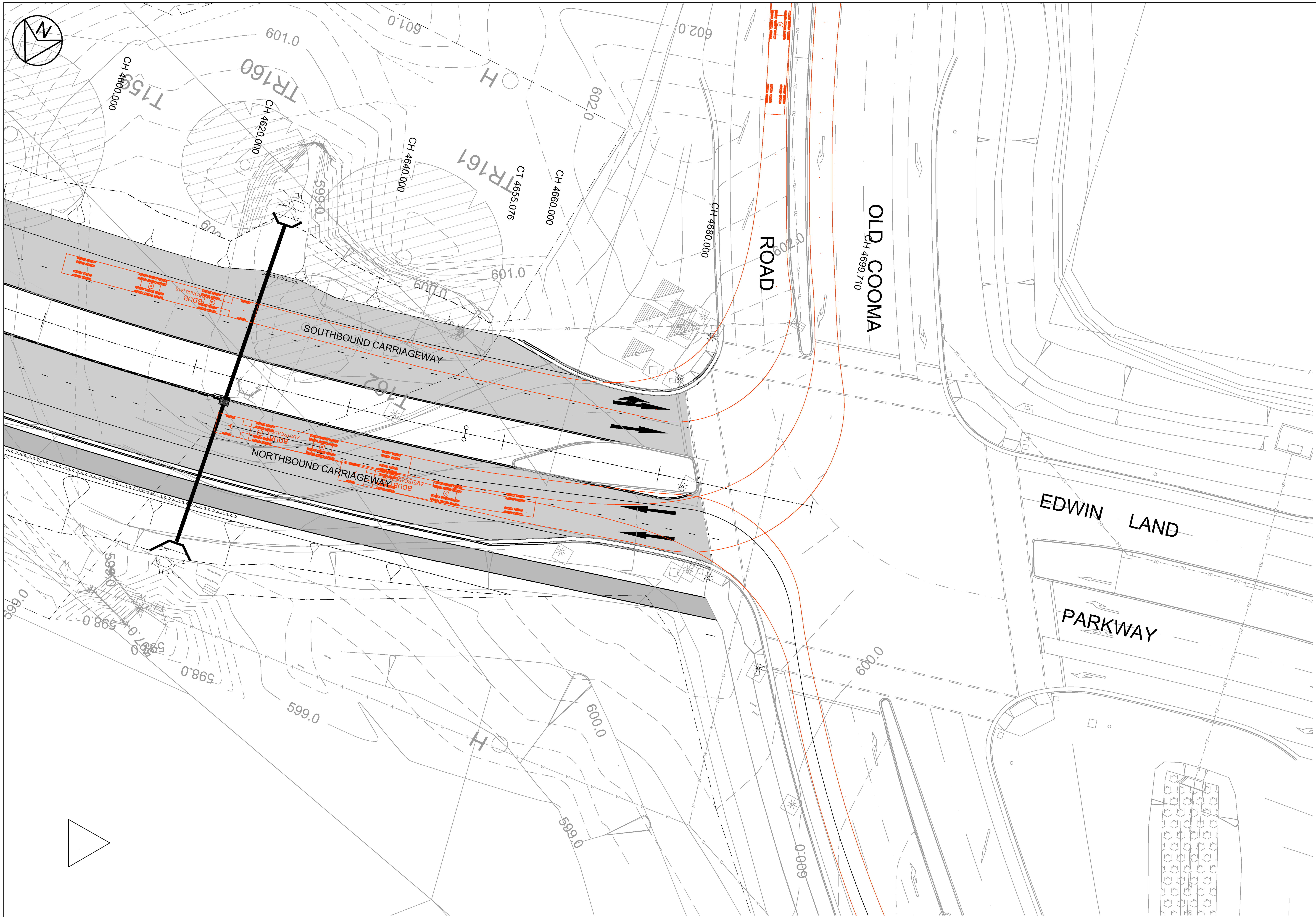


PLAN

NOTES

1. FOR LEGEND REFER TO DRG T-C0040.00-300.

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Revision	Amendment	Approved	Revision Date

Queanbeyan City Council

OPUS
Canberra Office
+61 2 6133 2700
Unit 18, Mitchell Business Centre
160 Lysaght Street,
ACT 2911, Australia

Drawn	Designed	Approved	Revision Date
J. LEITHEAD	C. NOVATI	M. HILL	13.07.2014

Project No. T-C0040.00
Scale 1:250@A1

Project
QUEANBEYAN CITY COUNCIL
ELLERTON DRIVE EXTENSION
PRELIMINARY SKETCH PLAN - STAGE 2

Sheet
INTERSECTION PLAN
EDWIN LAND PARKWAY - OLD COOMA ROAD

Drawing No. PSP REPORT APPENDIX H
Sheet No. SK05
Revision

Original Sheet Size A1 [841x594] Plot Date 22 Jul 2014 @ 10:15 AM Path G:\20_Newcastle_Projects\20_03 Other Projects\2014\T-C0040.00_Ellerton Drive Extension\Drawings\(C)Civil+AutoCAD\Sketches\T-C0040.00_S2_PSP_REPORT_H.dwg 710

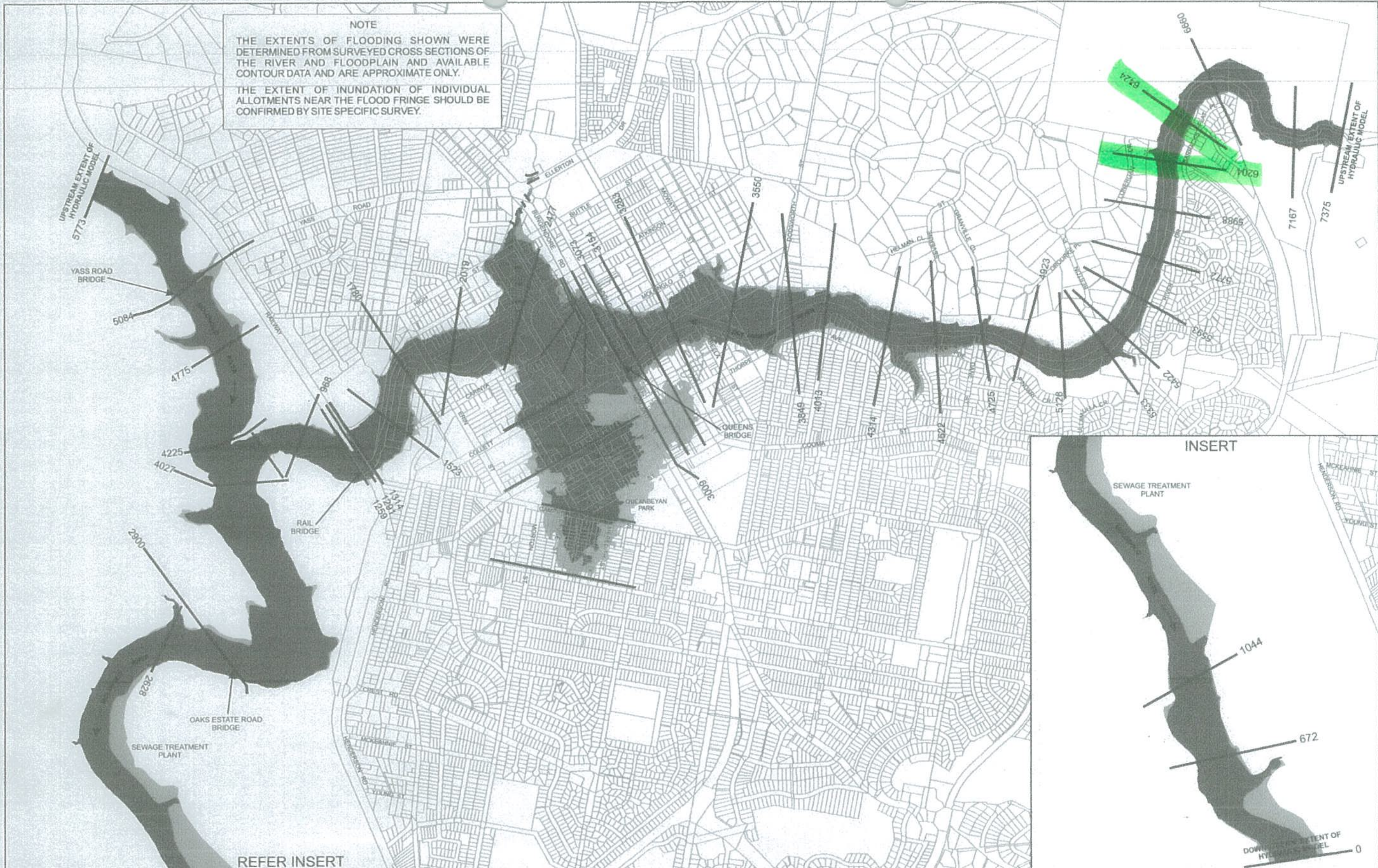
Appendix I – Queanbeyan River Flood Study (Extracted information)

FLOOD AND FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

NOTE

THE EXTENTS OF FLOODING SHOWN WERE DETERMINED FROM SURVEYED CROSS SECTIONS OF THE RIVER AND FLOODPLAIN AND AVAILABLE CONTOUR DATA AND ARE APPROXIMATE ONLY.

THE EXTENT OF INUNDATION OF INDIVIDUAL ALLOTMENTS NEAR THE FLOOD FRINGE SHOULD BE CONFIRMED BY SITE SPECIFIC SURVEY.



LEGEND

0 500 1,000 m
Scale

HEC-RAS Cross Section

1259 River Station Number

100yr ARI Low Hazard

100yr ARI High Hazard

QUEANBEYAN FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

Figure 2.3

QUEANBEYAN AND MOLONGLO RIVERS FLOOD HAZARD DIAGRAM
100 YEAR ARI

TABLE A1.5
HEC-RAS MODEL RESULTS
100 YEAR ARI 24 HOUR DESIGN FLOOD EVENT
QUEANBEYAN RIVER

Location	River Station	Peak Flood Level (m AHD)	Coincident Peak Discharge(1) (m^3/s)			Coincident Peak Flow Velocity(1) (m/s)		
			Left Bank	Channel	Right Bank	Left Bank	Channel	Right Bank
	7375	580.27	35.7	1383.6	5.6	1.2	2.6	0.7
	7167	579.89	11.1	1413.6		1.0	2.9	
	6660	579.38	29.8	1381.2	13.6	0.8	2.1	0.8
	6424	579.11	28.4	1401.4	19.0	0.9	2.2	0.9
	6204	578.80	22.9	1423.0	2.5	0.9	2.6	0.6
	5988	578.53	50.2	1397.6		1.0	2.5	
	5772	578.09	17.0	1416.4	13.5	0.9	2.8	0.8
	5593	577.47	15.6	1420.8	7.4	1.1	3.3	0.8
	5422	577.34	2.9	1436.5	3.2	0.6	2.3	0.5
	5333	577.34	9.0	1432.8	0.7	0.5	1.8	0.3
	5128	577.11	1.1	1441.6	2.8	0.3	2.0	0.3
	4923	576.85		1434.0	9.6		2.2	0.4
Dane Street	4725	576.67	5.7	1422.6	13.1	0.3	2.3	0.5
	4522	576.33	24.7	1365.1	47.5	0.3	2.9	0.9
	4314	576.32	11.5	1332.1	93.6	0.3	2.2	0.9
	4013	575.99	36.2	1369.9	26.0	0.3	3.0	0.7
	3849	576.01	29.1	1153.7	249.9	0.3	2.6	1.0
	3550	575.89	13.2	1112.0	306.2	0.3	2.5	0.9
	3283	575.66	16.8	1312.0	99.8	0.2	2.4	0.6
	3154	575.51	2.0	1342.4	82.8	0.1	2.0	0.3
	3073	575.47	0.2	1424.2	2.9	0.1	1.2	0.1
	3009	575.39	7.7	1107.5	313.8	0.1	1.4	0.4
	2994	575.36	2.9	171.3	33.9		0.2	
Queens Bridge	2989							

(1) Peak discharges and flow velocities relate to values coincident with peak flood levels in the Queanbeyan River. (i.e. Peak flows and velocities may not necessarily occur at the same time as peak flood levels at all locations in the modelled reach.)

TABLE A1.6
HEC-RAS MODEL RESULTS
3*100 YEAR ARI 24 HOUR DESIGN FLOOD EVENT
QUEANBEYAN RIVER

Location	River Station	Peak Flood Level (m AHD)	Coincident Peak Discharge[1] (m^3/s)			Coincident Peak Flow Velocity[1] (m/s)		
			Left Bank	Channel	Right Bank	Left Bank	Channel	Right Bank
	7375	585.64	283.5	3816.2	165.1	2.3	4.3	1.8
	7167	585.20	200.8	4004.1	59.2	2.3	4.4	1.6
	6660	584.92	470.7	3645.3	145.9	1.3	3.1	1.5
	6424	584.55	407.7	3715.0	157.6	1.4	3.5	1.6
	6204	584.20	530.7	3626.7	118.1	1.6	3.8	1.4
	5988	583.82	498.2	3759.2	13.4	1.9	3.9	1.0
	5772	583.45	293.4	3687.2	284.0	1.8	3.9	1.8
	5593	582.83	282.6	3726.3	243.6	2.0	4.6	1.9
	5422	582.88	157.2	3946.6	150.9	0.9	3.3	1.3
	5333	582.92	217.2	3998.7	39.1	1.2	2.7	0.9
	5128	582.68	46.3	4024.0	186.2	0.8	3.0	1.0
	4923	582.31	4.1	3988.0	255.2	0.4	3.5	1.1
Dane Street	4725	581.99	67.8	3996.1	175.9	0.6	3.8	1.0
	4522	581.83	539.6	3338.6	360.4	0.5	4.0	1.5
	4314	581.83	154.9	3276.7	805.4	0.4	3.1	1.5
	4013	581.64	444.8	3072.4	716.3	0.6	3.8	1.2
	3849	581.71	390.9	2462.1	1382.4	0.4	3.0	1.5
	3550	581.65	77.3	2186.8	1970.9	0.3	2.7	1.4
	3283	581.49	851.7	3041.0	341.2	0.5	3.0	0.5
	3154	581.40	825.5	2878.4	530.1	0.3	2.0	0.3
	3073	581.38	531.6	3484.4	217.8	0.2	1.2	0.2
	3009	581.34	673.3	2432.4	1130.9	0.3	1.4	0.4
	2994	581.31	786.1	2468.9	981.0	0.3	1.7	0.3
Queens Bridge	2989							

(1) Peak discharges and flow velocities relate to values coincident with peak flood levels in the Queanbeyan River. (i.e. Peak flows and velocities may not necessarily occur at the same time as peak flood levels at all locations in the modelled reach.)

