Parkes Way Widening

RoadsACT

7 May 2010

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# PSP Design Report

## Parkes Way Widening (Glenloch Interchange to Edinburgh Avenue)

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Prepared for

RoadsACT

Prepared by

**AECOM Australia Pty Ltd**
Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia
T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com
ABN 20 093 846 925

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# Executive Summary

Parkes Way is an existing road in Canberra that suffers from congestion problems. Roads ACT has enlisted AECOM to investigate upgrade works involving the widening of Parkes Way.

The proposed road widening into the existing median will provide an additional lane each way on Parkes Way between Glenloch Interchange and Edinburgh Avenue and includes widening of the Clunies Ross Street and Sullivans Creek bridges. Through the Acton Tunnel the compulsory left-turn lane is utilised as the 3rd lane and a new left-turn slip lane to Edinburgh Avenue is provided.

The signalisation of the intersection of the entry ramps to Commonwealth Avenue from the Parkes Way and London Circuit is included in the works.

The design standards selected for the project and adopted in subsequent road design are dictated by the existing design which is generally for an 80 km/h design standard. Bridge widening works will conform to current standards for SM 1600 loadings. The existing structures are yet to be checked for SM 1600 loadings.

Given the long lengths of widening, this PSP report is broken down into four segments to clearly outline the constraints imposed by the existing geometry along the Parkes Way and subsequent changes resulting from the proposed widening. The four segments along the Parkes Way are as follows:

- Glenloch Interchange to Black Mountain Peninsula;
- Black Mountain Peninsula to Clunies Ross Street;
- Clunies Ross Street to Acton Tunnel; and
- Acton Tunnel to Edinburgh Avenue.

The residual median between the Glenloch Interchange and Clunies Ross Street will be 4.2 m. A wire rope barrier will be installed in the median and the surface paved to minimise maintenance requirements.

Between Clunies Ross Street and Edinburgh Avenue the existing guardrail arrangement will be retained albeit on the realigned kerb line.

Street lighting between the Glenloch Interchange and Clunies Ross Street will be relocated from the median to the verges.

Bridges at Clunies Ross Street and Sullivans Creek will be widened by 3.2 m. There are two superstructure options for the widening at Clunies Ross Street whilst at Sullivans Creek the existing form of the superstructure and substructure will be replicated.

There are minimum impacts on existing utility services.

Traffic analyses have been undertaken to determine peak volumes along Parkes Way along with the potential to signalise the Parkes Way entry ramp to Commonwealth Avenue.

The pavement profile adopted for the proposed widening is a flexible pavement with a thin asphaltic concrete surfacing course. The cost estimate has assumed the need for a select fill layer in the pavement profile

The probable cost for the proposed works is $ 17.4 M.

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# 1.0 Introduction

## 1.1 Background

The developments either planned or under discussion over the next twenty years will increase the road network demand in Canberra. A significant proportion of these developments are located close to the centre of the Canberra metropolitan area. It will impact the current major transport corridor that extends from the proposed district of Molonglo to the Canberra Airport/NSW border known as East West Corridor. The East West Corridor transportation study under taken by AECOM provides the recommendation for a more detailed investigation for adding an additional lane each way on Parkes Way between Glenloch Interchange and Edinburgh Avenue.

AECOM were engaged by RoadsACT to undertake the PSP design documentation for the upgrade works from Glenloch Interchange to Edinburgh Avenue.

## 1.2 Preliminary Sketch Plan

This Preliminary Sketch Plan (PSP) report provides an overview of the concept design works undertaken by AECOM. It outlines the design objectives and the principles of the Parkes Way widening design. The documentation described within this report and the associated drawings defines the scope and probable construction cost of the works.

## 1.3 Scope of Works

The scope of works includes the following works:

- Widening Parkes Way in both directions from the eastern side of the Glenloch Interchange to Clunies Ross Street by using part of the existing median to provide the additional lanes;
- Widening Parkes Way at the Clunies Ross Street twin bridges by construction of extensions to the median side of the bridge decks using super tee girders supported on new piers and extended abutments;
- Widening Parkes Way at the Sullivans Creek bridge by extensions to the median side of the bridge decks by constructing a new cast insitu post tensioned box girder supported on new piers and extended abutments;
- Modifying the Clunies Ross Street ramps to match the road widening works;
- Widening Parkes Way eastbound within the median from the Acton Tunnel to east of the Edinburgh Avenue overpass,
- Modifying the Edinburgh Avenue off-ramp to replace the present compulsory right-turn lane which will now form the 3rd lane; and
- Adding signal controls to the intersection of the on-ramp from Parkes Way to Commonwealth Avenue southbound with the on-ramp from London Circuit to Commonwealth Avenue southbound.

No modifications are proposed to the westbound carriageway on-ramp from Edinburgh Avenue, i.e. the lane from the ramp remains as the added 3rd lane.

## 1.4 Project Inputs and Assumptions

The PSP design is based upon available information, including:

- Information gathered during site visits;
- Location of services (supplied in CAD/ DWF format by service authorities);
- Liaison with services authorities;
- Detailed field survey;
- Peak hour traffic surveys provided by Roads ACT to establish a SIDRA model of the intersection;
- Liaison with TaMS tree unit; and
- Comments on intersection layout from Client.

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# 2.0 Design Standards

## 2.1 Introduction

The design standards selected for the project and adopted in subsequent road and bridge design comply with the provisions detailed within the standards and guidelines listed below.

## 2.2 Design Standards

- Design Standards for Urban Infrastructure
- ACTEW Water Supply and Sewerage Standards
- AUSTROADS – Urban Road Design – Guide to Geometric Design of Major Urban Roads
- AUSTROADS – Part 5 Intersections at Grade – Guide to Traffic Engineering Practice
- AUSTROADS – Part 2 Intersections
- AUSTROADS – Part 14 Bicycles
- RTA – Road Design Guide
- SAA – AS 5100 Bridge Design Code

## 2.3 Previous Studies

The traffic study underpinning the warrant for the proposed widening of Parkes Way is the East to West Corridor Study which was undertaken 12 months ago. This study can be referred to for further details.

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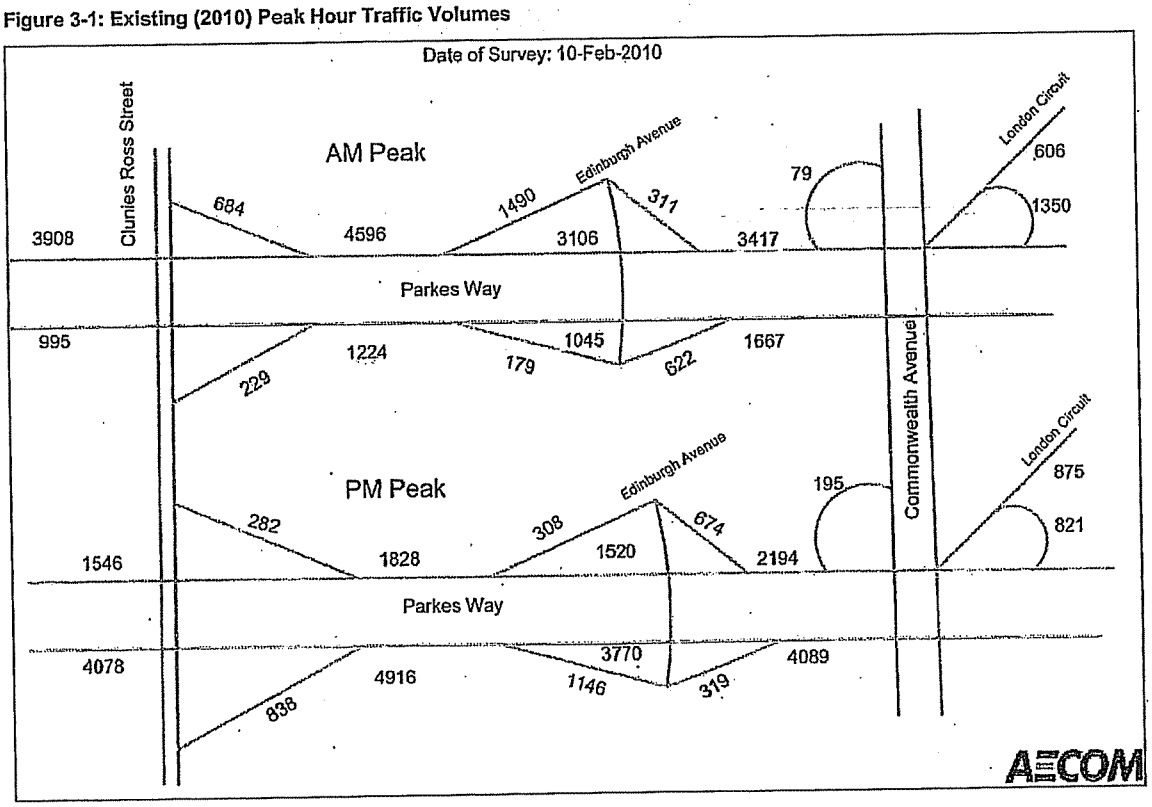
# 3.0 Road Capacity Analysis

