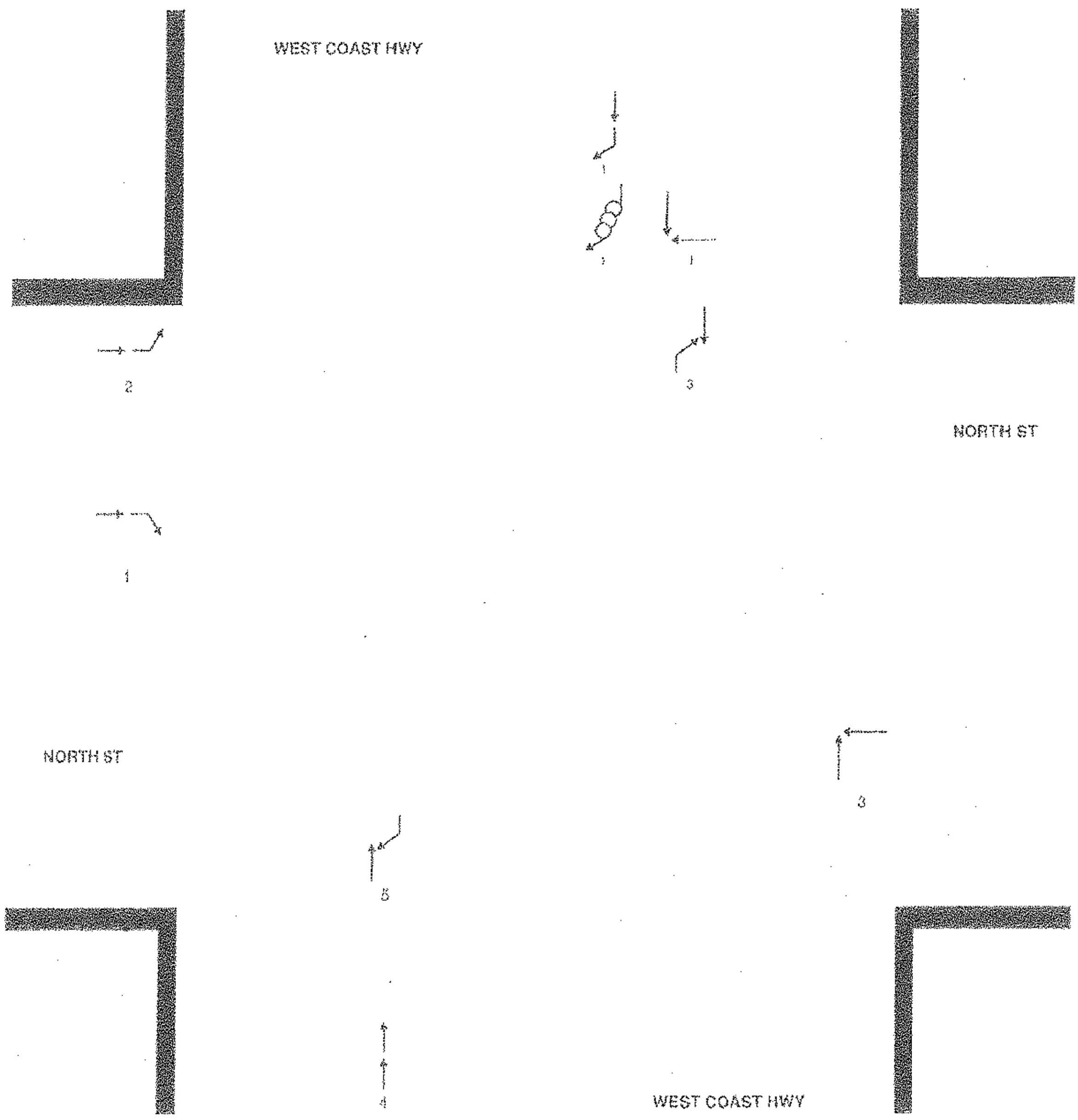
NOMINATION SUPPLEMENTARY FORM

Item	Estimate ($)	Estimate ($)	Estimate ($)
	Non Staged Project	Staged Project Stage One	Staged Project Stage Two
Pre-Construction Works			
Project Management	5000		
Design (includes survey, traffic analyses)			
Environmental, Heritage and Aboriginal Clearances/Requirements			
Construction Works			
Contract Management			
Traffic Control (Roadwork traffic management, etc)	10000		
Clearing			
Service Relocations (e.g.: Telstra, Water Corporation requirements)			
Drainage Installation	50000		
Earthworks			
Pavements	46500		
Concrete Works (e.g.: kerbing, islands, paths)			
Signs	1000		
Pavement Markings	2500		
Lighting			
Traffic Signals	30000		
Landscaping			
Road Safety Audit Cost			
Initial Road Safety Audit*			N/A
Anticipated cost of Design Audit			
Other			
Total	145000		
Staged Project: Total Cost			
TOTAL	145000		

*Note: Cost of Road Safety Audit in not an eligible cost under the Nation Building Program

Severity
Currently Showing

Fatal
Hospital
Medical
PDO Major
PDO Minor



Note

The crashes depicted above are placed figuratively, the exact location of the crashes is not reflected in the diagram.

Only RUM codes 11-18, 72, 31, 32, 39, 76 & 77 display within the collision diagram

ROAD USE MOVEMENT (RUM) CODES

	0	1	2	3	4	5	6	7	8	9
	PEDESTRIAN on foot, in toy/pram	INTERSECTION vehicles from adjacent approaches	VEHICLES FROM OPPOSING DIRECTIONS	VEHICLES FROM ONE DIRECTION	MANOEUVRING	OVERTAKING	ON PATH	OFF STRAIGHT, ON STRAIGHT	OFF PATH, ON CURVE	PASSENGERS AND MISCELLANEOUS