Appendix J – Mechanistic design (CIRCLY)

MAIN CARRIAGEWAY, DEEP STRENGTH ASPHALT (HEAVY DUTY), SUBGRADE CBR3

CIRCLY Version 5.0t (9 October 2012)

Job Title: EDE Pavement - Main Carriageway

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: EDE Main Title: EDE Main Carriageway

Load No.	Load ID	Movements
1	ESA75-Full	1.30E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: EDE Main Title: EDE Main Carriageway

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph4230	Iso.	4.23E+03	0.40			
2	rough	Asph7896	Iso.	7.90E+03	0.40			

3	rough	Cement5000	Iso.	5.00E+03	0.20			
4	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph4230	ETH	0.003594	5.000	1.000
2	bottom	Asph7896	ETH	0.002753	5.000	1.000
3	bottom	Cement5000	ETH	0.000310	12.000	12.000
4	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:

Project Reliability: Austroads 97.5%

Layer No.	Reliability Factor	Material Type
1	0.67	Asphalt
2	0.67	Asphalt
3	0.50	Cement Stabilised
4	1.00	Subgrade (Austroads 2004)

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	Asph4230	ESA75-Full	3.20E-06	1.30E-30
2	130.00	Asph7896	ESA75-Full	-1.44E-05	7.68E-05
3	220.00	Cement5000	ESA75-Full	-5.95E-05	7.74E-01
4	0.00	Sub_CBR3	ESA75-Full	1.74E-04	1.68E-05

INTERSECTIONS, DEEP STRENGTH ASPHALT (HEAVY DUTY), SUBGRADE CBR3

CIRCLY Version 5.0t (9 October 2012)

Job Title: EDE Pavement - Intersections

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: EDE Inter Title: EDE Intersections

Load No.	Load ID	Movements
1	ESA75-Full	1.40E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: EDE Inter Title: EDE Intersections

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph3015	Iso.	3.02E+03	0.40			
2	rough	Asph5628	Iso.	5.63E+03	0.40			

3	rough	Cement5000	Iso.	5.00E+03	0.20			
4	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph3015	ETH	0.004059	5.000	1.100
2	bottom	Asph5628	ETH	0.003110	5.000	1.100
3	bottom	Cement5000	ETH	0.000310	12.000	12.000
4	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:

Project Reliability: Austroads 97.5%

Layer No.	Reliability Factor	Material Type
1	0.67	Asphalt
2	0.67	Asphalt
3	0.50	Cement Stabilised
4	1.00	Subgrade (Austroads 2004)

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	Asph3015	ESA75-Full	-8.24E-07	7.93E-12
2	130.00	Asph5628	ESA75-Full	-9.63E-06	6.55E-06
3	235.00	Cement5000	ESA75-Full	-5.93E-05	8.02E-01
4	0.00	Sub_CBR3	ESA75-Full	1.77E-04	2.01E-05

MAIN CARRIAGEWAY, FULL DEPTH ASPHALT (HEAVY DUTY), SUBGRADE CBR3

CIRCLY Version 5.0t (9 October 2012)

Job Title: EDE Pavement - Main Carriageway

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: EDE Main Title: EDE Main Carriageway

Load No.	Load ID	Movements
1	ESA75-Full	1.30E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: EDE Main Title: EDE Main Carriageway

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph4230	Iso.	4.23E+03	0.40			

2	rough	Asph7896	Iso.	7.90E+03	0.40			
3	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph4230	ETH	0.003594	5.000	1.100
2	bottom	Asph7896	ETH	0.002753	5.000	1.100
3	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 97.5%

Layer No.	Reliability Factor	Material Type
1	0.67	Asphalt
2	0.67	Asphalt
3	1.00	Subgrade (Austroads 2004)

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	Asph4230	ESA75-Full	1.51E-05	1.43E-30
2	190.00	Asph7896	ESA75-Full	-9.17E-05	8.75E-01
3	0.00	Sub_CBR3	ESA75-Full	3.17E-04	1.12E-03

INTERSECTIONS, FULL DEPTH ASPHALT (HEAVY DUTY), SUBGRADE CBR3

CIRCLY Version 5.0t (9 October 2012)

Job Title: EDE Pavement - Intersections

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: EDE Inter Title: EDE Intersections

Load No.	Load ID	Movements
1	ESA75-Full	1.40E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: EDE Inter Title: EDE Intersections

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph3015	Iso.	3.02E+03	0.40			
2	rough	Asph5628	Iso.	5.63E+03	0.40			

3	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph3015	ETH	0.004059	5.000	1.100
2	bottom	Asph5628	ETH	0.003110	5.000	1.100
3	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:

Project Reliability: Austroads 97.5%

Layer No.	Reliability Factor	Material Type
1	0.67	Asphalt
2	0.67	Asphalt
3	1.00	Subgrade (Austroads 2004)

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	Asph3015	ESA75-Full	1.23E-05	1.54E-30
2	220.00	Asph5628	ESA75-Full	-1.00E-04	7.95E-01
3	0.00	Sub_CBR3	ESA75-Full	3.20E-04	1.27E-03

SIDE/ACCESS ROADS, FULL DEPTH ASPHALT (NOT HEAVY DUTY), SUBGRADE CBR3

CIRCLY Version 5.0t (9 October 2012)

Job Title: EDE Pavement - Side Roads

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: EDE Side Title: EDE Side Roads

Load No.	Load ID	Movements
1	ESA75-Full	1.00E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: EDE Side Title: EDE Side Roads

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph3825	Iso.	3.83E+03	0.40			
2	rough	Asph7140	Iso.	7.14E+03	0.40			

3	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph3825	ETH	0.003717	5.000	1.100
2	bottom	Asph7140	ETH	0.002855	5.000	1.100
3	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 97.5%

Layer No.	Reliability Factor	Material Type
1	0.67	Asphalt
2	0.67	Asphalt
3	1.00	Subgrade (Austroads 2004)

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	50.00	Asph3825	ESA75-Full	2.10E-05	1.10E-31
2	160.00	Asph7140	ESA75-Full	-1.21E-04	2.21E-01
3	0.00	Sub_CBR3	ESA75-Full	4.15E-04	5.61E-04

MAIN CARRIAGEWAY, UNBOUND GRANULAR (HEAVY DUTY), SUBGRADE CBR3

CIRCLY Version 5.0t (9 October 2012)

Job Title: EDE Pavement - Main Carriageway

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: EDE Main Title: EDE Main Carriageway

Load No.	Load ID	Movements
1	ESA75-Full	1.30E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: EDE Main Title: EDE Main Carriageway

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Gran_350	Aniso.	3.50E+02	0.35	2.60E+02	1.75E+02	0.35
2	rough	Gran_242	Aniso.	2.42E+02	0.35	1.79E+02	1.21E+02	0.35

3	rough	Gran_100	Aniso.	1.00E+02	0.35	7.40E+01	5.00E+01	0.35
4	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
4	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:

Project Reliability: Austroads 97.5%

Layer No.	Reliability Factor	Material Type
4	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:

Layer no. 1: Austroads (2004) sublayering

Layer no. 2: Austroads (2004) sublayering

Layer no. 3: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	200.00	Gran_350		n/a	n/a
2	200.00	Gran_242		n/a	n/a
3	260.00	Gran_100		n/a	n/a
4	0.00	Sub_CBR3	ESA75-Full	8.38E-04	1.00E+00

INTERSECTIONS, UNBOUND GRANULAR (HEAVY DUTY), SUBGRADE CBR3

CIRCLY Version 5.0t (9 October 2012)

Job Title: EDE Pavement - Intersections

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: EDE Inter Title: EDE Intersections

Load No.	Load ID	Movements
1	ESA75-Full	1.40E+07

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: EDE Inter Title: EDE Intersections

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Gran_350	Aniso.	3.50E+02	0.35	2.60E+02	1.75E+02	0.35
2	rough	Gran_242	Aniso.	2.42E+02	0.35	1.79E+02	1.21E+02	0.35

3	rough	Gran_100	Aniso.	1.00E+02	0.35	7.40E+01	5.00E+01	0.35
4	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
4	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:

Project Reliability: Austroads 97.5%

Layer No.	Reliability Factor	Material Type
4	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:

Layer no. 1: Austroads (2004) sublayering

Layer no. 2: Austroads (2004) sublayering

Layer no. 3: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	200.00	Gran_350		n/a	n/a
2	200.00	Gran_242		n/a	n/a
3	270.00	Gran_100		n/a	n/a
4	0.00	Sub_CBR3	ESA75-Full	8.19E-04	9.22E-01

SIDE/ACCESS ROADS, UNBOUND GRANULAR (NOT HEAVY DUTY), SUBGRADE CBR3

CIRCLY Version 5.0t (9 October 2012)

Job Title: EDE Pavement - Side Roads

Damage Factor Calculation

Assumed number of damage pulses per movement:
One pulse per axle (i.e. use NROWS)

Traffic Spectrum Details:

ID: EDE Side Title: EDE Side Roads

Load No.	Load ID	Movements
1	ESA75-Full	1.00E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA75-Full	SA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA75-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA75-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA75-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA75-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: EDE Side Title: EDE Side Roads

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Gran_350	Aniso.	3.50E+02	0.35	2.60E+02	1.75E+02	0.35
2	rough	Gran_242	Aniso.	2.42E+02	0.35	1.79E+02	1.21E+02	0.35

3	rough	Gran_100	Aniso.	1.00E+02	0.35	7.40E+01	5.00E+01	0.35
4	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
4	top	Sub_2004	EZZ	0.009300	7.000	1.600

Reliability Factors:

Project Reliability: Austroads 97.5%

Layer No.	Reliability Factor	Material Type
4	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:

Layer no. 1: Austroads (2004) sublayering
Layer no. 2: Austroads (2004) sublayering
Layer no. 3: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	150.00	Gran_350		n/a	n/a
2	150.00	Gran_242		n/a	n/a
3	250.00	Gran_100		n/a	n/a
4	0.00	Sub_CBR3	ESA75-Full	1.17E-03	7.93E-01

Appendix K – Risk Register

Project Title **Ellerton Drive Extension**	Project Number **T-C0040.00**	Prepared by: **Michael Hill**
	Division or Sub-Division **Road and Bridge Design**	Checked by: **Matthew Ing**
Scope of Assessment	**Risk Posed on the Design of the Ellerton Drive Extension**	Revision: **Rev 1**

(1) Haz Ref	(2) Activity/Process/ Material/Element	(3) Hazard	(4) Stage of Work	(5) Initial Risk: Probabilit	Severity	Risk Leve	(6) Risk Control Measures: Design action taken, record of decision process including option considered, design constraints and justification for options/actions not having been taken	(7) Residual Risk: Probabilit	Severity	Risk Leve	(8) Is there a 'significan t' residual risk to be passed	(9) If answer to (8) is Yes, Risk Responsi bility	(10) Status (Active / Closed)
1	PSP design	The PSP does not identify all design restraints and property issues arise requiring further community consultation.	Design	B	3	M	The PSP stage has to be designed to a high level of detail and the Council has done a complete review to ensure wider known community issues are taken into consideration at this stage.	A	2	L	N		Active
2	Design over 1800mm ACTEW water main.	This 1800mm water main creates considerable additional cost to the project.	Design / Construction	C	3	H	Relocation of the pipe is highly expensive and to be avoided. Consideration of pipe cover will be considered early in the design when optimising road levels. Cover slabs can be consider to optimise cover levels. Early ACTEW involvement is essential. Opus has discussed this issue with ACTEW and reviewed ACTEW as built drawings of this pipe already. It is unlikely this pipe will cause road design issues as this road was well planned during pipe construction.	B	3	M	N		Active
3	Overhead power lines crossing proposed road corridor.	Power lines have to be relocated due to clearance constraints.	Design	C	3	H	The power lines levels and constraints are to be surveyed and flagged early in the design so a constraints window can be developed through the road corridor and service avoidance can be manage from the start of the design. It is likely that the power line adjacent to the main reservoir we have to be relocated. This can be determined early in the design and programmed effectively to avoid construction delays.	B	3	M	N		Active
4	Archaeological constraints	The proposed road alignment will cross Aboriginal significant sites and projects is stopped	Design	E	5	S	The Archaeological assessment has been completed and a constraints window can be developed to focus on minimising archaeological disturbance. Aboriginal Heritage Impact Permits will be gained prior to construction start to avoiding expensive delays during construction. This will be done as part of the REF.	C	1	M	N		Active
5	Environmental constraints	Endanger species are found during construction	Construction	B	4	H	A species impact statement has been drafted and no endanger species are expected to be impacted. Careful monitoring on site is required to ensure endanged species are not being impacted during construction and the department of environment is to be keep well informed of our site audit process to ensure we are conducting works in an environmentally responsible manner. We will be placed in the best position to deal with any discoveries on site if the construction team have followed CEMP's properly.	B	3	M	Y	Works Contract or to follow CEMP	Active
6	Bush Clearance	QCC are not able to come to agreement with the NSW Office of Environmental and Heritage (OEH) regarding the land offset strategy.	Planning / Design	B	5	H	Council have conducted an SIS to NSW Director Generals requirements. A land off set strategy must work concurrently with this design project to ensure construction is not delayed if funding is granted.	B	4	H	Y	QCC	Active
7	Queanbeyan River Crossing	The bridge design does not interface with the road design and construction conflict occur.	Design and Construction	C	3	H	The road and bridge design is to be conducted by the same design team to minimise interface and contractor conflicts.	A	3	L	N		Active
8	Review process	Delay to programme due to extended reviews and addressing multiple comments.	Construction	D	2	H	Provide a team of engineers/designers who are experienced at designing to Austroads and RMS suppliments.	B	1	L	N		Active
9	Earthworks	Construction traffic damage the subgrade extensively and additional earthworks/treatment is required	Construction	C	3	H	Monitor earthworks material and set crushed rock working platform is required.	B	3	M	N		Active

Notes

1 Use Hazard Quantification Tables

Likelihood	
Probability of Occurrence	Probability Index
So unlikely that probability is close to zero	A
Unlikely to occur, though conceivable	B
Likely to occur sometime	C
Occurrence not surprising. May occur more than once	D

Severity	
Potential Maximum Consequence (Hazard Severity)	Hazard Severity Index
Minor delay to project / small additional cost (<50k)	1
Delay to project / Increase in costs	2
Major project delay / Major additional Cost	3
Significant Delay / Significant additional cost	4

Risk Level					
Hazard Severity Index	Probability Index				
	A	B	C	D	E
1	L	L	M	H	H
2	L	M	H	H	H
3	L	M	H	S	S
4	M	H	S	S	S

Risk Level Action		
Risk Level	Description	Action
L	Low	Check that risks cannot be reduced further by design
M	medium	
H	High	Amend design to reduce risk, or

(1) Haz Ref	(2) Activity/Process/ Material/Element	(3) Hazard	(4) Stage of Work	(5) Initial Risk			(6) Risk Control Measures: Design action taken, record of decision process including option considered, design constraints and justification for options/actions not having been taken	(7) Residual Risk			(8) Is there a 'significant' residual risk to be passed	(9) If answer to (8) is Yes, Risk Responsibility	(10) Status (Active / Closed)
				Probabili	Severity	Risk Leve		Probabili	Severity	Risk Leve			

occurrence inevitable. May occur many times	E		Project cannot continue.	5		5	M	H	S	S	S		S	Severe	seek alternative option.