## 3.1 Introduction

Capacity analyses were undertaken using 2010 and 2021 estimates of traffic volumes. The 2010 volumes were obtained from a recent survey of the section of Parkes Way being considered for widening, as well as the Parkes Way exit-ramp at Commonwealth Avenue and London Circuit East.

The results of the 2010 survey are summarised in Figure 3-1. Estimates of 2021 volumes were derived from the EMME modelling work done as part of the East West Corridor Study.

**Figure 3-1: Existing (2010) Peak Hour Traffic Volumes**




## 3.2 Midblock Capacity Analysis

"Level of Service" (LOS) is a measure to determine the operational conditions and efficiency of a roadway or intersection. The definition of LOS generally describes the operating conditions in terms of speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, and road safety. There are six levels of service, A to F, with LOS A representing optimum operating conditions (free flow) and LOS F the poorest (forced or breakdown in flow).

Midblock capacity analysis was done based on the updated AustRoads, Guide to Traffic Management, Part 3: Traffic Studies and Analysis, 2009 and the Highway Capacity Manual (2000) using calculation methods for basic freeway segments.

Table 3-1 to Table 3-3 summarise the results of the AM peak hour midblock level of service analyses for the section of Parkes Way being considered in this study, for the years 2010 (existing) and 2021 respectively. This indicates that Parkes Way is already congested in the AM peak and will continue to be congested in the future.

**Table 3-1 Volume Capacity Ratio – Parkes Way**

| Road | Section | # lanes | dir of dir 1 | V/C Dir 1 | | V/C Dir 2 | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 2010 | 2021 | 2010 | 2021 | 2010 | 2021 |
| Parkes Way | Glenloch Int-Clunies Ross | 2 | east | 1.12 | 1.03 | 0.28 | 0.34 | 1.12 | 1.03 |
| Parkes Way | Acton Tunnel | 3 | east | 1.31 | 1.07 | 0.32 | 0.38 | 1.31 | 1.07 |
| Parkes Way | under Edinburgh Av bridge | 2 | east | 0.89 | 0.76 | 0.30 | 0.38 | 0.89 | 0.76 |

**Table 3-2 Midblock LoS - 2010**

| Road | Section | # lanes | Peak Hr Direct 1 | LoS1 | Peak Hr Direct 2 | LoS2 |
|---|---|---|---|---|---|---|
| Parkes Way | Glenloch Int-Clunies Ross | 2 | 3908 | F | 995 | C |
| Parkes Way | Acton Tunnel | 3 | 4596 | F | 1107 | A-B |
| Parkes Way | under Edinburgh Av bridge | 2 | 3106 | F | 1045 | C |

**Table 3-3 Midblock LoS – 2021 (No Works)**

| Road | Section | # lanes | Peak Hr Direct 1 | LoS1 | Peak Hr Direct 2 | LoS2 |
|---|---|---|---|---|---|---|
| Parkes Way | Glenloch Int-Clunies Ross | 2 | 4859 | F | 1183 | D |
| Parkes Way | Acton Tunnel | 3 | 5316 | F | 1335 | C |
| Parkes Way | under Edinburgh Av bridge | 2 | 3579 | F | 1331 | D |

A key observation from these results is that the capacity of Parkes Way needs to be increased, by widening the road. Table 3-4 shows the midblock level of service with the proposed widening. There is no widening of Acton Tunnel, so it will still exhibit some congestion when Parkes Way is widened.

**Table 3-4 Midblock LoS – 2021 (With Widening)**

| Road | Section | # lanes | Peak Hr Direct 1 | LoS1 | Peak Hr Direct 2 | LoS2 |
|---|---|---|---|---|---|---|
| Parkes Way | Glenloch Int-Clunies Ross | 3 | 4859 | D | 1183 | A-B |
| Parkes Way | Acton Tunnel | 3 | 5019 | D | 1335 | C |
| Parkes Way | under Edinburgh Av bridge | 3 | 3579 | C | 1331 | C |

## 3.3 Merge and Weaving

An analysis of the capacity of freeway ramps and weaving areas on Parkes Way was undertaken using procedures in the Highway Capacity Manual. The capacity of the ramps is determined from the worst level of service provided by either:

- The ramp proper
- The merge/diverge area to/from the ramp
- The section of freeway adjacent to the ramp

The results of the AM peak hour analyses of freeway ramps are summarised in Table 3-5 and Table 3-6, for the years 2010 and 2021 respectively. This analysis identified capacity problems eastbound on Parkes Way in the

weaving section between the on-ramp from Clunies Ross Street and the off-ramp to Edinburgh Avenue in the AM peak. Similar problems may exist in the reverse direction in the PM peak on the Lawson Crescent off ramp onto Parkes Way (westbound).

**Table 3-5 Level of Service – Existing Weaving Sections on Parkes Way**

| Parkes Way Eastbound (Clunies Ross Street ON ramp – Edinburgh Avenue OFF ramp) | | Parkes Way Westbound (Lawson Crescent ON ramp and Lady Denman Drive OFF ramp) | |
|---|---|---|---|
| 2010 | 2021 | 2010 | 2021 |
| F | F | A | B |

Future analysis of the Clunies Ross Street ON ramp onto Parkes Way (EB) was also undertaken for the future as a merge instead of continuous lane. The results from that analysis are shown in Table 3-6. It shows that traffic from Clunies Ross Street will still have difficulty merging with eastbound Parkes Way traffic in the AM peak, although this traffic would not need to perform a weaving movement. There would be further congestion through Acton Tunnel and at the merge east of Edinburgh Avenue.

**Table 3-6 Level of Service – Future Merge Segments on Parkes Way (with widening)**

| Parkes Way Eastbound (Clunies Ross Street ON ramp) | |
|---|---|
| 2010 | 2021 |
| E | E |

## 3.4 Parkes Way to Commonwealth Avenue Entry Ramp

### 3.4.1 Options for Ramp

A SIDRA analysis of the Parkes Way off ramp onto Commonwealth Avenue was also undertaken as a part of this study, to help determine the design and impact of signal metering at the ramp junction with London Circuit East. The results from the analysis for the existing conditions are shown in Table 3-7, based on the give-way arrangement shown in Figure 3-2.