1	NEAR SIDE 1	THRU-THRU 11	SIDE SWIPE HEAD ON 21	Vehicles in same lanes REAR END 31		HEAD ON 51	PARKED 61	OFF CARRIAGEWAY TO LEFT 71	OFF CARRIAGEWAY RIGHT BEND 81	FELL IN/FROM VEHICLE 91
2	EMERGING 2	RIGHT-THRU 12	THRU-RIGHT 22	LEFT REAR 32	LEAVING PARKING 42	OUT OF CONTROL 52	DOUBLE PARKED 62	LEFT OFF CARRIAGEWAY INTO OBJECT/VEHICLE 72	OFF RIGHT BEND INTO OBJECT/VEHICLE 82	LOAD STRUCK VEHICLE 92
3	FAR SIDE 3	LEFT-THRU 13	RIGHT LEFT 23	RIGHT REAR 33	PARKING 43	PULLING OUT 53	ACCIDENT OR BROKEN DOWN 63	OFF CARRIAGEWAY TO RIGHT 73	OFF CARRIAGEWAY LEFT BEND 83	STRUCK TRAIN 93
4	PLAYING, WORKING LYING, STANDING ON CARRIAGEWAY 4	THRU-RIGHT 14	RIGHT RIGHT 24	U TURN 34	PARKING VEHICLES ONLY 44	CUTTING IN 54	CAR DOOR 64	RIGHT OFF CARRIAGEWAY INTO OBJECT/VEHICLE 74	OFF LEFT BEND INTO OBJECT/VEHICLE 84	STRUCK RAILWAY XING FURNITURE 94
5	WALKING WITH TRAFFIC 5	RIGHT-RIGHT 15	THRU LEFT 25	Vehicles in parallel lanes LANE SIDE SWIPE 35	REVERSING 45	PULLING OUT REAR END 55	PERMANENT OBSTRUCTION 65	OUT OF CONTROL ON CARRIAGEWAY 75	OUT OF CONTROL ON CARRIAGEWAY 85	ANIMAL OFF CARRIAGEWAY 95
6	FACING TRAFFIC 6	LEFT-RIGHT 16	LEFT LEFT 26	LANE CHANGE RIGHT 36	REVERSING INTO FIXED OBJECT 46	U TURN 56	TEMPORARY ROADWORKS 66	LEFT TURN 76		PARKED CAR RAN AWAY 96
7	DRIVEWAY 7	THRU-LEFT 17	U TURN 27	LANE CHANGE LEFT 37	LEAVING DRIVEWAY 47		TEMPORARY OBJECT ON CARRIAGEWAY 67	RIGHT TURN 77		VEHICLE MOVEMENTS NOT KNOWN 97
8	ON FOOTWAY 8	RIGHT-LEFT 18		RIGHT TURN S/S 38	LOADING BAY 48					
9	STRUCK WHILE BOARDING OR ALIGHTING 9	LEFT-LEFT 19		LEFT TURN S/S 39	FROM FOOTWAY 49		ON CARRIAGEWAY 69			
	OTHER 98	OTHER 10	OTHER 20	OTHER 30	OTHER 40	OTHER 50	OTHER 60 (MISSILE/ FLYING OBJECT)	OTHER 70	OTHER 80	OTHER 90