Appendix L – Cost Estimate (PSP)

PROJECT:	ELLERTON DRIVE QUEANBEYAN - STAGE 1					Prepared by: *S Rowe*
Project Summary						
	DATE: Sep-14			Estimate Stage: PRELIMINARY SKETCH		

Item	Estimate (excluding contingency)	Contingency %	Contingency Amount	Estimate (including contingency)	% of Total Estimate	Comments/Assumptions
1. Project Development						
1 (a) Route/Concept/EIS or REF	$1,104,659	30%	$331,398	$1,436,057		
1 (b) Project Management Services	$66,280	30%	$19,884	$86,164		6% of 1a
1 (c) Client Representation	$6,628	30%	$1,988	$8,616		10% of 1b
1 (d) Community Relations	$50,000	30%	$15,000	$65,000		
Sub total	**$1,227,567**	**30%**	**$368,270**	**$1,595,837**	**2.2%**	
2. Investigation and Design						
2 (a) Investigation and Design	$2,872,112	30%	$861,634	$3,733,746		6.5% of 5a
2 (b) Project Management Services	$172,327	30%	$51,698	$224,025		6% of 2a
2 (c) Client Representation	$17,233	30%	$5,170	$22,403		10% of 2b
Sub total	**$3,061,672**	**30%**	**$918,502**	**$3,980,174**	**5.6%**	
3. Property Acquisitions						
3 (a) Acquire Property	$0	30%	$0	$0		OPUS to confirm
3 (b) Professional Services For Propert	$0	30%	$0	$0		7.5% of 3a
3 (c) Project Management Services	$0	30%	$0	$0		6% of 3b
3 (d) Client Representation	$0	30%	$0	$0		10% of 3c
Sub total	**$0**	**#DIV/0!**	**$0**	**$0**	**0.0%**	
4. Public Utility Adjustments						
4(a) Adjustment to Utilities	$0	20%	$0	$0		Included in Construction
4 (c) Project Management Services	$0	20%	$0	$0		
4 (d) Client Representation	$0	20%	$0	$0		
Sub total	**$0**		**$0**	**$0**	**0.0%**	
5. Construction						
5(ai) Schedule of Rates	$44,186,342	38%	$16,594,948	$60,781,290		
5(b) Primary Testing						Incl in SOR
5(c) Insurance	$441,863	38%	$165,949	$607,812		1% of 5a
5 (d) Project Management Services	$2,651,181	38%	$995,697	$3,646,878		6% of 5a
5 (e) Client Representation	$265,118	38%	$99,570	$364,688		10% of 5d
Sub total	**$47,544,504**	**38%**	**$17,856,164**	**$65,400,668**	**91.3%**	
6. Handover						
6 (a) Handover and Finalisation	$50,000	30%	$15,000	$65,000		
6 (b) Project data and performance	$441,863	30%	$132,559	$574,422		1% of 5a
6 (c) Project Management Services	$26,512	30%	$7,954	$34,466		6% of 6b
6 (d) Client Representation	$2,651	30%	$795	$3,446		10% of 6c
Sub total	**$521,026**	**30%**	**$156,308**	**$677,334**	**0.9%**	
TOTAL	**$52,354,769**	**37%**	**$19,299,244**	**$71,654,013**	**100%**	**RMS Require 25% to 40%**
Project Management	$2,916,300			$3,991,533	5.6%	
Client Representation	$291,630			$399,153	0.6%	

Reality Checks	Excluding Contingency			Including Contingency	
	Rate	Unit	Qty	Rate	Unit
1. Project Cost (Incl Contingency)/ km	$13,088,692	/cway-km	4.00	$17,913,503	/cway-km
2. Project Cost / lane-km	$3,272,173	/lane-km	16.00	$4,478,376	/lane-km
3. Earthworks	$35	/m3	199,522	$48	/m3
4. Pavement-Main	$154	/m2	68,247	$211	/m2

No allowance for GST,Escalation,Carbon Tax

Appendix M – Landscaping Plant Species List

ELLERTON DRIVE, INITIAL PLANT SPECIES LIST

SCIENTIFIC NAME	COMMON NAME	ON SITE*
TREES		
Eucalyptus bridgesiana		Y
Eucalyptus melliodora		Y
Eucalyptus mannifera		Y
Eucalyptus polyanthemos ssp. Polyanthemos		Y
Eucalyptus macrorhyncha		y
Eucalyptus viminalis	Ribbon Gum	
Acacia implexa	Hickory Wattle	
Acacia melanoxylon	Blackwood	
Hakea decurrens ssp. Decurrens		
Hakea microcarpa	Small-fruited Hakea	
Hakea sericea	Silky Hakea	
LARGE SHRUB/BUSHY TREE		
Acacia dealbata ssp dealbata		Y
Acacia rubida		Y
Acacia buxifolia ssp. Buxifolia		Y
Acacia boormanii	Snowy River Wattle	Y
Callistemon sieberi	River Bottlebrush	
Leptospermum brevipes		
Leptospermum myrtifolium	Myrtle Tea-tree	
Leptospermum obovatum		
Kunzea ericoides	Burgan	Y
Banksia ericifolia	Heath-leaved Banksia	
Melaleuca parvistaminea		
SHRUBS, 0.5-1.2m tall		
Correa reflexa	Common Correa	
Grevillea ramosissima ssp. Ramosissima	Fan Grevillea	
Grevillea rosmarinifolia	Rosemary Grevillea	
Pimelea curviflora var. sericea		Y
Pimelea curviflora var. gracilis		
Pimelea glauca	Smooth Rice-flower	Y
Pimelea linifolia ssp. Caesia	Slender Rice Flower	
Pimelea linifolia ssp. Linifolia	Slender Rice Flower	
Crowea exalata		
Calytrix tetragona	Common fringe-myrtle	
Westringia fruticosa	Slender Western Rosemary	
SHRUBS, up to 0.45m tall		

Ajuga australis	Austral bugal	Y
Brachyscome ciliaris	Variable Daisy	Y
Brachyscome multifida		
Hardenbergia violacea	False Sarsaparilla	
Hibbertia calycina	Lesser guinea flower	
Hibbertia obtusifolia	Hoary guinea flower	Y
Hibbertia riparia	Erect Guinea-flower	
Viola hederacea	Ivy-leaved Violet	
Convolvulus angustissimus		
STRAPPY/GRASSES		
Dianella longifolia	Pale Flax-lily	Y
Dianella revolute	Flax-lily	Y
Carex appressa		Y
Juncus australis		
Juncus usitatus		Y
Lomandra filiformis ssp coriacea		Y
Lomandra filiformis ssp filiformis		Y
Lomandra filiformis ssp multiflora		Y
Lomandra longifolia	Spiny-headed mat-rush	
Thysanotus patersonii		
Poa labillardierei	Tussock-grass	

* As identified by the Species Impact Statement 2013 (NGH Environmental)

Appendix N – Queanbeyan River Bridge Crossing Report

Concept Design Report for
Twin Bridges over Queanbeyan River
Ellerton Drive Extension

Prepared by		Level 13 Tower 2 475 Victoria Ave Chatswood NSW 2067	
Name: Position:	Ruodong Pan Senior Bridge Engineer		
Checked by			
Name: Position:	Daniel Emery Principle Bridge Engineer	Tel. Fax.	+61 2 9325 5600 +61 2 9904 6777
Approved by			
Name: Position:	Michael Hill Business Manager Canberra	Reference: Status: Date:	T-C0040.00 Concept Design July 2014

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1 INTRODUCTION

Queanbeyan City Council (QCC) commissioned Opus International Consultants (Australia) Pty Ltd (Opus) to undertake the design and documentation for the extension of Ellerton Drive from the intersection of Old Cooma Road and Edwin Land Parkway to the northern driveway of 10 Ellerton Drive, Queanbeyan early 2014. The work includes the design and documentation for a 4 lane dual carriageway for approximately 4.6km in length and road geometry for the proposed bridge over Queanbeyan River.

The Queanbeyan road network requires upgrades to cope with the City's rising population. Queanbeyan City Council has been investigating additional traffic routes to reduce traffic on Queens Bridge and Cooma Street for a number of decades. The main feature of the current Queanbeyan road network is the lack of river crossings forcing traffic through the Queanbeyan Central Business District (CBD). It is also appreciated that the existing Queanbeyan river crossings are not serviceable during a 1:100 year storm event.

Queanbeyan City Council requires the Ellerton Drive extension project to be designed in two stages. The design scope for stage 1 is summarised as a bi-directional single carriageway with earthworks design to cater for future dual carriageway duplication. Stage 2 is the complete design of a bi-directional dual carriageway road. The extent of works runs from the northern entry to Council depot at 10 Ellerton Drive through to the intersection of Edwin Land Parkway and Old Cooma Road.

Five spans twin bridges have been identified as being required at the river crossing. Northbound bridge, 164m long (30m, 38m, 36m, 30m and 30m spans arranged from north to south) and 14.25 m wide, will carry two lanes of traffic and a shared use path. Southbound bridge, 164m long (30m, 38m, 36m, 30m and 30m spans arranged from north to south) and 11.20 m wide, will carry two lanes of traffic. Each of the twin bridges incorporates a 3% one way crossfall away from the central median, and has a 1% longitudinal grade falling to the south.

The superstructure consists of 1800mm deep Super Tee girders with a 200m minimum thick cast in place deck slab. The deck will be connected to abutment / pier headstocks via restraint blocks and associated dowels to transfer longitudinal and transvers load from deck surface. The spans will be connected together at the piers via a link slab. The southern abutments are proposed to be spill-thru type abutment with a 1.5H:1V batter. The northern abutments are proposed to be mechanically stabilized earth (MSE) wall to retain the 12m high formation. The abutment sill beams are supported on bored cast in place piles, socketed into rock. Each pier consists of two columns supported on bored cast in place piles, framed by a reinforced concrete headstock.

The Super Tee girders will be supported on laminated elastomeric bearings at their ends. The bearings may need to be replaced during bridge's design life (100 years). Two expansion joints are proposed at ends of bridge deck. Bridge traffic barriers are 1300mm high regular performance level barriers consisting of standard RMS concrete barriers with twin steel railings.

2 SCOPE OF THE REPORT

This report describes the Concept Design for the Twin Bridges over Queanbeyan River. The design proposal Form 62 and the bridge general arrangement drawings form part of this report.

This report will be addressing followings:

1) The concept design development and the
2) Compliance with and satisfaction of the Brief
3) Integration and multi-disciplinary design interface issues and risks associated with other discrete design elements and associated mitigation strategies
4) Durability issues and risks and measures to comply with the durability requirements for the discrete design elements or parts thereof
5) Performance criteria and measures to comply with the performance criteria specified for the discrete design elements or parts thereof
6) The design loadings, load combinations, exposure conditions and design standards that will be adopted for detailed design of the discrete Design elements or parts thereof
7) Safety by design (safe design)
8) Operation and maintenance issues, impacts and requirements
9) Constructability issues and measures, including constructability assumptions such as construction sequencing that are important to design solutions , traffic management during construction of the project works and the temporary works

3 DESIGN CRITERIA

3.1 Design Criteria and Relevant Design Documents

The parameters used for the concept design of the Twin Bridges over Queanbeyan River have been taken from a number of sources. These sources are as follows:

1) AS 5100 Bridge Design
2) RMS Bridge Technical Direction Manual
3) Bridge Waterway Manual – RTA – October 1994
4) Waterway design: A Guide to the hydraulic design of bridges, culverts and flood-ways, Austroads publication, 1994
5) Austroad Guide to Bridge Technology Part 4: Design Procurement and Concept Design
6) Austroad Guide to Bridge Technology Part 5: Structural Drafting
7) Austroad Guide to Road Design Part 5: Drainage Design
8) RMS Structural Drafting and Detailing Manual
9) Aesthetics of Bridges – Design Guidelines to Improve the Appearance of Bridges in NSW, RTA, July 2003

3.2 Design Loads

Key design loads for the Twin Bridges over Queanbeyan River are:

1) Traffic: SM1600
2) Pedestrian Load of 5kPa
3) Load combinations are in accordance with AS5100.2.
4) 100 year ARI and 2000 year ARI Flood Force
5) Wind load
6) Collision load on substructure

4 BRIDGE CONCEPT DEVELOPMENT

The key design elements of the Bridgeworks and the design methodology for each are briefly described below.

4.1 Bridge Configuration and Superstructure

According to design brief, following factors were taken into account in concept design:

- It is understood that the foot print of land required for this project is to be minimised through careful road cross section design and cut and full optimisation.
- Ellerton Drive will require considerable bush clearance which is to be minimised as part of this project and the Council are working with the NSW Office of Environment and Heritage to arrange an offset strategy.
- These elements of work should be optimised with two stage construction in mind, the first being construction of two lanes and ultimate earthworks (as cut and fill balances allow) and secondly construction of the ultimate four lanes with any minor earthwork adjustments.
- The design shall use the latest applicable Austroads and RMS Supplements for the works to undertake the full design and documentation of four lanes and connection to the traffic lights at Old Cooma Road.
- The design should take into consideration whole of life cost including maintenance and disposal costs.

According to road design, the northbound carriage way will consists of two 3.5m lanes and a 2.5m shared use path. Based on estimated AATD in Design Brief, the shoulder on the bridge was determined to be 1.2m wide.

The span over Queanbeyan River was determined fist. The distance between pier centre lines needs to be 38m to clear of normal water level. 1800mm deep Super Tee girders with cast in situ concrete deck slab is deemed to be the most effective and economical solution.