**Figure 3-2 Intersection - Parkes Way OFF ramp / London Circuit OFF ramp**

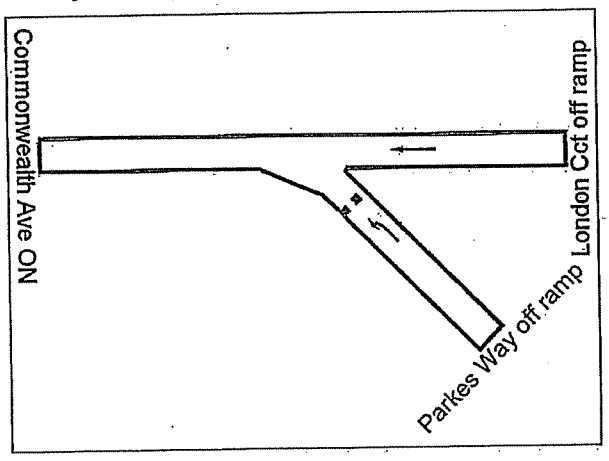


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**Table 3-7 SIDRA Results - Parkes Way OFF ramp / London Circuit OFF ramp GIVEWAY**

| Approach | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|---|---|---|---|---|
| Parkes Way off ramp | 1.106 | 117.3 | F | 788 |
| London Cct off ramp | 0.327 | 0.0 | A | 0 |
| Total | 1.106 | 80.9 | | 788 |

The results from SIDRA analysis demonstrate the current situation at the intersection in the morning peak, in which the queuing on Parkes Way ramp extents up to 800 metres on Parkes Way therefore blocking the traffic coming from Commonwealth Avenue off ramp on to Parkes Way.

An alternative ramp arrangement with traffic signals controlling movements at the ramp junction was tested. This included some localised widening near the ramp junction to create two lanes across the stop line from the Parkes Way ramp, as shown in Figure 3-3. The analyses were based on a short cycle time (20sec) for the signals. This resulted in manageable queue of 97m on the Parkes Way ramp, which is less than half the length of the ramp.

**Table 3-8 SIDRA Results - Parkes Way OFF ramp / London Circuit OFF ramp SIGNALS– AM Peak**

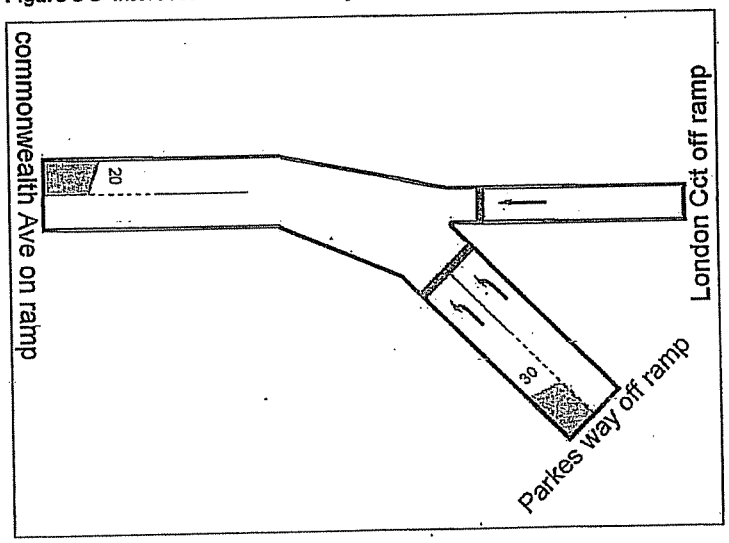
| Approach | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|---|---|---|---|---|
| Parkes Way off ramp | 0.922 | 21.6 | B | 97 |
| London Cct off ramp | 0.787 | 2.3 | A | 32 |
| Total | 0.922 | 15.6 | B | 97 |

Note: Based on layout shown in Figure 3-3.

**Table 3-9 SIDRA Results - Parkes Way OFF ramp / London Circuit OFF ramp SIGNALS– PM Peak**

| Approach | Deg of Satn (v/c) | Aver Delay (sec) | Level of Service | 95% Back of Queue (m) |
|---|---|---|---|---|
| Parkes Way off ramp | 0.809 | 23.4 | B | 67 |
| London Cct off ramp | 0.803 | 5.0 | A | 71 |
| Total | 0.809 | 13.9 | A | 71 |

**Figure 3-3 Intersection - Parkes Way OFF ramp / London Circuit OFF ramp – Signalised with extra lane**



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# 4.0 Existing Condition Analysis and Proposed Widening Constraints and Opportunities

The project has been divided into four sections for the purpose of analysing the design standards adopted when the road was designed and built in the late 1970s and the impacts the widening has on the existing road and associated infrastructure.

## 4.1 Glenloch Interchange to Black Mountain Peninsula

### 4.1.1 Existing conditions

#### 4.1.1.1 Horizontal Geometry

This section across the Black Mountain escarpment has a combination of curve radii beginning with 635 m (westbound) and 530 m (eastbound) left-hand curves at the west end and then two right-hand compound curves of 1800 m and 1020 m radius respectively.

In the eastbound direction the two right-hand curves have a 3% adverse crossfall which has created safety issues in the past during winter due to ice forming as a result of heavy dew or frost, or following rainfall. The road in this location does not receive the full benefit of early sun due to its low elevation and the shading created by Black Mountain; hence the icy conditions remain during the peak hours. The condition is further exacerbated by the 0.5% longitudinal gradient on the road.

The situation has been alleviated by a bituminous seal over the earlier asphaltic concrete surface to create a greater texture depth in the surface as a method of improving skid resistance.

#### 4.1.1.2 Vertical geometry

The crest vertical curves at the Glenloch Interchange end of the work provide the following design speeds.

i) Eastbound

The crest vertical curve at the start of the widening proposed where the existing 3 lanes merge into 2 lanes has a stopping sight distance equivalent to 80 km/h for cars and 85 km/h for trucks.

ii) Westbound

The crest vertical curve at the end of the widening proposed where the existing 2 lanes continue to William Hovell Drive and the exit lane to the Tuggeranong Parkway commences, has a stopping sight distance equivalent to approximately 80 km/h for cars and 85 km/h for trucks.

The existing diverge taper for the Tuggeranong Parkway exit ramp commences on the crest of the vertical curve and is difficult to detect for approaching traffic.

iii) Longitudinal Grading

A gradient of 0.5% connects the western end of the escarpment to a low point located prior to the rising grade of 5.7% to the Black Mountain Peninsula.

#### 4.1.1.3 Cross section

The existing cross section within this section is generally as follows for the eastbound and westbound carriageways:

- 2 x 2.7 m wide traffic lanes
- 3.0 m wide shoulder

The median separating the carriageways is 10.4 m wide measured face to face of the mountable kerb and gutter.

The Lady Denman Drive roadway embankment lies beyond the 3.0 m shoulder on the westbound carriageway and the steep Black Mountain escarpment within the Nature Park abuts the shoulder of the eastbound carriageway.

#### 4.1.1.4 Geometric Deficiencies

Deficiencies in the present design relate to:

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- Adverse crossfall on the eastbound carriageway pavement. AUSTROADS recommends the following speed/curve radii relationships for curves with adverse crossfall.
  - 80 km/h: 1250 m
  - 90 km/h: 1700 m
  - 100 km/h: 2250 m

  Of these compound curves the 1800 m radius meets a 90 km/h design speed. The second portion of the compound curve is only suitable for an 80 km/h design speed.
- Vertical curves on the east side of the Glenloch Interchange at the limit of the proposed widening work.

  Provided that the posted speed does not change to 90 km/h (eastbound) until after the merge between Belconnen and Tuggeranong traffic the AUSTROADS design criteria is met.

  Similarly for westbound traffic the 80 km/h posted speed should remain prior to the crest vertical curve approaching the Glenloch Interchange for AUSTROADS Guidelines to be met.

### 4.1.2 Proposed works

#### 4.1.2.1 Carriageway Widening to Form 3 Lanes

The widening of the carriageway to accommodate the extra lane will occur in the median due to the constraints identified in section 4.1.2.2.

By narrowing the existing 3.7 m wide lanes from 3.7 m to 3.5 m the resulting widening into the median is 3.1 m for each carriageway with a residual median width of 4.2 m.

The narrowed median will be flanked by semi-mountable kerbs which do not require any offsets from the edge of traffic lane to the kerb face for design speeds up to 100 km/h.