ROAD USER MOVEMENT CODE	Number of Crashes by Year						Severity					Surface			Light Condition						Day of Week							Time of Day								
	2007	2008	2009	2010	2011	Total	Fatal	Hospital	Medical	PDO Major	PDO Minor	Dry	Wet	Not Specified	Day	Dusk/Dawn	Dark Lights On	Dark Lights Off	Dark No Lights	Not Specified	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	0000 - 0259	0300 - 0559	0600 - 0859	0900 - 1159	1200 - 1459	1500 - 1759	1800 - 2059	2100 - 2359	Not Specified
10 Series : INTERSECTION																																				
11 - Thru - Thru	2	2				4			1	2	1	4			2					1	1	1			1	1					2	1		1		
10 Series Total	2	2				4			1	2	1	4			2					1	1	1			1	1					2	1		1		
20 Series : VEHICLES FROM OPPOSING DIRECTIONS																																				
22 - Thru - Right	4	2	2			8		2	1	4	1	8			3		5					1	2			3	2			1		1		4	2	
20 Series Total	4	2	2			8		2	1	4	1	8			3		5					1	2			3	2			1		1		4	2	
30 Series : VEHICLES FROM ONE DIRECTION																																				
30 - Other			1			1					1	1			1									1									1			
31 - Same Lane Rear End	1	1	1	4		7			1	3	3	5	1	1	4	1	1			1	1	1			4		1				1	2	2	2		
32 - Same Lane Left Rear	2					2			1		1	2			2						1			1						1		1				
33 - Same Lane Right Rear	1				1	2			1	1		2			2						1				1							1	1			
35 - Parallel Lanes - Sideswipe					1	1					1	1			1												1					1				
30 Series Total	4	1	2	4	2	13			3	4	6	11	1	1	10	1	1			1	3	1		2	5		2			1	1	5	4	2		
70 Series : OFF PATH, ON STRAIGHT																																				
74 - Off Right Away Obj			1	1		2				2		1	1				2									1	1		1						1	
77 - Right Turn - Hit		1				1				1		1			1										1						1					
70 Series Total		1	1	1		3				3		2	1		1		2								1	1	1		1		1				1	
All RUM Codes	10	8	5	5	2	28	0	2	5	13	8	25	2	1	17	1	8	0	0	2	4	3	2	2	7	5	5	0	1	2	4	7	4	7	3	0