The lengths of other spans were determined to be in the order of 30m to match the span over Queanbeyan River. Based on the consideration on services location, abutments height and clearance over Barracks Flat Drive, the bridge was determined to have five spans. Span lengths starting from north are 30m, 38m, 36m, 30m and 30m.

According to RMS BTD2011/06, the maximum span measured centre to centre between bearings, of 1800mm deep Super-T girder is 37m. The maximum span on the Twin Bridges is 38m measured centre to centre between piers, the effective span will be set as 37m.

A 6m long approach slab is provided at each abutment to minimise the effect of embankment settlement on the carriageway.

4.2 Substructure

The abutments consist of cast in situ concrete headstocks 1600 mm wide and 1500 mm deep and cast in situ wingwalls. Headstocks are supported on 2 no. 1200mm diameter bored reinforced concrete piles. Northern abutment piles are founded in Shale Bedrock. Southern abutment piles are founded in Limestone Bedrock.

At southern end, a spill-thru abutment can be built with a batter slope of 1.5H:1.0V. At northern end, spill- thru type abutment is not practical because the existing bank slope requires huge amount of backfill to form spill-thru abutment. A mechanically stabilized earth (MSE) wall is proposed at northern abutments. The abutment piles will be sleeved to avoid interaction between piles and MSE wall.

Each of the intermediate supports consists of concrete headstock 1500 mm wide and 1800 mm deep supported on two 1200 mm diameter bored reinforced concrete piles founded in Limestone Bedrock.

It is proposed to connect the super structure with pier headstocks through dowels cast in lateral restraint block. The longitudinal load effects will distribute to each pier based on their stiffness. Two expansion joints are proposed at each end of bridge deck. This arrangement needs to be confirmed in detailed design stage.

4.3 Shared Path

A 2.5 metres wide shared path is provided on the western side of the northbound for pedestrian and cyclist use.

The shared path will be constructed as part of the deck slab. The shared path has a 2% crossfall towards traffic barrier.

4.4 Traffic Barriers

Bridge traffic barriers are 1300mm high regular performance level barriers consisting of standard RMS concrete barriers with twin steel railings, which offers provision for cyclist.

An assessment of the traffic barrier performance level for the barriers located on the bridge has been carried out in accordance with Appendix B of AS 5100.1. Regular performance level traffic barriers are deemed to be adequate.

The selection of regular performance level barriers on the bridge is based on the following input:

➢ Average Annual Daily Traffic (AADT) = 8845		Design brief
➢ Road Type	RT = 1.0	Based on two way traffic
➢ Road Grade	GD = 1.0	Grade 1%
➢ Curvature Factor	CU = 1.85	R=500m on approach
➢ Under structure Conditions	US = 2.4	High occupancy land use, 16m above under–structure land use
➢ Design Speed	80 km/h	
➢ Adjusted AADT	RT×GD×CU×US)×AADT=39272	
➢ Percentage of Commercial Vehicles	15% (Assumed)	

- Rail offset 1.2m

AADT is conservative, Regular performance is deemed to satisfy.

AS 5100.1—2004 42

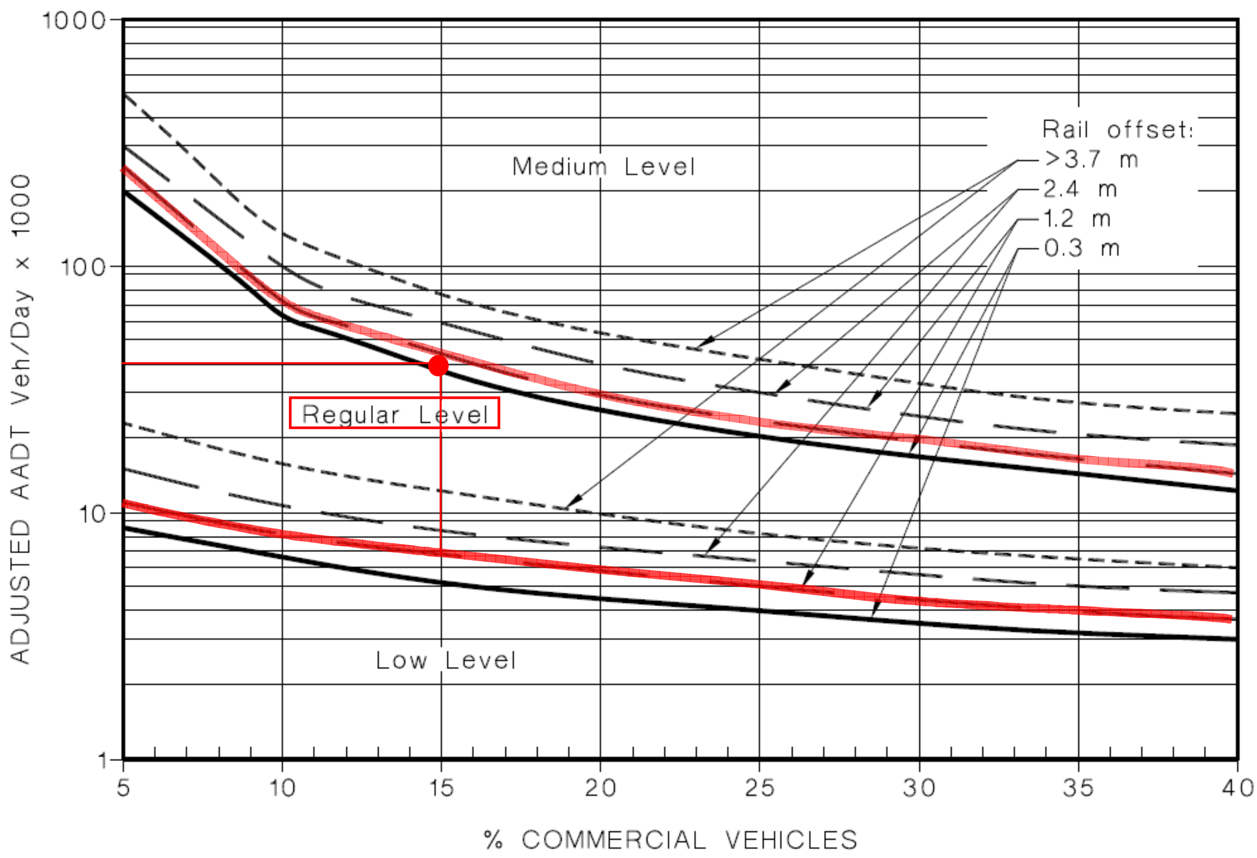

FIGURE B6 THRESHOLD LIMITS, 80 km/h

4.5 Deck Drainage

The bridge deck has a longitudinal fall of 1% and crossfall of 3% over the carriage way away from the central median and 2% across the shared path toward the carriage way.

Surface runoff will be captured in scupper drains and taken down to a diameter 225 mm fibre reinforced concrete (FRC) stormwater pipe located below the lower traffic barrier.

Gully pits and pipes will be provided at the southern and northern approaches to intercept water runoff entering and exiting the bridge.

The scupper drains in the deck consist of a square grate; the grate is a non-slip FRP product with adequate load bearing capacity to support a wheel load. The grating has openings of only 13mm square, and as such provides a safe, slip-resistant flat surface for pedestrians and cyclists. The square drains mini mesh FRP grate is cut from a larger sheet, and as such small sizes can easily be accomplished. The concrete will be screeded to a low point beneath the grate where the water will be drained by a diameter 150mm stainless steel pipe through the deck and down to the longitudinal FRP stormwater pipe. The longitudinal grade of the pipe is the same as the longitudinal grade of the bridge, so that the bottom of the pipe will always be above the soffit of the planks, to reduce any visual impact.

The suspended longitudinal pipe connects to a buried longitudinal pipe through a penetration in southern abutment. Run off water from the deck will be taken from the buried pipe behind southern abutment, and into a stormwater pit, where it will be included in the local stormwater drainage system.

This arrangement reduces maintenance requirements by only using one longitudinal pipe on the bridge.

5 DURABILITY

The required design lives of the bridge structures are 100 years. The options considered consist primarily of reinforced or prestressed concrete elements. Concrete specifications and cover requirements to reinforcement and prestressing strands will be in accordance with Roads and Maritime Services and AS5100 requirements. The steel railings of the traffic barrier will be hot dip galvanised and may require re-application of the protective system to maintain the design life of 100 years. Inaccessible, exposed elements are manufactured from stainless steel where they cannot be readily replaced.

The soil aggressively testing is not available at the concept design stage. This needs to be investigated and incorporated into later design stage in the future.

AS 2159 will be used for the pile concrete strength and cover requirements. AS 5100.5 will be used to determine the cover requirements for the remaining structural elements for the various concrete exposure classifications.

The reinforcement grade adopted for the Bridges will be deformed bars (Grade 500N) with yield strength of 500 MPa. The pressurising strands are 7-wire, ordinary, diameter 15.2 mm with tensile strength of 1840 MPa and minimum breaking force of 250 kN, relaxation class 2. The force in each 15.2 mm diameter strand at the mid-span of each girder immediately after the release of the tensioning jack will be 188 kN.

6 DESIGN INTEGRATION WITH OTHER DESIGN COMPONENTS

6.1 Road alignment

The road geometry (including long section and cross sections) for the proposed bridge over Queanbeyan River takes into consideration allowances for services, existing infrastructure, future widening, clearance over Barracks Flat Drive for trucks, desirable height from RMS and a minimum of 600mm clearance over the 1:100year flood level.

The road alignment at the bridge location consists of a straight horizontal bearing and constant 1% longitudinal grade falling to the south. Both westbound and eastbound carriageways have a constant 3.0% cross fall away from the central median.

6.2 Landscaping

The landscaping plan and specifications includes plant type, plant size, plant spacing, planting schedule, details for planting, details for grassing and seeding, and defect maintenance requirements. For details refer to separate report.

6.3 Noise

In general, for receivers located close to a proposed bridge structure alignment, a higher bridge structure relative to the height of the receiver is likely to provide a level of acoustic benefit. This is due to the screening provided by the road bridge structure itself and the safety barrier (solid concrete barrier) at the edge of the bridge. This may also reduce the height requirements of any proposed noise barrier (in addition to the safety barrier) to block direct line of sight between the road traffic and receivers.

For the receivers on Barrack Flat Drive and Doeberl Pl, higher bridge levels are likely to provide a level of acoustic benefit due to potential screening provided by the bridge barrier. However, this benefit may not be significant if direct line of sight between the road traffic and receivers still exists. For details refer to separate report.

6.4 Hydrology and hydraulics

A preliminary flood study was undertaken by Opus to estimate the flood levels associated with 100 year and 2000 year ARI flood events. The table below summarises the flood levels and minimum clearances to the underside of the bridge beams.

Table 1 Flood Levels

ARI	Flood Level	Minimum Clearance
100yrs	RL579.11m	11m
2000yrs	RL584.55m	5.5m

Scour protection of the abutment slopes is required. It is proposed to use a rock layer to help protect the spill through embankments.

The superstructure arrangement of these bridges allows for scuppers and longitudinal drainage pipes to be accommodated between the beam alignments. The concept arrangement will be checked against hydrology findings in later stage.

6.5 Pavement

As per design brief, the new road carriageway shall be designed for a road pavement life of 40 years. The road surface is to include a wearing course.

The GA shows a 75mm wearing course on concrete deck. However, this needs to be investigated in the detail design stage as the bridge is located in a noise sensitive area. The pavement type BD1 may be more suitable for this location. The actual thickness of pavement type BD1 is 102 mm and the thickness consists:

- 45mm Stone Mastic Asphaltic (SMA 14) with A15E binder,
- 7mm seal with C170 binder,
- 45mm AC14 layer with AR450 binder. Base course with 14mm bitumen primer

  and
- 5mm waterproofing membrane with 10mm cover aggregate and a quick dry primer.

The pavement adjacent to the bridge approaches consists of granular pavement with sprayed seal wearing surface (Pavement tag LR03).

6.6 Survey

Opus commissioned Leach Steger to carry out a survey in project area. An electronic file titled **14001_001_Rev B** was received on 24th April, 2014. Following information were identified:

- Existing property fences (including type of construction, ground level, top of fence level and overall heights)
- Ground level, top of wall, overall height and type of any retaining walls
- Access points into adjoining properties, such as gates, etc.
- Existing kerb & gutter, (back of kerb, face of kerb, invert of gutter and lip of
- Gutter are all required) including locations of any stormwater pits
- Vehicular kerb crossings including returns
- Noise attenuation mound
- Road pavements, medians and traffic islands including traffic lane lines, edge of seal and edge of shoulder (where there is no kerb and gutter). All changes of pavement surfacing are to be picked up
- Formed pram ramps and footpaths including construction material
- Above ground services, such as utility poles, power lines, street lights, transformers, telecommunications elevated junction boxes etc.
- Traffic signals including pole locations and road signage

- Surface features of all existing underground services such as water mains, sewers, telecommunication services, electricity, gas, storm water drainage lines & pits, etc.
- Surface and invert/obvert levels, diameters and sizes of lintels, pits or access chambers of all stormwater and sewer lines
- Depths of watermains and telecommunication services at hydrant and telecommunication pits
- Position and size of other items within the road reserve and park areas, such as trees, plantations, bus shelters, guardrails etc.
- All significant changes in grade of the existing surface
- Position of existing survey marks
- Dial before you dig information, shown as approximate alignments using surface fixtures as a guide for locations.

The co-ordinate system is MGA 1994 Zone 55 (GDA 1994) and the datum is AHD.

6.7 Geotechnical

The geotechnical information for the bridge site is summarised below. Refer to the Geotechnical Investigation Report, GEOTFYSH09703AA-AC DRAFT Rev1, for detail.

There are five boreholes (B-1, B-2, B-3, B-4 and B-5) can be referred for bridge foundation design. The foundation conditions at the proposed bridge crossing differ to the north and south of the Queanbeyan River. To the north of the river, sand and clay colluvium overlies moderately weathered to fresh shale bedrock. To the south of the Queanbeyan River fill and sand, gravel and clay alluvium overlies variably weathered limestone. It is expected that footings will comprise piled footings to rock.

Open bored piles are unlikely to be practicable particularly on the southern piers and abutment. Continuous flight auger piles or cased bored piles should be practicable. For cased piles provision should be made for suitable cleaning buckets, dewatering equipment and concrete tremies.