#### 4.1.2.2 Median form

The narrowed median will require:

- Paving to eliminate maintenance requirements in this relatively narrow strip and problematic safety issues for maintenance personnel that would be associated with a vegetation solution.
- Wire rope barriers over the total length. A post spacing of 2.5 m can be adopted given the 2.1 m clearance to the traffic lane which is acceptable for speeds up to 100 km/h.
- Relocation of the existing street lighting columns to the verges.

#### 4.1.2.3 Line marking

The carriageways will require remarking to account for the narrowing of the lanes to 3.5 m. This will affect the present lane line separating the existing two lanes.

#### 4.1.2.4 Street lighting

The existing twin arm street lights will need to be relocated to the verges as single arm columns.

Give the steep sloping areas of the Black Mountain escarpment and the 1 in 1 batter on the Lady Denman Drive embankment the new light columns will need bases scalloped into the aforementioned batters.

Street light electrical cables will require installation at the edge of the existing paved shoulder requiring the reinstatement of trenches and pavement finishes. On the Black Mountain side the existing concrete formed high-capacity table drain will need to be cut through and reinstated following the installation of the cabling.

#### 4.1.2.5 Stormwater drainage

In this section the majority of the stormwater drainage sumps are located at the edge of the shoulder and hence are not affected by the works.

Notwithstanding there are several sumps on the median edge of the westbound carriageway which will need to be relocated to the new median kerb line together with their collector pipes.

The existing pavement edge sumps and collector pipework which are connected to transverse drainage lines discharging into Lake Burley Griffin are not affected by the works.

Subsoil drains at the existing median will require replacing and new subsoils installed at the interface between the new and existing pavements.

In later stages of the design development checks will need to be made on the capacity and therefore the spacing of the existing sumps with respect to:

- Requirements for minimising water spread beyond the shoulder and onto traffic lanes;
- Aquaplaning due to additional water flowing across the carriageway from the additional paved area; and
- Potential icing management using an appropriately sized sealing aggregate, particularly on the curved sections of the road with adverse crossfall.

## 4.2 Black Mountain Peninsula to Clunies Ross Street

### 4.2.1 Existing conditions

#### 4.2.1.1 Horizontal Geometry

The horizontal curves leading up onto the Black Mountain Peninsula and around to Clunies Ross Street consist of a 310 m radius left-hand curve followed by a 420 m radius right-hand curve. Both of these curves have 3% superelevation.

These radius curves equate to 75 km/h and 83 km/h design speeds respectively adopting the linear distribution of 'f' (friction) for 'e' (superelevation) of 5% maximum.

#### 4.2.1.2 Vertical Geometry

The crest vertical curve at Black Mountain Peninsula has a stopping sight distances equivalent to approximately 80 km/h for cars and 85 km/h for trucks whilst the crest curve approaching Clunies Ross Street has stopping sight distance equivalent to approximately 90 km/h for cars and 95 km/h for trucks.

The gradients in this section range from 5.7% on the eastern approach to the Black Mountain Peninsula to 1.95% approaching the vertical curve near Clunies Ross Street.

A sag vertical curve is located at about the midpoint of this section.

#### 4.2.1.3 Cross section

The cross section is generally as noted in section 4.1.1.3 the exception being the interface with Lady Denman Drive which changes from being above Parkes Way to below Parkes Way with steep batters approaching slopes of 2 (horizontal) and 1 (vertical). A narrow verge flanked by G4 type guardrail separates the westbound carriageway from the road embankment batters.

#### 4.2.1.4 Geometric deficiencies

The geometric deficiencies in this section relate to the:

- Posted speed limit of 90 km/h being in excess of the AUSTROADS guidelines for the Black Mountain Peninsula crest vertical curve; and
- Posted speed limit of 90 km/h being in excess of the AUSTROADS guidelines for both horizontal curves.

### 4.2.2 Proposed works

#### 4.2.2.1 Carriageway widening to Form 3 Lanes

The work is identical to that outline in section 4.1.2.1.

#### 4.2.2.2 Median Form

The work is identical to that outline in section 4.1.2.2.

It should be noted that the installation of the wire rope barrier in the median in this Section will limit stopping sight distances as follows

i) Eastbound

- 310 m radius curve: 100 m (equivalent to 75 km/h design speed; cars and 68 km/h design speed; trucks)

- 420 m radius curve: 115 m (equivalent to 80 km/h design speed; cars and 70km/h design speed; trucks)

Offsetting the wire rope barrier to the 1.5 m minimum from the kerb line marginally increases the sight distance (+5%).

#### 4.2.2.3 Line marking

The work is identical to that outline in section4.1.2.3.

#### 4.2.2.4 Streetlighting

The work is generally similar to that outlined in section 4.1.2.4, the exception being the lighting columns on the westbound carriageway verge will need to be located behind the guardrail.

#### 4.2.2.5 Stormwater drainage

The work is generally similar to that outlined in section 4.1.2.5, the exception being:

- There are a greater number of sumps located at the median edge of the carriageway which will require relocation along with the connecting pipe network; and
- Issues associated with icing is not applicable in this section.

## 4.3 Clunies Ross Street to Acton Tunnel

### 4.3.1 Existing conditions

#### 4.3.1.1 Horizontal Geometry

Between Clunies Ross Street and the Acton Tunnel horizontal curves vary from 400 m to 550 m (at the Acton Tunnel) in radius.

Both of these curves have superelevations of 3%.

These radii and superelevations equate to design speeds of 85 km/h and 88 km/h adopting the linear distribution of 'f' (friction) for 'e' (superelevation) of 5% maximum.

#### 4.3.1.2 Vertical Geometry

The vertical geometry in this section commences with a -2.25% gradient at Clunies Ross Street reducing to 0.7% at Sullivans Creek. This latter grading continues through the Acton Tunnel.

Apart from the sag vertical curve west of Sullivans Creek there are no other vertical curves in this Section.

#### 4.3.1.3 Cross section

The carriageway widens from 2 lanes to 3 lanes on the east side of Sullivans Creek which is a result of the entry ramp from Clunies Ross Street joining the eastbound carriageway.

On the westbound carriageway a 3rd add-on lane commences at the Edinburgh Avenue interchange entry ramp and continues through to Clunies Ross Street where it becomes a compulsory exit ramp to Clunies Ross Street.

Both carriageways in the 3 lane section are configured as follows:

- 3 x 3.7 m wide traffic lanes
- 3.0 m wide left-hand shoulder
- 1.2 m wide right-hand shoulder

Within the 2 lane section between Clunies Ross Street and Sullivans Creek the configuration is:

- 2 x 3.7 m wide traffic lanes
- 3.0 m wide left-hand shoulder
- 1.2 m wide right-hand shoulder

The ramps to and from Clunies Ross Street have:

- 3.7 m wide traffic lane

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- 1.8 m wide shoulder

The median width varies in this section commencing with 10. 2 m at Clunies Ross Street; 15.4 m (and varies) at Sullivans Creek; and 4.8 m at the approach to the Acton Tunnel.

#### 4.3.1.4 Geometric deficiencies

Apart from the horizontal curves as noted in section 4.3.1.1 being less than the posted speed limit there are no other deficiencies in this section.

### 4.3.2 Proposed works

#### 4.3.2.1 Carriageway Widening to Form 3 Lanes

The widening to 3 lanes will occur in the median between Clunies Ross Street and Sullivans Creek.

Beyond Sullivans Creek on the eastbound carriageway the widening in the median will taper and merge into the existing median width approximately 250 m west of Acton Tunnel.

On the westbound carriageway the widening also joins the existing median opposite that of the eastbound carriageway.

The widening described above together with the existing 3 lanes formed by the on ramp commencing at Clunies Ross Street (eastbound) and Edinburgh Avenue (westbound) enables the 3 lanes between Clunies Ross Street and the Acton Tunnel to be formed, i.e. the existing compulsory left-turn lanes will form the 3rd lane.

The entry and exit ramps at Clunies Ross Street will be reconfigured to join/depart the main carriageways respectively as ramps with merging/diverging tapers rather than the present lane-adds and lane-drops.