Crash Grouping		RUM Codes	This Study Area (%)	Network Average	Flag
Crash Nature	Rear End	31,32,33,55,61,62	43	24	Over-represented
	Head On	21,51	0	0	
	Sideswipe Opposite Dirn	23,24,25,26	0	0	
	Sideswipe Same Dirn	34,35,36,37,38,39,42,53,54,64	4	8	
	Right Angle	10,11,12,13,14,15,16,17,18,19,47,48,49	14	41	Significantly under-represented
	Right Turn Thru	22,27	29	8	Significantly over-represented
	Hit Pedestrian	01,02,03,04,05,06,07,08,09,98	0	1	
	Hit Animal	69,95	0	0	
	Hit Object	70,72,74,76,77,80,82,84,94	7	13	
	Non Collision	52,70,71,73,75,76,77,80,81,83,85	4	1	
	Not Known		0	4	
Lighting	Daylight		61	71	Under-represented
	Dawn Or Dusk		4	5	
	Dark - Street Lights On		29	1	Significantly over-represented
	Dark - Street Lights Off		0	19	Under-represented
	Dark - Street Lights Not Provided		0	1	
	Not Known		7	3	
Grade	Level		64	71	
	Crest Of Hill		0	18	Under-represented
	Slope		25	3	Significantly over-represented
	Not Known		11	8	
Road Condition	Wet		7	18	Under-represented
	Dry		89	79	Over-represented
	Not Known		4	3	
Crash Severity	Fatal		0	0	
	Hospital		7	5	
	Medical		18	14	
	PDO Major		46	62	Under-represented
	PDO Minor		29	19	Over-represented
Alignment	Curve		7	14	
	Straight		71	72	
	Not Known		21	14	

Note: Use the comparison of crash patterns at a selected site with network average values as a rough indicator of problems at a location. Moderate variances between the figures should not be given undue weight, as the crash population is generally very small for intersections or small roads.

In Crash Tool, a variance of less 10 is not flagged. A variance between 10 and 19 is flagged as "Under-represented" or "Over-represented". A variance of 20 or more is flagged as "Significantly under-represented" or "Significantly over-represented"

For selections of fewer than 6 crashes, Crash Tool will not provide a flag.

Crash Cost Savings Category	Nature – Built Up
Year	2012
Discount Rate (usually 5% for Black Spot)	5

Countermeasure : Indented left turn slip (give way, stop or signal control)

Approach Leg : West

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	PV
Capex -=	110000																					
Opex -=		350	350	350	350	350	350	350	350	350	350											
Crash Cost Savings		40768	40768	40768	40768	40768	40768	40768	40768	40768	40768											

Countermeasure : Traffic signal: Overhead mast arms

Approach Leg : North & South

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	PV
Capex -=	35000																					
Opex -=		5000	5000	5000	5000	5000	5000	5000	5000	5000	5000											
Crash Cost Savings		49665	49665	49665	49665	49665	49665	49665	49665	49665	49665											

MCM BCR	3.75
MCM NPV	511994.92

Intersection Crash Ranking
Interactive Report

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* denotes a result higher than expected. Some categories may overlap, eg: some crashes may have occurred both at night and in the wet.