Table 2 Proposed Rock Socket Design Parameters

Location	Rock Class	Design Modulus E_{field} (MPa)	Ultimate Shaft Adhesion f_s (kPa)	Ultimate Bearing q_{bm} (MPa)	Pile length from ground to toe L(m)
Abutment A	Shale Bedrock	2800	1000	60	3.0
Pier 1	Limestone Bedrock	900	500	12	4.0
Pier 2	Limestone Bedrock	900	500	12	4.5
Pier 3	Limestone Bedrock	900	500	12	10.5
Pier 4	Limestone Bedrock	2400	1500	40	5.0
Abutment B	Limestone Bedrock	2400	1500	40	7.5

6.8 Environmental

The pier arrangements for the twin bridges have been selected to avoid placing piers within the creeks. The superstructure arrangement allows construction of the deck from above, eliminating the need for temporary scaffolding beneath the deck and hence reducing the construction impact on the river below.

A Fisheries permit will be required from the Department of Primary Industry. The permit is based on the final design and therefore the design work shall take this into consideration, and any comments by the Department of Primary Industry included in the design.

Refer to Review of Environmental Factors for other information.

6.9 Utilities

ACTEW AGL 1800 diameter watermain

There is an ACTEW AGL 1800 diameter watermain in close proximity to the proposed road alignment from the intersection with Old Cooma Road to the crest of the hill adjoining Fairlane Estate (Barracks Flat Drive area). Near the crest of the hill the watermain crosses the proposed road alignment and continues onto Googong Dam.

The proposed piles for northbound are at least 10m apart from the watermain. The proposed piles for pier 4 of southbound are 2.5m apart from the watermain. It will be prudent to acquire ACTEW AGL's comments and conditions in detailed design to confirm the pile location.

Council watermain

A Council watermain is located in close proximity to the road from the intersection with Old Cooma Road through to the reservoir located in Greenleigh. The watermain is 300mm in diameter with several stop valves and overflow pipes that cross the proposed road alignment.

Proposed pile on northern abutment is 2m apart from this watermain. Council will be consulted for acceptable clearance to locate the pile.

Sewer main

There is also a sewer main runs under span 4. The proposed piles have four metres clearance to the sewer main. However, the related authority needs to be consulted in detail design stage.

Storm watermain

Storm watermain runs under span 3 and span 4 of southbound. The closest distance between pile and storm watermain is 3m. The acceptableness shall be confirmed in detail design.

A Utility Services Works Report will be provided with detail design report to include following details:

- The existing and proposed utility services in the project area
- The reasons for the adjustment and/or protection of each utility service
- The design of the adjustment and/or protection of each utility service
- The strategy for adjustment and/or protection of each utility service
- Each Service Authority's requirements for its utility services
- The program and cost estimate for each utility service.

6.10 Lighting

The Roadway lighting will be designed to Category V3 to AS/NZS 1158.1.1:2007 and AS/NZS 1158.1.3:1997 during Detailed Design.

The following design criteria are recommended:

- luminance-based requirements for straight sections
- Illuminance-based requirements for the intersections, converging and diverging traffic streams.
- All road lighting poles to be located a minimum 0.5 (to face of pole) from the back of the Shared User Path where practical. The set back of the poles in general would be a minimum of 4 meters from the travel lane.
- The preferred pole types would be standard poles or impact absorbing type as both types are acceptable following RMS design guide tables included on RMS drawing number EM827.
- Sylvania roadster luminaries are proposed
- The most economic roadway lighting solution is proposed to be 250W HPS IP66 luminaries mounted on 12 meter poles.
- The lighting design should incorporate dished bowl type luminaries for their higher light output allowing increased spacing compared with the flat visor type. Additional glare control is appropriate to reduce spill light onto residential properties, the flat (aero screen) type may be considered.

The bridge lighting is still to be confirmed by relevant party at this stage.

7 DESIGN COMPLIANCE

7.1 Design Compliance

The design drawings and report have been subjected to cross discipline reviews to ensure that integration of all individual design elements has been considered.

In addition to the cross discipline review, an internal verification of the engineering design and documentation of the bridge has been carried out. This involved a senior engineer undertaking a review of the design in a formalised verification.

A technical review of the design and documentation of the Bridge has been carried out by senior engineers.

The design documentation will be reviewed by QCC and RMS. The review comments will be incorporated into the subsequent design submissions.

7.2 Certificates

A design certificate will be provided prior to the IFC status for the drawings.

8 Safety in Design

Safety in design will be addressed in a number of ways during the project. A list of potential risks will be identified and mitigated where possible, some of these had safety in design elements.

Based on previous project experience, a Safety-in-Design (SID) risk register has been developed by the designer at this early stage. Some Hazards that have not been eliminated, during the SID process, still pose a residual Risk. The designer has identified appropriate Risk Control Measures, to reduce the Residual Risk Rating of all remaining Hazards.

Safety in Design Risk Register

(1) Haz Ref	(2) Activity/Process/ Material/Element	(3) Hazard	(4) Stage of Work	(5) Initial Risk Level[1] Probability	Severity	Risk Level	(6) Risk Control Measures: Design action taken, record of decision process including option considered, design constraints and justification for options/actions not having been taken	(7) Residual Risk Level Probability	Severity	Risk Level	(8) Is there a 'significant'[2] residual risk to be passed on? (Y/N)	(9) If answer to (8) is Yes, information flow: D/P/F[3]	(10) Status (Active / Closed)
1	Undefined re-routing of vehicle, cycle, and pedestrian	* Vehicle and cycle collision * Struck by vehicle	Construction	D	5	S	Contractor to provide Traffic Management Plan.	A	5	M	N		
2	Undefined re-routing of ship	* Worker struck by ship in the creek * Ship hitting on going construction of bridge	Construction	B	5	H	Contractor to provide Traffic Management Plan.	A	5	M	N		
3	Plant accident	Large plant with heavy loads on narrow, steep local roads causing * injury to worker * injury or death to public	Construction	C	4	S	Contractor to provide Traffic Management Plan.	A	4	M	N		
4	Access onto bridge construction site	Failure of temporary tracks - general construction traffic accessing site causing worker injury	Construction	B	4	H	Contractor to ensure proper Temporary Works Design (e.g. ground stability).	A	4	M	N		
5	Temporary works	Failure of temporary works due to: * inadequate design * improper installation * overloading	Construction	B	5	H	Ensure proper certification of temporary works design.	A	5	M	N		
6	Stability of the existing permanent structures affected by the works	Collapse of existing permanent structures causing damage to property and injury or death.	Construction	B	4	H	Ensure proper certification of temporary works design.	A	4	M	N		
7	Failure of batter slope	Failure of batter slope causing injury to worker	Construction	C	3	H	Proper design and constrcution of batter slopes.	A	3	L	N		

(1) Haz Ref	(2) Activity/Process/ Material/Element	(3) Hazard	(4) Stage of Work	(5) Initial Risk Level[1]			(6) Risk Control Measures: Design action taken, record of decision process including option considered, design constraints and justification for options/actions not having been taken	(7) Residual Risk Level			(8) Is there a 'significant'[2] residual risk to be passed on? (Y/N)	(9) If answer to (8) is Yes, information flow: D/P/F[3]	(10) Status (Active / Closed)
				Probability	Severity	Risk Level		Probability	Severity	Risk Level			
8	Machinery overturn during loading/unloading	* soft grounds * machinery failure * failure of temporary support	Construction	C	4	S	Safe Work Method Statement (SWMS)	A	4	M	N		
9	Tidiness of construction area	Slips and trips	Construction	D	3	S	Contractor to maintain construction site tidy.	A	3	L	N		
10	Manual handling	Injury due to heavy weights	Construction	E	3	S	Safe Work Method Statement (SWMS)	A	3	L	N		
11	Working near existing services	Striking existing services (buried and exposed) causing: * damage to property * injury or death to workers * inconvenience to public	Construction	D	5	S	Information on known existing services to be shown on drawings. Contractor to undertake full services investigation (dial before you dig) prior to construction.	A	5	M	N		
12	Working at height	Worker falling	Construction	E	5	S	* Design to minimise the amount of work done at height such as the use of precast Super T girders which are fully decked to provide a safe working platform during construction. * Safe Work Method Statement (SWMS)	A	5	M	N		
13	Elements or materials at height	Elements or materials falling onto workers below	Construction	E	4	S	Safe Work Method Statement (SWMS)	A	4	M	N		

(1) Haz Ref	(2) Activity/Process/ Material/Element	(3) Hazard	(4) Stage of Work	(5) Initial Risk Level[1]			(6) Risk Control Measures: Design action taken, record of decision process including option considered, design constraints and justification for options/actions not having been taken	(7) Residual Risk Level			(8) Is there a 'significant'[2] residual risk to be passed on? (Y/N)	(9) If answer to (8) is Yes, information flow: D/P/F[3]	(10) Status (Active / Closed)
				Probability	Severity	Risk Level		Probability	Severity	Risk Level			
14	Working over and in waterways	Falling and drowning	Construction	E	5	S	* The use of precast girders to obviate the need for falsework and formwork over and within the watercourse. * Span lengths were optimised to minimise the number of piers. * Design reinforcement that facilitates pre-fabrication. * Safe Work Method Statement (SWMS) to address this.	A	5	M	N		
15	Unexpected or underestimated flood levels	Worker injury	Construction	B	5	H	Contractor to provide Management Plan for action prior to and during rain events.	B	2	M	N		
16	Construction of piles	Barge overturn during piling works - machinery imbalance or failure (sinking, leaking)	Construction	C	5	S	* Either provide platform for the temporary works instead of barge or safely anchor barge. * Safe Work Method Statement (SWMS)	A	5	M	N		
17	Construction of piles	Long and heavy pile reinforcement cages causing injury to worker	Construction	E	3	S	Safe Work Method Statement (SWMS)	B	3	M	N		
18	Bridge under construction	Collapse of structural elements	Construction	B	5	H	* Bridge design allows for a suitable seating length for the precast beams. * Contractor to ensure correct concrete strength is achieved prior to removal of formwork.	A	5	M	N		
19	Unprotected vertical bar ends	Injury due to unprotected bar ends	Construction	D	3	S	Vertical bars to be protected by caps.	A	3	L	N		
20	Concrete pouring / finishing	Cement induced dermatitis	Construction	E	3	S	Safe Work Method Statement (SWMS)	A	3	L	N		
21	Cranage of structural elements such as precast Super T girders	Struck by moving machinery or turning of plant	Construction	C	5	S	Safe Work Method Statement (SWMS)	A	5	M	N		

(1) Haz Ref	(2) Activity/Process/ Material/Element	(3) Hazard	(4) Stage of Work	(5) Initial Risk Level[1]			(6) Risk Control Measures: Design action taken, record of decision process including option considered, design constraints and justification for options/actions not having been taken	(7) Residual Risk Level			(8) Is there a 'significant'[2] residual risk to be passed on? (Y/N)	(9) If answer to (8) is Yes, information flow: D/P/F[3]	(10) Status (Active / Closed)
				Probability	Severity	Risk Level		Probability	Severity	Risk Level			
22	Cranage of structural elements such as precast Super T girders	Struck by collapse of lifting crane or lifted element exceeding crane capacity	Construction	B	5	H	Weights are documented on drawings to determine required crane capacity.	A	5	M	N		
23	Placing of precast Super T girders	Unable to fit in girders due to vertical and horizontal curve.	Construction	D	1	H	Tolerance to be strictly controlled.	A	1	L	N		
24	Installation of lighting and other services	Working at height / fall from height	Construction	D	4	S	* Lighting columns located between handrails with easy access from the footways.* Temporary platfroms to be used by the contractor when access from footways is insuficient.* Safe Work Method Statement (SWMS)	A	4	M	N		
25	Bridge surfacing	Burnt by hot bitumen	Construction	C	3	H	Suitability of proposed system to be reviewed prior to acceptance.	A	3	L	N		
26	Incorrect welding	Injury such as burn or blinding	Construction	C	4	S	Safe Work Method Statement (SWMS)	A	4	M	N		
27	Flammable materials not removed from site of hot works	Injury due to fire or explosion	Construction	C	4	S	Safe Work Method Statement (SWMS)	A	4	M	N		
28	Bridge in service	Ship collision with pile cap when water level is higher than pile cap.	Operation	C	5	S	Bridge designed for ship collision.	A	5	M	N		
29	Bridge maintenance	Working at height / fall from height	Maintenance	C	4	S	* Handrails to be hot-dip galvanized to minimise re-painting. * Services to be located in footways covered with removable precast panels. * Abutment and pier headstocks designed to provide space to locate temporary jacks for bearing maintenance.	A	4	M	N		

(1) Haz Ref	(2) Activity/Process/ Material/Element	(3) Hazard	(4) Stage of Work	(5) Initial Risk Level[1] Probability	Severity	Risk Level	(6) Risk Control Measures: Design action taken, record of decision process including option considered, design constraints and justification for options/actions not having been taken	(7) Residual Risk Level Probability	Severity	Risk Level	(8) Is there a 'significant'[2] residual risk to be passed on? (Y/N)	(9) If answer to (8) is Yes, information flow: D/P/F[3]	(10) Status (Active / Closed)
30	Bridge demolition	Injury to worker and general public	Demolition	C	5	S	* Design uses precast units (Super T girders and footpath panels) to make it easier to dismantle bridge. * Safe Work Method Statement (SWMS)	A	5	M	N		

Notes
Use Hazard Quantification Tables
Information codes: D = Information detailed on drawings (add drawing nos); P = Information for Pre-Tender Health and Safety Plan; F = Information for Health and Safety File
Project Manager (or Design Team Leader, as appropriate) to check and approve Record unless the design work has been carried out directly by the Project Manager (or Design Team Leader) in which case the Record is to be checked and approved by the Project Director (or Sub-Project Director, as appropriate).

Likelihood	
Probability of Occurrence	Probability Index
So unlikely that probability is close to zero	A
Unlikely to occur, though conceivable	B
Likely to occur sometime	C
Occurrence not surprising. May occur more than once	D
Occurrence inevitable. May occur many times	E

Severity	
Potential Maximum Consequence (Hazard Severity)	Hazard Severity Index
Minor injury/illness resulting in lost time of 3 days or less	1
Injury/illness causing lost time more than 3 days	2
Major illness/injury to one or more persons not causing permanent disability	3
Single fatality or single/multiple permanent disability	4
Multiple fatality	5

Risk Level					
Hazard Severity Index	Probability Index				
	A	B	C	D	E
1	L	L	M	H	H
2	L	M	H	H	H
3	L	M	H	S	S
4	M	H	S	S	S
5	M	H	S	S	S

Risk Level Action		
Risk Level	Description	Action by Designer
L	Low	Check that risks cannot be further reduced by simple design changes
M	Medium	
H	High	Amend design to reduce risk, or seek alternative option. Only accept option if justifiable on other grounds.
S	Severe	

9 URBAN DESIGN

Following urban design philosophy was adopted in bridge concept design:

1. Have an open appearance with minimal impact on the surrounding area.
2. Bridge traffic barriers with low profiled concrete plinths and twin steel rails are preferred over full height concrete barriers.
3. Spill through abutments are preferred to encourage maximum light beneath the bridges.