The ramp merge/diverge tapers are designed for 100 km/h design speed on Parkes Way and are largely formed by linear line markings and chevrons rather than new kerb lines.

The 1.2 m wide sealed shoulder will be maintained on the right-hand side of each carriageway as required by the location of the barrier kerb and guardrail.

#### 4.3.2.2 Median Form

The existing median is flanked by barrier kerbs with G4 guardrail aligning with the kerb face.

The kerb and guardrail will be removed and the additional pavement extended by 3.1 m into the variable width median.

It is intended that the barrier kerb and guard rail be reinstated on the new edge of the median given the need to join with the existing guardrail flanking the 4.8 m wide median at the approaches to the Acton Tunnel.

Part of the vegetation in the median will need to be removed and replaced with low maintenance shrub planting within mulched beds to remove the need for regular access for mowing the grass.

#### 4.3.2.3 Linemarking

The linemarking will require adjustment to suit the new configured lane and merge/diverge arrangements, new lane lines, and edge lines on both shoulders.

#### 4.3.2.4 Streetlighting

The existing streetlighting is located on the verges and hence will not require relocation.

However, in the next phase of the design lighting levels will need to be verified given the wider pavements, i.e. exceeding 3 lanes in the areas of ramp entries and exits.

#### 4.3.2.5 Stormwater drainage

In areas of superelevation where the sumps are located on the median edge the sumps and connecting pipe systems will require relocation to within the median.

As in sections 4.1 and 4.2 the drainage flow paths with the widened pavement will need to be verified as the design develops to ensure conditions with a build-up of water film on the pavement surface does not result in the creation of aquaplaning conditions.

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## 4.4 Acton Tunnel to Edinburgh Avenue

### 4.4.1 Existing conditions

#### 4.4.1.1 Horizontal Geometry

The horizontal curve in the tunnel is a 550 m radius left-hand curve with superelevation of 3%. This radius, when evaluated with AUSTROADS Guidelines equates to a design speed of 88 km/h adopting the linear distribution of 'f' (friction) for 'e' (superelevation) of 5% maximum.

The horizontal stopping sight distance on the westbound carriageway is controlled by the central wall of the tunnel. The available distance is 115 m which equates to a design speed of approximately 80 km/h for cars and 70 km/h for trucks.

On the eastbound carriageway the shoulder increases the sight distances to 130 m which equates to a design speed of approximately 90 km/h for cars and 80 km/h for trucks.

East of the tunnel the 550 m radius left-hand curve connects to a 450 m radius right-hand curve which has 3% superelevation and an equivalent design speed of 85 km/h adopting the aforementioned parameters.

The bridge pier at Edinburgh Avenue is the limiting factor for sight lines. A 115 m stopping sight distance is available which effectively limits speeds to approximately 80 km/h for cars and 70 km/h for trucks.

#### 4.4.1.2 Vertical Geometry

The vertical geometry in this section consists of generally flat grades of 0.5% or less.

These gradients do not impose any restrictions on sight lines.

#### 4.4.1.3 Cross section

Within Acton Tunnel the cross section of each carriageway is:

- 3 x 3.7 m wide traffic lanes; one lane being the Edinburgh Avenue exit ramp;
- 3.0 m wide left-hand shoulder; and
- 1.2 m wide right-hand shoulder.

East of the tunnel the cross section is the same, however; at the exit ramp gore the right-hand shoulder decreases to 0.6 m in width at the end of the G4 guardrail and barrier kerb.

Beyond the exit ramp gore the cross section configuration is:

- 2 x 3.7 m wide lanes;
- 3.0 m wide left-hand shoulder; and
- 0.6 m wide right-hand shoulder.

The ramps to and from Edinburgh Avenue are configured as follows:

a) Exit ramp
   - 4.3 m wide traffic lane;
   - 2.5 m wide left-hand shoulder; and
   - 0.6 m wide right-hand shoulder.

b) Entry ramp
   - 3.7 m (minimum) wide traffic lane at the ramp gore area widening to two lanes 7.4 m wide at the ramp commencement at Edinburgh Avenue ; and
   - 1.8 m wide left-hand shoulder.

The median width varies from 4.8 m wide at the Acton Tunnel portal to 12.0 m at the Edinburgh Avenue overbridge.

Both edges of the median are flanked by G4 type guardrail and barrier kerbs up to the point where the median begins to widen from 4.8 m. The barrier kerb is replaced by a semi-mountable kerb east of this point which is generally coincident with the entry/exit ramp gore areas.

#### 4.4.1.4 Geometric deficiencies

As stated in Section 6.1.1 the deficiencies are limited to restrictions imposed by the horizontal alignment and flanking guardrails and the walls of the Acton Tunnel

### 4.4.2 Proposed works

#### 4.4.2.1 Carriageway widening to form 3 lanes

i) Eastbound

The widening to 3 lanes is achieved as follows:

- Tunnel section

  The existing compulsory left-turn lane to Edinburgh Avenue becomes the 3rd lane.

- East of tunnel

  A new 3.5 m wide left-turn slip lane is constructed immediately east of the tunnel portal. The lane width tapers from the full 3.5 m at this location to zero width at the point of connection to the existing construction over a distance of 150 m.

  A new 5m high retaining wall will be required to replace the existing wall which needs to be demolished as a result of the pavement widening. This wall will stone clad to match the appearance of the existing walls.

- Exit ramp gore to east of Edinburgh Avenue overbridge

  Widening of 3.1 m into the median east of the exit ramp gore achieves the 3rd lane. The 3.1 m of widening is achieved by narrowing the existing 3.7 m wide traffic lanes to 3.5 m gaining an extra 0.4 m of width on the existing pavement.

  The 0.6 m wide left-hand shoulder will be maintained and widened to 1.2 m at the Edinburgh Avenue central pier where a Type F concrete barrier will be required to protect the pier from potential damage by errant vehicles.

ii) Westbound

The existing westbound add-lane from the Edinburgh Avenue entry ramp will be maintained thus forming the 3rd lane east of this location.

Due to the constraints of the existing Acton Tunnel it is only possible to achieve a 80 km/h design speed on the merge taper for a reconfigured entry ramp joining 3 lanes developed east of the Edinburgh Avenue overbridge.

Given the resultant sub-standard merge arrangement and the volume of traffic (1,146 vehicles/hour) entering Parkes Way from Edinburgh Avenue, a decision was made in consultation with Roads ACT to maintain the present lane-add arrangement with only 2 lanes east of the entry ramp gore.

#### 4.4.2.2 Median form

The median width (eastbound) will be reduced in width by 3.1 m east of the Edinburgh Avenue exit ramp gore area. The new median edge will be flanked by semi-mountable kerbs up to and beyond the Edinburgh Avenue bridge pier.

As mentioned previously a Type F barrier will be introduced to protect the bridge pier from errant vehicles.

The grassed median will be maintained.

The required clear zone is 9.0 m and as a consequence a barrier is required where the residual median width is less than this dimension. This occurs between the Edinburgh Avenue exit ramp gore and a location approximately 100 m east of the Edinburgh Avenue overbridge.

A wire rope barrier is therefore proposed at this location linking into the G4 guardrail.

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#### 4.4.2.3 Linemarking

The linemarking will require adjustment to suit the new configured lane and merge/diverge arrangements, new lane lines, and edge lines on both shoulders.

#### 4.4.2.4 Streetlighting

The existing streetlighting is located on the verges and hence will not require relocation.

However, in the next phase of the design lighting levels will need to be verified given the wider pavements, i.e. exceeding 3 lanes in the areas of ramp entries and exits.

#### 4.4.2.5 Stormwater drainage

In areas of superelevation where the sumps are located on the median edge the sumps and connecting pipe systems will require relocation to within the median.

As in sections 4.1 and 4.2 the drainage flow paths with the widened pavement will need to be verified as the design develops to ensure conditions with a build-up of water film on the pavement surface does not result in the creation of aquaplaning conditions.

