ConnectBetter

Boyd Road Technical Note

Prepared for: NZ Transport Agency

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1. Introduction

Background

The New Zealand Transport Agency (NZTA) propose to replace the current Kawarau Falls one-lane bridge on SH6 with a two lane replacement adjacent to the current bridge. Following feedback from the community, NZTA have subsequently commissioned Abley Transportation Consultants to undertake a high-level comparative transport modelling assessment to consider the merits of an alternative bridge option connecting between Boyd Road and the Eastern Access Road to the east of the Remarkables Park shopping centre. The indicative alignment assessed and reported in this technical note differs from the Boyd Road options that had been considered earlier in the planning process and these previous options connected further to the east along the Eastern Access Road.

Transport modelling using the Queenstown-Lakes Tracks Transportation Model has been undertaken and NZTA Economic Evaluation Manual (EEM) procedures have been applied to measure the relative economic efficiency of the proposed replacement bridge and Boyd Road indicative alignment.

Transport Modelling

The Queenstown-Lakes District Council (QLDC) Tracks Transportation Model has been used to forecast the future traffic volumes and to produce outputs to enable an economic assessment of the transportation benefits of the two options.

The validated current base year of the model is 2012, with 2026 and 2041 future assessment years included to model the impact of future development and growth on the network. The model has been independently peer reviewed by Beca and has been signed off as appropriate for use.

The Tracks model is a 'Winter' model which represents typical traffic conditions from July to September and has three periods as follows:

- Morning peak (two hour model from 7-9am),
- Interpeak (seven hour model from 9am-4pm)
- Evening Peak (two hour model from 4-6pm)

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There are 245 morning and evening peak periods per annum and 505 interpeak periods per annum as calculated from SH6A traffic count profiles.

The following previous model build and validation reports provide further detail of the model build process, including network and land use assumptions and study-area wide validation results:

- Queenstown Lakes District Council Interim Model Update Technical Note Version 3, Abley Transportation Consultants, February 2014.
- Queenstown Lakes Transport Model Building Report 2001 – 2021, Gabites Porter Consultants, May 2006.
- Wakatipu Transportation Study: Draft Transportation Model Validation Report, GHD Limited and Beca Infrastructure Limited, February 2007.

2. Modelling Methodology

Model Refinement in Frankton

The transport model was refined in late 2014 in the vicinity of the Kawarau Falls Bridge and surrounding network as part of the preparation for business case assessments in Frankton including the proposed Eastern Access Road (EAR). All new roading infrastructure in the vicinity of Frankton was identified and added into the model in the model refinement process. Greenfield development areas that were included in the future forecast year models are as follows:

- Queenstown Gateway
- Shotover Park
- Queenstown Central
- Quail Rise
- Remarkables Park
- Hansen Road (Plan Change 45)

The zone system in the vicinity of Frankton was also refined and eight additional zones added. The land use forecasts for the District follow Statistics New Zealand high projections and include the full development of the residential and commercial greenfield areas listed above by 2041. Other land use inputs were provided by QLDC staff and Rationale planning consultants.

Infrastructure upgrades occurring between 2012 and 2026 and beyond included in the model were as follows:

- Roundabout at Grant Road with four laning of SH6 between Grant Road and EAR
- Glenda Drive improvements
- Eastern Access Road from SH6 including EAR/SH6 roundabout through to Hawthorne Drive

Two additional improvements were included in the Do Minimum to provide adequate Level of Service in the Do Minimum as per the EEM requirements. Whilst these works may not be planned or be preferred options for providing improvements at each location, they have been included to avoid unmanageable congestion within the transport model. The two improvements are:

- Dual circulating lane roundabout at SH6/SH6A intersection
- Dual circulating lane roundabout at current Remarkables Park shopping centre access

Local Area Validation

Additional 2013 data was collected in the Frankton vicinity and validation completed. **Table 2.1** displays the modelled and observed traffic volumes at key locations in and around Frankton for each of the three periods.