10 CONSTRUCTABILITY

The site does not pose any major constructability constraints.

Piers will be located to avoid the alignment of the flow channel.

Existing utilities will be protected or removed prior to any construction activities which may have an impact on them.

Barrack Flat Drive will be affected during construction of southern end span. However, traffic can be switched to the existing dirt track located at the north of Barrack Flat Drive.

It is understood, the northbound bridge will be constructed first. The abutments and approaches of northbound bridge will be detailed to provide convenient joint to southbound abutments and approaches. The design will aim to avoid demolishment on any part of northbound bridge during construction of southbound bridge.

11 OPERATION AND MAINTENANCE

The proposed bridges are concrete structures that require less maintenance compared to a steel structure.

The Super Tee girder bridges over the river utilise laminated elastomeric bearings, which may require replacement during bridge design life. Provisions and specification will be noted on detail design drawing for bearings replacement.

Expansion joints are reduced to two and are located at ends of bridge. This minimises the maintenance and repair work if required. Link slabs at the pier locations reduce the number of deck movement joints and reduce maintenance requirements.

APPENDIX A – General Arrangement

APPENDIX B – Form 62

BRIDGE DESIGN PROPOSAL - SUMMARY AND APPROVALS

WBS No: TBD **Sketch No:** TBD **File No:** TBD

RMS Region:	Southern	Bridge No:	
Road No:		Local Government Area:	Queanbeyan City Council
Project:	Ellerton Drive Extension		
REASON FOR NEW BRIDGE:	To allow Ellerton Drive to pass over Queanbeyan River		
PROPOSED BRIDGE:	Bridge over Queanbeyan River - Stage one Northbound		

Number and length of spans:		5(30/38/36/30/30)	m	Overall length:	164	m
Bridge width: Between traffic barriers		9.4	m	Overall:	14.25	m
Number of footways: 1	Width:	2.5	m	Side:	North	
Type of wearing surface:	75mm thick bituminous surfacing					
Superstructure:	7 No. 1800mm deep Super Tee girders with 200mm thick in situ deck slab					
Substructure:	Abutments: Piers:	2 No. 1200mm diameter bored piles socketed into rock. 2 No. 1200mm diameter RC columns supported on 900mm diameter bored piles socketed into rock.				
Clearances:	11.00m minimum clearance above 100yr flood level					
Special features and requirements:	None					

ALIGNMENT

Horizontal alignment:	Straight / ~~Curved~~ *	Bearing	207° 45 ‘ 53 “	Radius	N/A	
~~Skew~~ *	° ‘ “ L/R	Crossfall	3.0%	* Strike through to delete		
Vertical Alignment	Grade: 1%	~~Summit~~ / ~~Sag Curve~~: *				
RL Datum:	AHD	Coordinate Grid (MGA, ISG, Local):			MGA	
Chainages at end of deck:	Abutment A		3356.00	Abutment B	3520.00	
Levels at end of deck:	Abutment A		593.970	Abutment B	592.444	
Source of horizontal and vertical alignment information: (eg: Bridge Site Survey Drwg No, MX File etc)		Measured on Road Design Control Line (Refer Drg)				

ESTIMATED COST AND SIGN OFFS

Estimated construction cost** = Deck area*** m2 @ estimated deck unit rate $/m2

	$2337m^2$	@ $ TBD	= $ TBD

** Cost does not include any allowances for design, supervision or cost variations

*** Deck Area measured between bottom faces of parapets + clear footway width

Recommended	**Concurrence**	**Submitted**	**Approved**
Supervising Bridge Engineer (New Design)	Principal Bridge and Structural Engineer / Senior Bridge Engineer (New Design)	RMS Project Manager	Principal Bridge Engineer / Senior Bridge Engineer (New Design)
****Consultant’s Rep	**** Consultant’s Director		**** RMS Regional Mgr
Date:	Date:	Date:	Date:

**** Other than RMS Bridge Engineering in-house or managed designs

BRIDGE DESIGN PROPOSAL - SUMMARY AND APPROVALS

WBS No: **TBD** **Sketch No:** **TBD** **File No:** **TBD**

EXISTING BRIDGE			
Drawing No:	N/A	General File No:	N/A
Bridge No:	N/A	Year Constructed:	N/A
Type of substructure:	N/A	Type of superstructure:	N/A

Width between parapets or kerbs:		N/A	m	Footways:	N/A
Length:		N/A	m	Number of spans:	N/A
Deck level RL:	N/A	Above H.F.L.:	Yes / No	Navigation Clearance:	N/A
Condition (incl. any load rating):					

Proposed future use of existing bridge:	N/A
Public Utility Services (No off, size and type):	N/A

CLEARANCES				
Horizontal:	Actual	N/A	m from	N/A
	Required	N/A	m	N/A
Vertical:	Actual	11	m above	100yr flood level
	Required	0.3	m	100yr flood level

APPROACHES		
Road Plans No (or File No):	TBD	
Design Speed:	80	km/hr
No of Lanes:	2	
Median Width:	1.8	m
Shoulder Widths:	1.2	m
Verge Width:	0	m
Formation Width:	14.25	m
AADT/ Year:	8845 (2031)	
% of Commercial Vehicles:	15	%
Pavement type on approaches:	Flexible Pavement	

BRIDGE DESIGN PROPOSAL - SUMMARY AND APPROVALS

WBS No: **TBD** **Sketch No:** **TBD** **File No:** **TBD**

WATERWAY							
WATERWAY REPORT No:	Queanbeyan Flood Plan Risk Management Study and Plan		Date:	2014			
General Comments:	TBD						
Catchment Area:	TBD	km^2	Normal water level RL	570.000			
Is waterway navigable?	Yes / ~~No~~ *	Is waterway tidal?	~~Yes~~ / No *	MHWS RL	TBD	MLWS RL	TBD
Observed H.F.L.	RL	No	Date	TBD			

Flood Event	Flood Level RL	Discharge	Stream velocity	Afflux
*Flood ARIs shall be amended t o suit service level of crossing	RL	m^3/s	m/sec	m
20* year ARI	TBD	TBD	TBD	TBD
100* year ARI	RL579.11m	1423	2.6	TBD
2000 year ARI	RL584.55m	530	3.8	TBD

Proposed Clearance:	11	m	above	100yr Flood Level		

Estimated Depth of Scour:	TBD	m	Scour protection required?	Yes / No / To be determined *
Estimated depth of debris for debris loading:	TBD	m		

SUBSTRUCTURE								
							TBD indicates To Be Determined	
GEOTECHNICAL REPORT No:	GEOTFYSH09703AA-AC DRAFT Rev1			Date	1 July 2014			
Geotechnical investigation completed	~~Yes~~ / No *	Further geotechnical investigation required					Yes / ~~No~~ *	
FOUNDATIONS								
Founding material:	Shale Bedrock at North of Queanbeyan River and Limetone at South							
Type of foundations:	Abutments:		2 No. 1200mm diameter bored piles					
(Spread footings or pile type)	Piers:		2 No. 1200mm diameter bored piles					
Allowable Bearing Pressure:	~~SLS~~ / ULS *	12000		kPa				
Maximum Pile Loads:	~~SLS~~ / ULS *	Abutment Piles	3820	kN	Pier Piles	8290	kN	
Pile Contract Levels:	Abut A RL	583.000		Abut B RL	576.500			
	Piers RL	570.500 / 567.000 / 567.000 / 575.500						

Basis for determination of Contract Levels and type of foundations:	Refer to geotechnical information presented in the Bridge Design Report.
Environmental Factors considered in selecting type of foundation: (Report attached Yes / No / N/A *)	There are no overriding environmental factors that impact on the selection of the foundation type.
WHS Factors considered in selecting type of foundation: (Report attached Yes / No / N/A *)	There are no OHS factors driving the selection of the foundation type.

BRIDGE DESIGN PROPOSAL - SUMMARY AND APPROVALS

WBS No: TBD **Sketch No:** TBD **File No:** TBD

SUPERSTRUCTURE:

Type of Superstructure:	7 No. 1800mm deep super Tee girders with 200mm thick in situ deck slab		
No of Spans:	5	Span Lengths:	30m, 38m, 36m, 30m, 30m
Reason for Selection:	Multi Criteria (Clear of water, Cost effectiveness, Constructability, Appearance etc.).		
WHS Factors considered in selection of Superstructure type: (Report attached ~~Yes~~ / No / ~~N/A~~ *)	Super Tee girders can span river, provide a working platform upon erection ensuring safe access above river.		
Environmental factors considered in selection: (Report attached ~~Yes~~ / No / ~~N/A~~ *)	There are no environmental factors driving the selection of the superstructure.		

DESIGN LOADINGS (Assume AS5100 unless stated otherwise)								
Traffic loading	SM1600							
No of 3.2m wide design lanes:	2		SM1600 loading:		Yes / ~~No~~ / ~~N/A~~ *			
Non Standard Truck loading:	TBD		Construction loading:		TBD			
Footway loading:	5kPa		Other loading:		None			
Fatigue Load Effects:	No of heavy vehicles per lane per day:		TBD		Route Factor :	0.3		
Superimposed Dead Load:	Bituminous Surfacing – 75mm thick							
Temperature	Range:	0 - 42℃	Gradient:		Bridge type 2, T=20℃			
Design Wind Speed:	ULS	48	m/s		SLS	35	m/s	
Differential Settlement:	TBD							
Mining Subsidence Parameters:	N/A							
Stream Flow Effects:	TBD							
Impact Loads:	~~Ship~~ / ~~Vehicle~~ / ~~Train~~ *		Part of the structure:		N/A			
Earthquake Design Parameters:	Acceleration coefficient	0.09	Importance factor	1.0	Site Factor	1.0	BEDC	1
Other Loadings:	None							

ARTICULATION					
Method of Resisting Longitudinal Forces:	Longitudinal force will be distributed to piers based on their stiffness.				
Method of Resisting Transverse Forces:	Lateral force will be transferred to substructure through lateral restraint block				
Longitudinal Movements (mm):	Thermal Expansion 15	Thermal contraction	22	Creep and shrinkage	41
Ultimate deck joint movements: (+ve opening, -ve closing):		Opening (mm)	77	Closing (mm)	19
Mining Subsidence:	N/A	Abutments integral with superstructure?			~~Yes~~ / No *

Deck Joints:		**Bearings:**		
Location	Type	Location	Number	Type
Abutment A	Expansion Joint	Abutment A	7	Laminated Elastomeric Bearing
Abutment B	Expansion Joint	Piers	14×3	Laminated Elastomeric Bearing

BRIDGE DESIGN PROPOSAL - SUMMARY AND APPROVALS

WBS No: **TBD** **Sketch No:** **TBD** **File No:** **TBD**

		Abutment B	7	Laminated Elastomeric Bearing

Bearing Replacement:	Provision made for jacking off substructure?	~~Yes~~ * / Not Required / ~~Falsework required~~

BRIDGE DESIGN PROPOSAL - SUMMARY AND APPROVALS

WBS No: TBD **Sketch No:** TBD **File No:** TBD

PROVISIONS FOR PUBLIC UTILITY SERVICES ON THE PROPOSED BRIDGE:

	Water	Sewer	Gas	Electricity	Telstra	Other
Number						
Size						
Side						

DRAINAGE:	Scuppers	Yes
If no scuppers, is width of flow contained in shoulder?		
Piped storm water under deck necessary		Yes

LIGHTING:	TBD

BARRIER TYPES:				
Traffic:	Class	~~Nil~~ / ~~Low~~ / Regular / ~~Medium~~ / ~~Special~~ *		
	Type	~~FHCF~~ / ~~TCF+1~~ / TCF+2 / ~~TB~~ / ~~Other~~ *		
Pedestrian:	Yes		Median:	N/A
Between carriageway and footway:	Yes			
Safety Screens:	Yes		Noise Walls:	Yes

FHCF = Full Height Concrete Type F; TCF+1 = Truncated Type F + single RHS rail; TCF+2 = Truncated Type F + 2 RHS rail; TB = Thrie Beam

DURABILITY	
Exposure Classification:	B1
Soil/Water Aggressivity:	TBD
Special durability measures (eg cathodic protection)	TBD

SPECIAL REQUIREMENTS	Required ?	Report Details
Environmental (eg EIS, REF):	Yes / No *	
Fisheries:	Yes / No *	
Heritage:	Yes / No *	
Navigation (MSB, DPW):	Yes / No *	
Planning (DUAP):	Yes / No *	
Other:	Yes / No *	
Has Pier and Abutment position been pegged:	Yes / No *	
Is more pegging required:	Yes / No *	

BRIDGE DESIGN PROPOSAL - SUMMARY AND APPROVALS

WBS No: **TBD** **Sketch No:** **TBD** **File No:** **TBD**

CONCURRENCES			
Safety audit required?	Yes / No **	Safety audit completed?	Yes / No **
Audit Details	TBD		

Concurrence in Road Design Aspects:

Bridge geometry conforms to road design horizontal and vertical alignment, carriageway layout and cross falls	Yes / No **

I have taken this proposal and the associated sketches to site, located the abutments and piers, and I confirm that the design represents the conditions on site and meets the project objectives.

NOTE:
The RMS Project Manager or consultant Design Manager is responsible for obtaining the relevant Asset Managers concurrence

RMS Project Manager/ Design Manager ****		Date:	

Concurrence with asset management aspects:

Has risk assessment been done?	Yes / No **	If no risk assessment, is one required?	Yes / No **
Any additional requirements			

I have examined the Design Proposal and consider it satisfactory to proceed with the Detail Design.

RMS Regional Asset Manager		Date:	

Concurrences noted:

Supervising Bridge Engineer (New Design) / Design Manager ****		Date:	

** Strike through to delete
**** Other than RMS Bridge Engineering in-house or managed designs

Appendix O – Safety in Design Report

ELLERTON DRIVE EXTENSION QUEANBEYAN

SAFETY-in-DESIGN WORKSHOP

Workshop Report

November 2014

ABN 36 082 506 171

Prepared by:-

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1.0 Summary report

1.1 Background

Queanbeyan is experiencing a boom in growth with the addition of new townships, subdivisions and infill development. As a result, Queanbeyan's road network requires several upgrades to accommodate the City's rising population. Ellerton Drive Extension forms a major part of these upgrade works.