# 5.0 Bridge Widening

## 5.1 Background

In order the facilitate the widening of Parkes Way the bridges crossing Clunies Ross Street and Sullivans Creek require widening into the median. There are two options for the widening of the Clunies Ross Street bridge; a single RTA standard super tee girder and concrete deck slab or a cast insitu prestressed single box girder. Sullivans Creek bridge is to be widened using cast insitu prestressed box girders. Both structures will be supported by new and independent abutments and piers to minimise interaction with the existing structure.

To minimise the impacts on the aesthetic appearance of the new structure to traffic along Clunies Ross Street (underneath the bridge), the existing and new piers will be clad in metal sheeting all around to smoothly blend and give the appearance of one large pier. As there is virtually no traffic travelling underneath the Sullivans Creek Bridge similar measures have been deemed unnecessary for Sullivans Creek Bridge.

Both the Clunies Ross Street and Sullivans Creek bridges have not been verified for SM1600 loadings at this point in time.

## 5.2 Design Inputs

The following information has used in the design input:

- Work-as-executed drawings for Clunies Ross Street bridge;
- Work-as-executed drawings for Sullivans Creek bridge; and
- AS 5100.

## 5.3 Proposed Concept Design

### 5.3.1 Clunies Ross Street Bridge

#### 5.3.1.1 Existing Structure

The existing Clunies Ross Street bridge consists of a set of twin bridges each with a shoulder and two lanes of traffic. Each bridge is of prestressed twin box girder construction and is divided into three spans being supported by two reinforced rectangular concrete piers on either side of Clunies Ross Street below and concrete abutments at each end. Footings for both the concrete piers and abutments consist of two or three rows of raked and vertically driven steel H piles.

The handrailing on the left-hand shoulder side of the bridge will be required to be upgraded to meet cycle lane requirements.

#### 5.3.1.2 New Structure

The new bridge widening structure for the Clunies Ross Street bridge is proposed to be constructed in between the two existing twin box girder bridges. Each bridge is to be widened by approximately 3.5 m on the median side.

The widening consists of two options:

- A single 1500 deep RTA standard super tee girder and concrete deck slab. The substructure consists of new abutments and concrete piers adjacent to the existing substructure location. The new structure is to be independent, minimising interaction with the existing structure.

  To minimise the impacts on the aesthetic appearance of the new structure to traffic along Clunies Ross Street (underneath the bridge), the existing and new piers for the super tee option would be joined and wrapped by metal sheeting to smoothly blend and give the appearance of one larger pier.

- A single prestressed box girder to generally match the shape and form of the existing twin prestressed box girders. With this option the shape and form of the existing pier would be replicated.

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Pile caps will be constructed parallel along the edges of Clunies Ross Street to pick up both the eastbound and westbound piers. The top level of the pile cap will match the existing pile cap and each pile cap will be founded on rock via four bored concrete piles.

The connection between the new and existing decks will utilise a suitable longitudinal jointing system

Further investigations are required to determine the widening method given the horizontal curvature of 500 m radius of the bridges and as to whether a straight super tee option would be able to address the needs of the curvature.

### 5.3.2 Sullivans Creek Bridge

#### 5.3.2.1 Existing Structure

The existing Sullivans Creek bridge consists of a set of twin bridges, one for eastbound traffic, one for westbound traffic. Each bridge is of prestressed cast insitu box girder construction, with six girders for the eastbound carriageway and five girders for the westbound direction. The bridges are supported by concrete abutments founded with driven steel H piles and by two tapered reinforced concrete piers located approximately at third points. The tapered piers come down onto a common pile cap which is supported by steel piles driven into the creek bed below.

#### 5.3.2.2 New Structure

The new bridge widening structure for Sullivans Creek bridge is proposed to be constructed in between the two existing twin bridges. Each bridge is to be widened by between 3.1 m and 3.3 m on the median side.

The proposed structure for each widening consists of a box girder replicating the form of the existing box girders and concrete deck slab to ensure the aesthetic integrity of the new construction with the existing construction. The substructure consists of new abutments and concrete piers adjacent to the existing substructure location. The new structure is to be independent, minimising interaction with the existing structure.

The connection between the new and existing decks will utilise a suitable longitudinal jointing system.

One pile cap will be constructed below each of these new piers adjacent to the existing pile caps. The existing pile cap may need to be cut back to make room for the new structure. Each pile cap will be founded on rock via four bored concrete piles.

The new pier will match the size and form of the existing pier to ensure a continuation of the aesthetics of the existing structure.

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# 6.0 Signalisation of the Intersection of the entry ramps from Parkes Way and London Circuit to Commonwealth Avenue

The signalisation of the intersection of the entry ramps to Commonwealth Avenue from the Parkes Way and London Circuit is included in the works.

The East West corridor Study identified that queue on the ramp from Parkes Way to Commonwealth Avenue will increase with increased growth along the Parkes Way corridor primarily as a result of the development in Molonglo and also from increased demand from the GDE connection to Parkes Way at Glenloch interchange.

This report investigates and documents the findings of a scheme to signalise the intersection of these ramps as a low cost interim measure until such time as the NCA fund an interchange that connects all movements to these two arterial roads.

## 6.1 Location

The location of the study is focussed on the intersection of the London Circuit and Parkes Way ramps as shown in Figure 6-1.

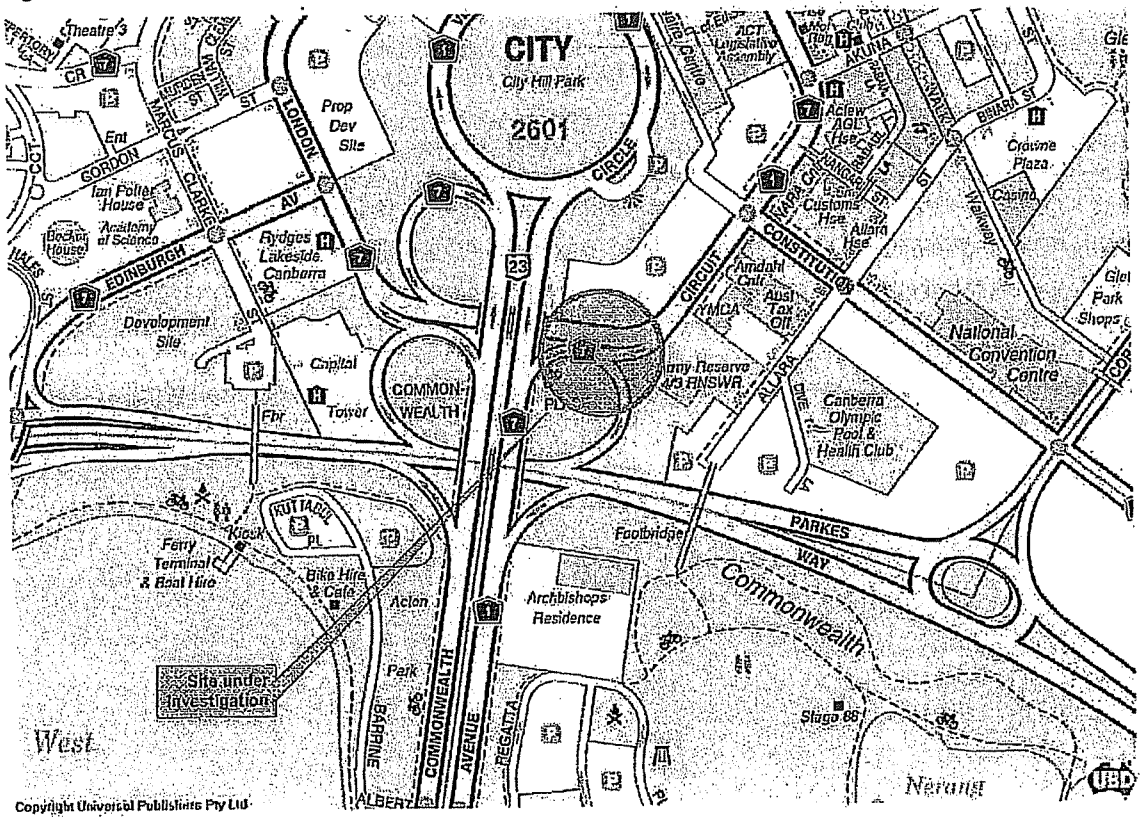


Figure 6-1 Location of Study

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## 6.2 Existing Situation

The existing situation at this interchange is that the off ramp from London Circuit to connect to Commonwealth Avenue has priority over the Parkes Way ramp connection to Commonwealth Avenue. This control provides priority for buses but results in queues onto Parkes Way.