L = Local Road
S = State Road

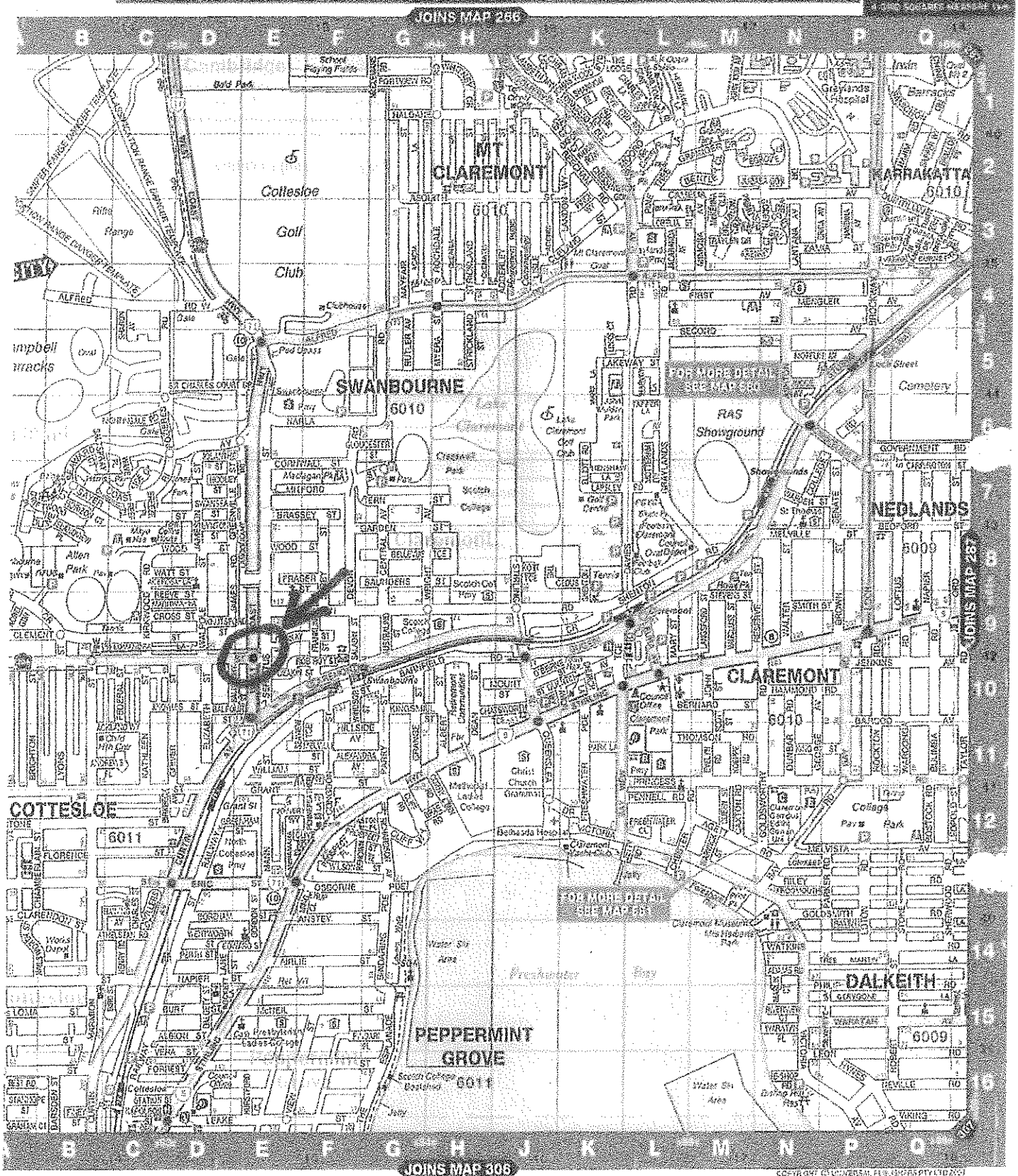
State Frequency Rank No. 826 State Cost Rank No. 856 Intersection No. 51673

Summary of Intersection Crashes

Street 1	WEST COAST HWY	Authority Name	COTTESLOE (T)
Street 2	NORTH ST	Region	METROPOLITAN
Street 3		Cost	$1,290,766
Intersection Classification	State and Local Roads	Total Crashes	28

Crash Details

Rear End	Side Swipe	Right Angle	Right Thru	Wet	Night	Ped	Cycle	Truck	Motorcycle	Casualty
11	1	4	8	2	9	0	0	0	1	7



PRESS POST BOX
TE STATION
LF COURSE
RCES
SPITAL
TEL
INFORMATION CENTRE
LIBRARY
LOOKOUT 180 , 360
MASONIC CENTRE
MEMORIAL / MONUMENT
MOTEL
ONE-WAY TRAFFIC ROUTE
PICNIC AREA
PLACE OF WORSHIP
PLAYGROUND
POLICE STATION
POST OFFICE
ROUNDABOUT
SCHOOL - PRIVATE
SCHOOL - PUBLIC
SCOUTS
SERVICE STATION
SHOPPING CENTRE
SWIMMING POOL
TELEPHONE
TOILETS
TRAFFIC LIGHT
WEIGHBRIDGE
WINERIES