The proposed extension was identified in the *Googong and Tralee Traffic Study 2031* which Council adopted in early 2010. The study used land use data and traffic flows in the Queanbeyan/ Canberra area to analyse, test and optimise a number of 2031 future land use and infrastructure scenarios.

The traffic study found that traffic congestion on Cooma Street and the Queens Bridge improved only with the inclusion of the proposed Ellerton Drive Extension which is to provide an alternative route around the CBD. The new link will also provide an access over the Queanbeyan River in major flood events.

The proposed link will commence at the current end of Ellerton Drive and link to the new Edwin Land Parkway intersection at Old Cooma Road. It is envisaged that the road will generally be a two lane road with room for an on-road cycleway and an off-road shared path for pedestrians and cyclists. A bridge over the Queanbeyan River will be required and will be set for the 1:100 year flood event. However, design work for the project is taking into account the ultimate four lane road (if required past the 2031 forecast).

The benefits of the new road and alignment include:

- Provision of a free flow, controlled access, 80km/h design speed road for local residents as well as traffic travelling between Queanbeyan and the ACT
- Maintaining a connection between the east and the rest of Queanbeyan during a 1:100 year flood event
- An additional connection point for the Fairlane Estate and Greenleigh Estate (emergency only).

The recent announcement that both Federal and State governments would each provide $25.0 million to fund the project's construction has meant that this major infrastructure project can move forward. This funding is in addition to the $2.2 million provided by the State Government in 2014/2015 for development and early works.

OPUS International Consultants (OPUS) has undertaken the concept design on behalf of Queanbeyan City Council (QCC) and will undertake the detailed design of the road as well as the bridge detailed design. The design will need to take into consideration of noise studies, geotechnical investigations as well as the Species Impact Statement (SIS). Roads and Maritime Services are providing assistance to QCC on the project.

As part of the planning process a Safety-in-Design workshop is required in order to bring together key project stakeholders to identify key issues/hazards associated with the safe construction, operation and maintenance of the project and develop appropriate changes in the design to eliminate or manage the hazards.

The Australian Centre for Value Management (ACVM) was commissioned to facilitate and report on this workshop which was undertaken on **17th November 2014**.

A list of participants who attended the workshop can be found in **Appendix 1**.

1.2 Workshop objectives

The objectives for the workshop, as presented to the participants, were to:

- *Obtain a common understanding of the project and its current position*
- *Identify key hazards associated with the safe construction, operation and maintenance of the upgrade project and develop appropriate changes in the design to eliminate/ manage the hazards*
- *Identify a way forward to make the design robust as it is progressed.*

This report has been compiled by ACVM and seeks to provide an objective overview of the aspects discussed and the workshop outcomes formulated by the end of the day.

1.3 Workshop activities

The workshop process builds on the perspectives, as well as the detailed and specialist knowledge which reside with the workshop participants, then structures the safety-in-design identification and review from a functional base (ie. what is the project purpose and objectives, what are the key safety issues and risks we face from various perspectives and how can we eliminate/manage these risks through the design in order to achieve the project objectives?).

The workshop commenced with a presentation of the project context and overview. The project purpose and objectives as well as its givens and constraints were reviewed which allowed the workshop group to gain a common understanding of the current situation and determine how well the design responded to the project requirements.

Key issues/hazards in relations to safety-in-design (relevant to this project) as identified by the project team were reviewed and then added to by the rest of the workshop participants using their wider perspective.

The workshop participants then worked as a team in identifying what could be done in the design to eliminate the issue/hazard or what options could be considered. As a result a series of strategies and activities were highlighted for further action by the project team to progress the project (see ***Sections 2.2 and 2.3***).

1.4 Summary of safety risks that can be influenced by the design

A summary of key safety risks identified by the workshop group are shown below. Strategies to address them can be found in Sections 2.2 and 2.3.

Safety risks during construction

- Construction work undertaken near utilities (eg. overhead or underground power)
- Construction work over water (ie. piling, pile caps and superstructure works)
- Steepness of batter slopes in cuttings
- Potential land contamination issues.

Safety risks during ongoing operation and maintenance

- Culvert structures proposed for fauna underpasses and for flooding at two locations which could impact on user safety
- Extensive maintenance required on road median (natural grasses is proposed as the finish for medians). The medians need to be wide enough for safe maintenance by machine (slasher/sprayer). Consider maintenance in developing the width and finish of the shared pathway
- The safety of narrow shoulder widths to accommodate on-road cyclists and cyclists on the bridge
- The safe access and asset maintenance of stormwater, water and sewer assets. Batter slopes are proposed to be 2:1 and are acceptable of inspections but if machinery is needed to clean pits, etc it could be an issue
- Safe permanent access to bridge piers/ headstocks over water and access to abutments
- Safe maintenance of street lighting /working at heights and under live traffic
- The transitioning of traffic from 60-80km/h on the northern curve at Ch700
- Safety of the finished road surface (skid resistant as against noise impacts)
- Throwing objects onto traffic from the bridge onto Barracks Flat Drive
- Pedestrians crossing the road at uncontrolled crossing points
- Maintenance of stormwater treatment sites before it goes into the river as well as stormwater and treatment of emergency spills from the bridge.

1.5 Conclusions drawn

As a result of sharing information during the workshop, the group drew the following conclusions:

- The workshop confirmed that the design appears robust and has been improved from the asset owners perspective
- A number of risks (not just safety) have been identified and a direction formed as to how they should be resolved. It will require some tweaking and refining of the current design. However, there is confidence that we are developing a robust design and that a construction and maintenance methodology can be developed that will work
- Queanbeyan City Council needs to balance what practical safety improvements can be provided with the limited budget available
- Queanbeyan City Council also needs to ensure that the road asset delivered fits into the regime of their other assets for future maintenance.

1.6 Next steps?

To provide the workshop group with the next steps in the process, Tim Alexander, Project Manager, QCC Project Team, outlined the following points:

- A draft workshop report will be prepared by ACVM and forwarded to OPUS International for distribution to key participants for comment and then finalisation
- The risks highlighted in the workshop will be collated, discussed and the design refined accordingly and progressed
- The critical risks identified appear to be the fauna/pedestrian crossing issues and the bridge and shoulder width risks. Other significant issues have been resolved to a level that allows us to move forward to detailed design
- A safety road audit is still required to be undertaken
- The project is still on track to meet its first major milestone.

2.0 Project context

2.1 Introduction

The information presented in this section is a summary of project context presented to the workshop group to provide the background, overview and the current planning on the Ellerton Drive Extension Project. The workshop group also shared and obtained a common understanding of the project purpose and objectives as well as the givens and constraints that the project was being planned within. This would allow the participants later in the workshop to highlight critical safety risks and identify measures to overcome them.

2.2 Concept design presentation

Michael Hill, EDE Design Project Manager OPUS International Consultants, presented sketch plans for the project (see **Appendix 2**) highlighting key features and challenges along the route in order to allow the participants to obtain an understanding of the work undertaken to date so they could later identify key potential hazards and risks in the safe construction, operation and maintenance of the project that may be influenced by the design.

Key points raised in presentation were:

- OPUS International Consultants role in the project
- Proposed posted speed limits throughout the alignment (including the transition from 60km/h to 80km/h)
- The design will enable B-Double vehicle movements around Queanbeyan
- Climbing lanes (northbound and southbound)
- The project will be a staged development being:
  - Stage 1 – 2 vehicle lanes, shared pathway and earthworks for a dual carriageway (to meet the Traffic Study identified need in 2017)
  - Stage 2 – 4 vehicle lane ultimate configuration (to meet the Traffic Study identified need in 2031)
- Summary of alignment connections (access to Jumping Creek Estate, Lonnegan Drive – gated locked access, connection to 74 Barracks Flat Road – left in/left out, connection to Old Cooma Road)
- Bridge Crossing – Summary of bridge objective and concept configuration (crossing the Queanbeyan River)
- Cross Drainage summary
- Utility Services – Risks and potential clashes.

2.3 Project purpose and objectives

The workshop group reviewed the purpose and objectives of the project and agreed with the following:

Project Purpose (ie. why are we doing this project?)

It is to:

- Support the future traffic growth associated with the land use changes in Googong and Tralee and provide a flood free access for through traffic for the 1:100 year flood event as well as provide the opportunity to improve the amenity of Monaro Street (main street through the Queanbeyan CBD).

Project Objectives (What must the project achieve to be successful?)

To be successful the project should:

- Support and provide access to the future traffic growth associated with the land use changes in Googong and Tralee
- Provide improvements to ensure that the road network in Queanbeyan will meet the future transport demand

- Provide an alternative route of choice (attractive to use) for heavy vehicles, especially those accessing the quarry to the south on Old Cooma Road
- Improve connectivity and accessibility between Queanbeyan and the ACT region
- Improve efficiency and effectiveness of the road network in line with the Googong and Tralee Traffic Study 2031 and flood immunity requirements.

2.4 Givens and constraints we are working within

The group reflected on the givens and constraints that the project was being planned within. These were identified, amended where necessary, added to and agreed by the group as outlined below.

- The intersection at Ellerton Drive, Yass Road and Bungendore Road is not part of the current design scope. However, impacts at this intersection need to be considered
- A divided carriageway will be provided in the vicinity of the proposed Jumping Creek Subdivision
- The project is to start construction by mid 2015
- Early works need to be considered (ie. start in June/July 2015) in order to meet the project timeframe and funding profile
- There is a need to continue to engage and be transparent with the community and stakeholders about the project
- Biodiversity impacts of the project need to be carefully managed
- Legislatively, there are multiple authorities required to give environmental approvals for the project to proceed
- With the funding coming from three levels of government, procedures and standards in relation to a range of project aspects (ie. community releases, road standards, etc) need to be clarified and worked through
- Funding and funding sources need to be managed and matched to the required project timeframes
- There are existing utility services within the road corridor that may require relocation. The most sensitive service being the main water supply pipeline to the ACT
- The difficult terrain and constructability issues need to be considered and carefully managed
- The Queanbeyan River runs through the project and requires a bridge crossing as part of the project. Corridor access and earthworks transfer either side of the river need to be considered
- There is a need to supply an access off the Ellerton Drive Extension to the Jumping Creek Estate development early in the project
- Funding is a constraint. The funds are limited and there may need to be a decrease in the scope of work (in timing and amount). Intersection treatments may require separate funding.

3.0 Safety-in-design hazard identification and assessment outputs

The information presented in this section is a consolidation of the general outputs by the workshop participants as they shared information, highlighting and discussing safety hazards/risks. For those considered by the group as having potential to be eliminated or managed in the design, strategies and actions were identified to address them.

3.1 Key safety-in-design issues/hazards identification and strategies

At the commencement of the workshop, the participants were reminded of the focus of safety-in-design workshops being the identification of hazards associated with the safety of workers and those in the vicinity during construction, operation and maintenance with the aim of determining whether they can eliminated and/or managed through the design.

If the hazard identified cannot be eliminated or managed through the design, then a strategy relating to operating procedures during construction and operation would need to be put in place through contract documentation and Safe Method Work Statements (SWMS), etc.

To assist the group identify hazards relevant to the Ellerton Drive Extension Project, the generic hazard prompts developed by Roads and Maritime that may apply to designs was distributed to participants. These prompts included:

- Electricity and timing of relocation
- Piling and lifting of girders near power lines
- Working close to traffic
- Work close to plant
- Work at heights
- Haul on public roads (eg soils, large precast elements)
- Steep grades
- Cyclist strategy
- Pedestrians
- Logical, safe traffic management with appropriate design speed and acceptable to the TMC and regional network manager
- Work over water
- Confined spaces
- Temporary sight distance
- Gas
- Asbestos
- Need for temp signals
- Basins
- Separation of light and heavy plant
- Blasting
- Site security from unwanted visitors
- Maintenance safety including traffic management.

The safety-in-design identification process for this workshop involved the workshop group reviewing the key safety issues/hazards (relevant to this project) as identified by the project team and then adding others by the rest of the workshop participants using their wider perspectives.

The workshop participants then worked as a team identifying what could be done in the design to eliminate the issue/hazard or what options could be considered. As a result a series of strategies and activities were highlighted for further action by the project team to progress the project.

The group acknowledged that as more information becomes available further issues/risks would be identified that would need to be assessed. Further, it was acknowledged that some of the risks identified below may change in terms of likelihood and/or consequence over time and so will also require ongoing monitoring.

The information produced by the group in the workshop is shown below and can be used to populate a risk register and safety-in-design report as required as part of the concept design and detailed design outputs.