The observed traffic volumes in February 2010 are shown in Figure 6-2.

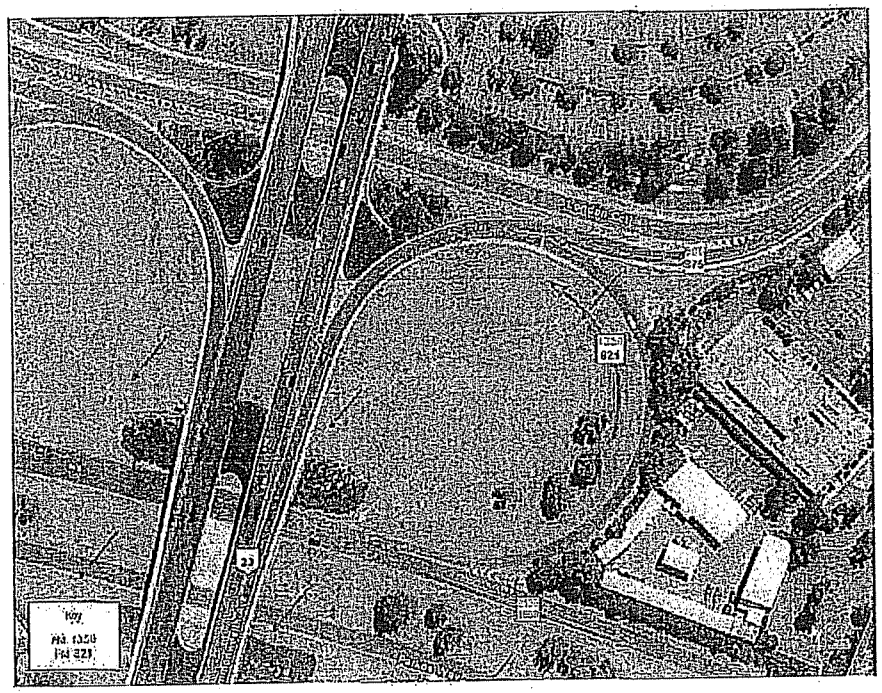

**Figure 6-2 Observed Traffic volumes February 2010**

Source AECOM 2010

The intersection was modelled using AA Sidra 3.2 with the 2010 existing traffic flows. On site observations showed that the queue often extends back to the Acton Hotel on ramp so as to block joining traffic. The Sidra analysis showed that the intersection is currently performing as shown in and is considered to reasonably represent the existing traffic conditions.

| Performance Measure | AM | | PM | |
|---|---|---|---|---|
| | Parkes Way Ramp | London Circuit Ramp | Parkes Way Ramp | London Circuit Ramp |
| Degree of Saturation | 1.106 | 0.327 | 1.019 | 0.472 |
| Average delay seconds | 117.3 | 0 | 64.1 | 0 |
| Level of Service | F | A | E | A |
| Queue m | 599 | 0 | 222 | 0 |

This quantifies the extent of congestion and delay at this intersection and demonstrates that during peak periods there are extensive delays and queues on the Parkes Way Ramp..

## 6.3 Proposal

The proposal to reduce the queuing back onto Parkes Way is to signalise the intersection. The advantage of signalising is that it also provides for on road cyclists to safely cross the London Circuit ramp to Commonwealth Avenue.

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In order for the intersection to minimise queues it is necessary for the signal cycle times to be kept quite short. It is also necessary to ensure that buses exiting the City along London Circuit are not unduly delayed. Therefore for this analysis it been proposed that the ramp signals do four cycles to one at the adjacent intersection of Constitution Avenue / London Circuit i.e. runs at a 30 second cycle time with a 3 second yellow and a one second all red period

Two options have been tested:

- Retaining the existing lane configuration and
- Adding a short lane to Parkes Way ramp.

These configurations are shown in Figure 6-3 and Figure 6-4.

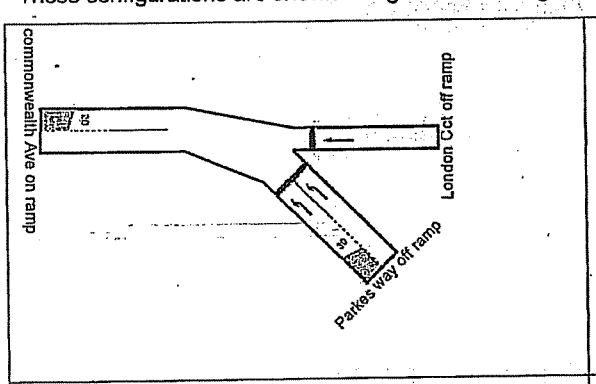


Figure 6-3 Indicative current geometry

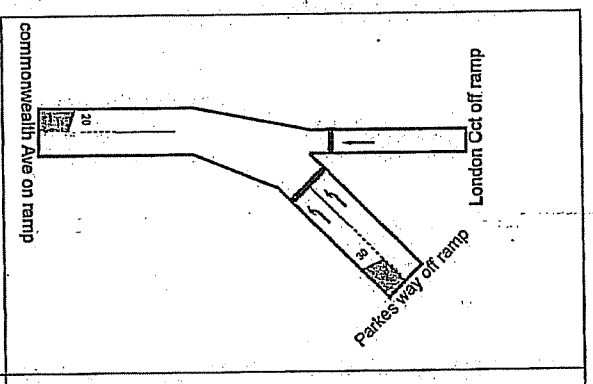


Figure 6-4 Two lane Approach from Parkes Way

The results of the analysis are shown in Table 6-1and Table 6-2.

**Table 6-1 Intersection Performance Characteristics Signalised Existing Geometry**

| Performance Measure | AM | | PM | |
|---|---|---|---|---|
| | Parkes Way Ramp | London Circuit Ramp | Parkes Way Ramp | London Circuit Ramp |
| Degree of Saturation | 1.,843 | 0.787 | 1.121 | 1.138 |
| Average delay seconds | 1542 | 2.3 | 248.3 | 254.1 |
| Level of Service | F | A | F | F |
| Queue m | 3416 | 26 | 571 | 640 |

**Table 6-2 Intersection Performance Two Lane Approach on Parkes Way Ramp**

| Performance Measure | AM | | PM | |
|---|---|---|---|---|
| | Parkes Way Ramp | London Circuit Ramp | Parkes Way Ramp | London Circuit Ramp |
| Degree of Saturation | 1.010 | 1.049 | 0.84 | 0.976 |
| Average delay seconds | 57.9 | 99.4 | 24.3 | 25.5 |
| Level of Service | E | F | B | B |
| Queue m | 263 | 233 | 56 | 157 |

Note assumed that 3 second yellow and 1 second all red to take account of lower speeds in this environment

If it were possible to operate the signals more like ramp metering with very quick cycle times of 20 seconds and only a 2 second yellow period with a one second all red, then the scheme would operate very well at Los C in both the AM and the PM. The practicality of such a scheme however would need to be assessed not only against the signal performance but also the safety aspects of very short displays which generally do not operate in Canberra – (an exception being the pedestrian signals on Bunda Street at the Canberra Centre).

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The results from this assumption are shown in the table below.

| Performance Measure | AM | | PM | |
|---|---|---|---|---|
| | Parkes Way Ramp | London Circuit Ramp | | |
| Degree of Saturation | 1.028 | 0.866 | 0.840 | 0.854 |
| Average delay seconds | 59.1 | 3.4 | 24.3 | 5.7 |
| Level of Service | E | A | B | A |
| Queue m | 230 | 36 | 56 | 69 |

The conclusion from all of this analysis is that it is possible to improve the delays at the intersection of these two ramps from existing. In the peak periods the cycle time would need to operate at 30 seconds but with only 2 seconds yellow display period and one second all red.

This shows that the solution is extremely sensitive to the yellow and all red times and also the driver reaction times in stopping and starting.

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# 7.0 Existing services

## 7.1 Sewer

There is a 750 mm diameter trunk sewer main (North Canberra MOS) crossing Parkes Way at a 45 degree skew between Sullivans Creek Bridge and the Action Tunnel. This main connects to two maintenance pits on the outer verge of each carriageway. This main should have sufficient cover depth so as not to be impacted on by the proposed road widening; however, care will need to be taken during construction works to ensure the integrity of the asset. There are also two 150 m diameter risings mains, operational and decommissioned, crossing Parkes Way at Black Mountain Peninsula to the north of Garryowen Drive.

## 7.2 Water supply

There is a 450 mm diameter bulk supply water main crossing Parkes Way to the west of Clunies Ross Street bridge. There are also two 150 mm diameter reticulation mains crossing Parkes Way to the east and west of the Acton Tunnel. The proposed work should not impact on these services.

## 7.3 Electricity

There is a 50 mm diameter streetlight cable along the outer verge of each carriageway extending from Glenloch Interchange. These cables then shift to the median to service the existing street light columns and then shift back to the outer carriageway verges approximately 100 m west of Clunies Ross Street Bridge. The cables extend along the outer verges of Parkes Way to the Acton Tunnel. The streetlight cabling crosses Parkes Way at the following locations:

- Midway between Glenloch Interchange and Clunies Ross Street Bridge;
- Either side of Sullivans Creek Bridge; and
- Either side of the Acton Tunnel.

There is a second electrical cable running parallel to the existing streetlighting cable located in the Parkes Way median between the Black Mountain escarpment area and the last median located streetlight immediately west of Clunies Ross Street. At present the function of this cable is unknown and therefore requires confirmation in the next stage of design.

There is preference by TaMS to maintain the existing street lighting in the median. This could not be achieved due to design constraints previously mentioned. As an alternative, the street lighting is proposed to be relocated to the outer verge of each carriageway in these areas.

There are two locations where HV electrical cables cross the Parkes Way carriageways; there is an overhead HV cable crossing Parkes Way to service Black Mountain Peninsula along Garryowen Drive, and the other instance the underground cable approximately 200 m east of the Acton Tunnel.

## 7.4 Stormwater

There is no accurate stormwater information available along Parkes Way between Glenloch Interchange and Sullivans Creek Bridge. Previous survey has identified a number of sumps within the median which will require relocation for the proposed widening.

The extent of relocation work is discussed in the carriageway analysis Section of this Report.

## 7.5 Communication

There are existing 100m PVC TELSTRA conduits located along the outer verge of the westbound carriageway between Sullivans Creek and Garryowen Drive. These services should not be impacted by the proposed widening.

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## 4.0 Pavements

No work has been carried out at this stage on the design of the structure of widened pavements.

For the PSP stage it has been assumed that a flexible pavement with a dense grade asphaltic concrete surfacing course with a two coat seal will be used, noting the use of the seal to alleviate black ice conditions around the Black Mountain escarpment.

The adopted design for the cost estimate has assumed the need for a select fill layer in the pavement profile. However, given that the Black Mountain escarpment and Sullivans Creek sections were constructed with run-off-quarry materials when the lake was reclaimed it is likely that this layer will not be required.

The use of a stone mastic asphalt inlieu of the dense grade asphalt will be considered of the next phase of the design.

Given the long lengths of widening it is considered that a flexible pavement rather than a full depth asphaltic concrete pavement will provide the optimum pavement construction, particularly when the existing pavement is a flexible pavement with a thin asphaltic concrete surface.

From work as executed records it appears that the existing shoulder on Parkes Way from Glenloch Interchange to Clunies Ross Street has a lesser pavement than the main carriageway. Hence, whilst there is potentially the option to narrow the shoulder by 0.5 m to provide the minimum required width for cycling that is 2.5 m, this option has not been considered due to the lesser pavement on Clunies Ross Street.

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# 9.0 Temporary Traffic Management

## 9.1 Staging

Given that the majority of the construction work is within the median the length of lane diversion will be onto the shoulder as discussed in section 4.0. Temporary traffic management is dependent on the length of sections of the road that would be tolerable to motorists travelling at low speeds through the work area.

It is therefore recommended that the works be staged as follows working from east to west:

1) Stage 1:

   Acton Tunnel to east of Edinburgh Avenue including the entry ramps to Commonwealth Avenue signalisation with the London Circuit entry ramp.

2) Stage 2:

   Clunies Ross Street to Acton Tunnel including the two bridge widenings.

3) Stage 3:

   Black Mountain Peninsula to Clunies Ross Street.

4) Stage 4:

   Glenloch Interchange to Black Mountain Peninsula.

## 9.2 Temporary traffic management

The widening into the median allows the creation of suitable work spaces created by relocating the outer traffic lanes onto the existing sealed shoulders.

The through lanes are narrowed to 3.0 m in width and work spaces of 3.0 m width can be created between the edge of the construction and a temporary barrier. A width of 1.0 m is allowed to accommodate any deflection in the barrier within the 3.0 m work zone.

These arrangements, which are generally typical for the whole length of Parkes Way are shown on the drawings.

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# 10.0 Items to be addressed

The following issues require further resolution during the development of the designs.

1. Given the non-conformance of sections of the Parkes Way to AUSTROADS design standards and given the original design speed of 80 km/h consideration needs to be given as to whether the posted design speed should be reduced to 80 km/h rather than the present 90 km/h posted speed.
2. Stormwater drainage with respect to:
    a. Conforming pipe connections and outlet
    b. Aquaplaning conditions on widened pavements, particularly in areas of adverse crossfall
3. Further design on bridge widening to confirm the use of super tees or cast insitu pretensioned box girders at Clunies Ross Street and cast-in situ pretensioned box girders at Sullivans Creek.
4. Checking of the existing bridge designs for the capability to sustain SM 1600 loadings.
5. Geotechnical investigations to provide parameters for the pavement designs.

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## 11.0 Probable Cost Estimate

| DESCRIPTION | AMOUNT |
|---|---|
| GENERAL | $ 597,000 |
| PROVISION FOR TRAFFIC | $ 81,000 |
| EARTHWORKS | $ 279,500 |
| UNDERGROUND SERVICES | $ 63,500 |
| SEWERAGE | $ 10,000 |
| STORMWATER DRAINAGE | $ 219,000 |
| SUBSOIL DRAINAGE | $ 418,000 |
| CONDUITS | $ - |
| WATER SUPPLY | $ 10,000 |
| FLEXIBLE PAVEMENT CONSTRUCTION | $ 1,576,000 |
| CONCRETE KERBS, FOOTPATHS AND MINOR WORKS | $ 1,174,500 |
| ROAD FURNITURE | $ 607,000 |
| INCIDENTAL WORKS | $ 1,688,000 |
| LANDSCAPE | $ 6,000 |
| ROAD SIGNS | $ 62,000 |
| PAVEMENT MARKING | $ 31,000 |
| TRAFFIC SIGNALS | $ - |
| STREET LIGHTING | $ 345,500 |
| Signalisation of Commonwealth Avenue entry ramps | $ 375,000 |
| *Sub total* | $ 7,543,000 |
| | |
| Clunies Ross Street Bridge | $ 1,380,000 |
| Sullivans Creek Bridge | $ 2,370,000 |
| *Sub total* | $ 3,750,000 |
| | |
| *Sub total* | $ 11,293,000 |
| Contingency 40% | $ 4,517,200 |
| GST | $ 1,581,020 |
| **Total Inc GST** | **$ 17,391,220** |