3.2 Key issues/hazards identified by the project team for consideration

Reference	Issue/Hazard	Potential Consequences	How Critical?	Can it be designed out? (Yes/No)	What can we do in the design to eliminate it or reduce its consequences? What options can we consider?	Outcome/ Strategy/ Action	Who
1	A culvert structure (approx. 2m high) is proposed for a fauna underpass and for flooding. Two locations - Jumping Creek and Ch 1660	Used as public underpass and flash flooding causes drowning	H	Y	Consider two separate structures at each location (one that is flood free – safer). Better for maintenance Design drainage system to ensure animals and pedestrians can use same culvert at different levels	Depends on topography and water flows at each location. Both locations should allow flood free movement of animals Allow pedestrian facility at Jumping Creek but not at Ch1660	OPUS to design appropriate structures
2	Road median treatment (natural grasses) and require extensive maintenance Width of median for safe maintenance and finish of median to be considered Shared pathway issues	Maintenance personnel hit by traffic while conducting maintenance activities	H	Y	Consider a permanent low maintenance option finish (ie. chip, bitumen seal, etc) Eliminate using workers on foot and minimise vegetation maintenance in the median Use of slasher/ sprayer machinery Include finish in REF	Include type of median and width in the REF Use mountable kerbs Width of median to be 6m so machinery can be used (slasher/sprayer). Low safety risk Aesthetically should consider natural grass Adopt the proposed cross section and document risk assessment of ongoing operation Adopt the shared pathway of 2.5m wide then 1m outside 3m shoulder Consider barrier on outside shared pathway where needed	OPUS

Reference	Issue/Hazard	Potential Consequences	How Critical?	Can it be designed out? (Yes/No)	What can we do in the design to eliminate it or reduce its consequences? What options can we consider?	Outcome/ Strategy/ Action	Who
3	Undivided Median. No barriers in median	Head-on vehicle collision resulting in injury or death	L			Design without median barrier. Low safety risk	OPUS
4	Narrow shoulder width to accommodate on-road cyclists and cyclists on the bridge Currently shared path with barrier to roadway but for on-road cyclists use of shoulder is 1.2m width (narrow). Vehicles travelling at 80km/h	Cyclist hit by vehicle on the bridge	H	Y	Consider signage and design in access breaks to indicate on-road cyclists to use share pathway to cross bridge Allow min 1.2m both sides of road Check Ausroads guidelines Consider cantilever so that shoulders are 2m wide on bridge and shared pathway approx. 2.5m stretching girder width	Document risk assessment of options to justify direction taken Review bridge design to maximise shoulder and lane widths within the girder widths available Ideally aim for 2m shoulders	OPUS
5	Stormwater asset maintenance (pits, headwalls and catch drains). Batter slopes are 2:1 and appears OK for inspections but if machinery is needed to clean pits, it could be an issue	Accident occurs when maintaining stormwater assets (pullovers not sufficient)	H	Y	At each drainage crossing point, examine in the design how stormwater assets will be accessed after construction (from roadway or from local road network) Same process for access to water mains. Need vehicle access (minimum access conditions for a "bobcat")	At each drainage crossing point, examine in the design how stormwater assets will be accessed after construction (from roadway or from local road network) Same process for access to water mains. Need vehicle access (minimum access conditions for a "bobcat")	OPUS
6	Access to water and sewer utilities (water mains, reservoirs, pump stations, etc)	Vehicle accidents due to difficult maintenance access			As with item 5 (only a few locations)		OPUS

Reference	Issue/Hazard	Potential Consequences	How Critical?	Can it be designed out? (Yes/No)	What can we do in the design to eliminate it or reduce its consequences? What options can we consider?	Outcome/ Strategy/ Action	Who
7	Excavation, slope stability (eg. excavations/ trenches, embankment stability). All cuts are 2:1. Where larger cuts are required, benching has been allowed for	Collapse of excavation		N	Treated by flattening out cuts as much as possible Benching Match the cuts and batters to geotechnical investigation findings		Contractor to consider Make provision for temporary slope stability measures in contract documents
8	Rock fall in rock cut	Injury caused from being hit by falling rock		N	As per item 7 Check geotechnical investigations to determine if potential for loose rock that may fall during operation		
9	Working near utilities (eg. overhead or underground power)	Striking of services particularly if not identified during survey investigation Injuries to staff		Y	Identify utility locations and undertake potholing where services are crossing the project Check clearances for two high voltage and one low voltage service Ensure “Dial Before You Dig” service is used	Identify utility locations and undertake potholing where services are crossing the project Check clearances for two high voltage and one low voltage service Ensure “Dial Before You Dig” service is used	OPUS
10	Working near traffic (eg. Barracks Flat Drive, existing Ellerton Drive, Old Cooma Rd, etc)	Traffic delays and accidents		N	Appropriate traffic controls during construction High risk of vandalism and throwing items off overpass at Barracks Flat Road. Put appropriate safety measures in place		Contractor to consider

Reference	Issue/Hazard	Potential Consequences	How Critical?	Can it be designed out? (Yes/No)	What can we do in the design to eliminate it or reduce its consequences? What options can we consider?	Outcome/ Strategy/ Action	Who
11	Maintaining access during construction (local accesses for adjoining property owners)	Traffic delays and accidents		N	Ensure appropriate safety procedures and safety plans are put in place (SWMS, etc)		Contractor to consider
12	Working over water - piling and pile caps	Injuries associated with erection of, and working off, platforms/steep embankments.		Y		Current design is for one span bank to bank and sheet piles on edge of river	OPUS
13	Working over water - superstructure	Falling elements Injury due to poor access		Y		Current design is for Super T girders butted together	OPUS
14	Permanent access to bridge piers/ headstocks over water	Injury or drowning while accessing pier pile caps for maintenance.		Y	Cast in attachment points Use appropriate scaffolding Consider use of an integral structure	Constructability analysis to determine the appropriate course of action	OPUS
15	Access to abutments	Injury due to trips or falls, or interaction with live traffic Increased crime and injury due to people residing under the bridge.	M	Y	Provide appropriate headroom under bridge. Access from Barracks Flat Road and provide a stairway with locked gates up to abutments Consider fencing off area and having gates (examine further in detailed design)	Provide appropriate headroom under bridge. Access from Barracks Flat Road and provide a stairway with locked gates up to abutments Consider fencing off area and having gates (examine further in detailed design)	OPUS
16	Failure of girder lifting lugs	Falling precast elements causing injury or death		N		Undertake proper structural design and checks	
17	Erection of bridge girders	Girders falling causing injury/death		N	As above	Undertake proper structural design and checks	

Reference	Issue/Hazard	Potential Consequences	How Critical?	Can it be designed out? (Yes/No)	What can we do in the design to eliminate it or reduce its consequences? What options can we consider?	Outcome/ Strategy/ Action	Who
18	Flooding of Queanbeyan river during construction	Flood events with works being inundated or washed away. Safety to staff compromised trying to remove equipment and evacuate site.		N?		Location of site compounds identified are not very flood prone Obtain notification when flood waters are released	Contractor to consider
19	Damage to unidentified services and injury to people undertaking excavation	Striking of services, particularly if not identified during survey investigation Injuries to staff		N	Corridors are fixed Potholing and specify in contract	Identify utility locations and undertake potholing where services are crossing the project. Corridors are fixed Check clearances for two high voltage and one low voltage service Ensure "Dial Before You Dig" service is used. Specify in contract	Specify in contract documents
20	Depth of excavation	Construction activities/ lack of soil stability		N	Have only minimum depth of trenching where possible and use SWMS Match excavation depths and safety measures to geotechnical investigation findings		
21	Maintenance of street lighting / working at heights and under live traffic	Falling and vehicle collision		Y	Current design is for lights at intersections, the bridge and the northern curve Street lighting control points to be outside clear zones Long lasting bulbs for low maintenance	Current design is for lights at intersections, the bridge and the northern curve Street lighting control points to be outside clear zones Long lasting bulbs for low maintenance	OPUS & QCC

Reference	Issue/Hazard	Potential Consequences	How Critical?	Can it be designed out? (Yes/No)	What can we do in the design to eliminate it or reduce its consequences? What options can we consider?	Outcome/ Strategy/ Action	Who
22	Safety for church access	Potential accidents due to right turning movements	H	Y	Design median to prevent right out turning movement	Design median to prevent right out turning movement	OPUS
23	Northern curve at Ch700 (transitioning from 60 – 80 km/h speed)	Loss of control of vehicle	H	Y	Reduce posted speed to 60km/h, provide dividing median, add lighting within this bend, design a 220m radius curve Consider wider lane widths at this point and provide other visual cues, signage, etc Consider taking shared path off-road and tighten up shoulders to 1m, etc to ensure it looks like a 60km/h zone Consider sight distance to Church and whether the road could continue at 80km/h for longer length	Reduce posted speed to 60km/h, provide dividing median, add lighting within this bend, design a 220m radius curve Consider wider lane widths at this point and provide other visual cues, signage, etc Consider taking shared path off-road and tighten up shoulders to 1m, etc to ensure it looks like a 60km/h zone Consider sight distance to Church and whether the road could continue at 80km/h for longer length	OPUS to provide advice

3.3 Key issues/hazards identified by the workshop group for consideration

Reference	Issue/Hazard	Potential Consequences	How Critical?	Can it be designed out? (Yes/No)	What can we do in the design to eliminate it or reduce its consequences? What options can we consider?	Outcome/ Strategy/ Action	Who
24	Road surface (skid resistant as against noise)	Safety and cost aspects		Y	Open grade – quite Chip seal – noisy but cheaper	Undertake cost benefit and balance pavement cost with noise walls requirement costs	OPUS
25	Temporary river crossing during construction period for materials and other access			N		Cover environmental issues in REF. Contractor to consider	Contractor issue
26	Throwing objects onto traffic from bridge onto Barracks Flat Drive	Safety of road users on Barrack Flat Drive		Y	Provide safety screens on bridge to prevent	Undertake a risk assessment procedure and determine if there is a need to supply safety screens if required. RMS to supply procedure/template	OPUS
27	Carriageways too wide	Safe crossing of road during maintenance		N		Use SWMS	QCC
28	Steepness of batter slopes in cuttings. Grassing batter slopes	Safety during maintenance		Y	Designing to 2:1 batter, designing to geotechnical investigation findings with slope stabilisation	Check to ensure that batters are not washed out Use SWMS	OPUS
29	Potential land contamination	Known natural land contaminated areas in Jumping Creek		Y	Environmental (not safety) issue need to contain dust and runoff Avoid excavation in this area or cap appropriately	Measures put in place to minimise this impact	OPUS
30	Alignment of the road in east/west direction with sunsets/sunrises glare hazard			N		Road is predominantly north/south Consider less reflective road pavement	OPUS

Reference	Issue/Hazard	Potential Consequences	How Critical?	Can it be designed out? (Yes/No)	What can we do in the design to eliminate it or reduce its consequences? What options can we consider?	Outcome/ Strategy/ Action	Who
31	Pedestrians cross road at uncontrolled crossing points	Safety risk during operation		Y	Not encouraging use of underpass at Ch1660 Pedestrian underpass shared at Jumping Creek Estate Consider the use of boundary fencing and direct pedestrians to safe crossing points (to be determined)	Not encouraging use of underpass at Ch1660 Pedestrian underpass shared at Jumping Creek Estate Consider the use of boundary fencing and direct pedestrians to safe crossing points (to be determined)	OPUS
32	Overhead powerlines around the bridge, box culvert sites and noise walls/use of cranes	Safety risk during construction			Corridor of road fixed Relocate services to avoid clashes particularly high safety risk services	QCC to liaise with service agencies on relocation, safety risks, etc	QCC
33	Confined spaces/ stormwater pits	Safety during maintenance		N	Ensure spaces and pits are big enough to access Use SWMS during maintenance	Ensure spaces and pits are big enough to access Use SWMS during maintenance	OPUS & QCC
34	Securing of construction site from public	Unsafe and uncontrolled access to construction site		N	Stipulate in contract to construct boundary fencing first Direct pedestrians and others to safe crossing points		Contractor to consider
35	Location of compound sites	Unsafe access points to site for materials delivery and disposal Site proximity to conflict uses (ie. public, etc)		N	A number of sites identified Control the risk so access to site is controlled	In progress	OPUS and contractor
36	Maintenance of stormwater treatment sites before it goes into river	Uncontrolled access to any basins		Y	Designed to go into Jumping Creek catchment and treated there. Environmental issue Fencing of basins	In progress	OPUS & QCC

Reference	Issue/Hazard	Potential Consequences	How Critical?	Can it be designed out? (Yes/No)	What can we do in the design to eliminate it or reduce its consequences? What options can we consider?	Outcome/ Strategy/ Action	Who
37	Stormwater and emergency spillway treatment from bridge			Y	Collected and treated in basins Protection and fencing of basins	Collected and treated in basins Protection and fencing of basins	OPUS & QCC
38	Signposting	Maintenance and access of signpostings		N	No high or exposed gantries. Low risk		

3.4 Summary of safety risks that can be influenced by the design

A summary of key safety risks identified by the workshop group are shown below. Strategies to address them can be found in Sections 2.2 and 2.3.

Safety risks during construction

- Construction work undertaken near utilities (eg. overhead or underground power)
- Construction work over water (ie. piling, pile caps and superstructure works)
- Steepness of batter slopes in cuttings
- Potential land contamination issues.

Safety risks during ongoing operation and maintenance

- Culvert structures proposed for fauna underpasses and for flooding at two locations which could impact on user safety
- Extensive maintenance required on road median (natural grasses is proposed as the finish for medians). The medians need to be wide enough for safe maintenance by machine (slasher/sprayer). Consider maintenance in developing the width and finish of the shared pathway
- The safety of narrow shoulder widths to accommodate on-road cyclists and cyclists on the bridge
- The safe access and asset maintenance of stormwater, water and sewer assets. Batter slopes are proposed to be 2:1 and are acceptable of inspections but if machinery is needed to clean pits, etc it could be an issue
- Safe permanent access to bridge piers/ headstocks over water and access to abutments
- Safe maintenance of street lighting /working at heights and under live traffic
- The transitioning of traffic from 60-80km/h on the northern curve at Ch700
- Safety of the finished road surface (skid resistant as against noise impacts)
- Throwing objects onto traffic from the bridge onto Barracks Flat Drive
- Pedestrians crossing the road at uncontrolled crossing points
- Maintenance of stormwater treatment sites before it goes into the river as well as stormwater and treatment of emergency spills from the bridge.

3.5 Conclusions drawn

As a result of sharing information during the workshop, the group drew the following conclusions:

- The workshop confirmed that the design appears robust and has been improved from the asset owners perspective
- A number of risks (not just safety) have been identified and a direction formed as to how they should be resolved. It will require some tweaking and refining of the current design. However, there is confidence that we are developing a robust design and that a construction and maintenance methodology can be developed that will work
- Queanbeyan City Council needs to balance what practical safety improvements can be provided with the limited budget available
- Queanbeyan City Council also needs to ensure that the road asset delivered fits into the regime of their other assets for future maintenance.

3.6 Next steps?

To provide the workshop group with the next steps in the process, Tim Alexander, Project Manager, QCC Project Team, outlined the following points:

- A draft workshop report will be prepared by ACVM and forwarded to OPUS International for distribution to key participants for comment and then finalisation
- The risks highlighted in the workshop will be collated, discussed and the design refined accordingly and progressed

- The critical risks identified appear to be the fauna/pedestrian crossing issues and the bridge and shoulder width risks. Other significant issues have been resolved to a level that allows us to move forward to detailed design
- A safety road audit is still required to be undertaken
- The project is still on track to meet its first major milestone.

Appendix 1. List of Participants

ELLERTON DRIVE EXTENSION, QUEANBEYAN
SAFETY-IN-DESIGN WORKSHOP – PARTICIPANTS LIST

Roads and Maritime Services

Ian Archer	Senior Project Manager
Jeff Rheinberger	Senior Project Manager
David Norman	Lead Designer (Road)

Queanbeyan City Council Team

Tim Alexander	Project Manager
Derek Tooth	Engineering Services Manager
Eli Ramsland	Project Engineer
Andre Pretorius	Manager, Water and Sewer
Nathan Cooke	Works Manager
Indumathi Appan	Asset Manager
Abdul Abujubbeh	Supervisor, Water and Sewer
Brian Drury	Supervisor, Roads Maintenance
Tim Geyer	Manager, Parks and Recreation

OPUS International Consultants

Michael Hill	EDE Design Project Manager
Matthew Ing	National Bridge Director
Peter Taylor	Senior Civil Designer
Ross Prestipino	Facilitator, ACVM

Appendix 2. Sketch Plans of Ellerton Drive Extension