Table 2.1 Model Validation in the Frankton area

Location	Observed	Modelled	GEH	Observed	Modelled	GEH
Morning Peak	Forward			Back		
Glenda Dr	840	645	5.1	491	224	10.0
Hawthorne Dr	471	421	1.7	204	302	4.4
Riverside Rd	73	73	0	140	106	2.2
Lucas Pl E of Kawarau Rd	426	432	0.2	285	342	2.3
SH6 North of Lucas Pl	1253	1189	1.3	430	726	8.7
Lucas Place	1176	790	8.7	416	424	0.3
SH6 Sth of Lucas Pl	603	490	3.4	542	393	4.9
SH6 Nth of Humphrey St	688	395	8.9	654	495	4.7
SH6 South of Peninsula Rd	238	167	3.6	342	335	0.3
Inter Peak	Forward			Back		
Glenda Dr	2128	1857	2.3	2238	1789	3.8
Lower Shotover Rd	647	719	1.0	676	743	1.0
Lucas Place	1157	1093	0.7	1128	1091	0.5
SH6 Nth of Humphrey St	1994	1801	1.6	2067	2085	0.1
SH6 South of Peninsula Rd	912	1105	2.3	1126	1444	3.4
Evening Peak	Forward			Back		
Glenda Dr	398	463	2.2	809	772	0.9
Hawthorne Dr	914	825	2.2	1076	818	5.9
Riverside Rd	186	119	3.9	116	84	2.3
Lucas Pl E of Kawarau Rd	915	818	2.3	902	809	2.3
SH6 North of Lucas Pl	1394	1439	0.8	1365	1672	5.6
Lucas Place	997	1043	1.0	1227	1165	1.3

SH6 Sth of Lucas Pl	676	523	4.4	417	633	6.7
SH6 Nth of Humphrey St	720	647	2.0	684	533	4.4
SH6 South of Peninsula Rd	472	459	0.5	270	247	1.1

Boyd Road Bridge Option

The Boyd Road bridge option is modelled as a two lane, two way corridor with a carriageway width of 10 metres. The total length of the route as modelled is 1.65 km and intersects with the new Eastern Access Road in the Remarkables Park development. The intersections at either end are controlled with a single circulating 30 metre roundabout. A concept diagram supplied by the NZTA showing an indicative alignment is included in **Figure 2.1.** The posted speed limit is assumed to be 70 km/h from the existing SH6/Boyd Road intersection until it crosses the river where it reduces to 50 km/h through the future urban Remarkables Park development. The Boyd Road option also retains the existing single-lane bridge crossing the Kawarau River.

The strategic transport model has not been designed to model the operation of the Kawarau Falls Bridge signals in a sophisticated manner, and has not been calibrated against specific operational data. However, the signal operation has been approximated by introducing a standard two phase signal file with similar capacity. The modelled parameter settings allow for a green phase of up to one minute in each direction with a clearance time of 10 seconds between phases. It is estimated that the current approximately 200m long bridge would take up to 30 seconds to clear at the end of every phase based on an average travel speed of 25 km/h when traversing the bridge. Subsequently the effective capacity of the bridge as modelled is equivalent to permitting up to a 3 minute long green phase followed by 30 second clearance time and then up to 3 minutes in the reverse direction followed by a further 30 second clearance time.

Figure 2.1
Concept Sketch of Boyd Road alternative route

3. Modelling Results

All day directional traffic volumes for the base year (2012) and each of the future modelled years (2026 and 2041) under both the Kawarau Falls Bridge and Boyd Road options are presented in the figures in Appendix A. A summary of traffic volumes are shown in the table below.

Table 3.1
Modelled Traffic Volumes

All Day Traffic Volumes	2012 Kawarau Falls Bridge		2012 Boyd Road Option	
	NB	SB	NB	SB
SH 6 South of Peninsula Rd	2057	2452	1900	2292
Boyd Road	0	0	157	160
Kawarau Bridge	3437	3789	3280	3629
All Day Traffic Volumes	2026 Kawarau Falls Bridge		2026 Boyd Road Option	
	NB	SB	NB	SB
SH 6 South of Peninsula Rd	4905	4917	2958	2988
Boyd Road	0	0	2416	2397
Kawarau Bridge	6955	6870	4539	4472
All Day Traffic Volumes	2041 Kawarau Falls Bridge		2041 Boyd Road Option	
	NB	SB	NB	SB
SH 6 South of Peninsula Rd	7637	7223	3724	3524
Boyd Road	0	0	5755	5422
Kawarau Bridge	10255	9707	4500	4286

The modelled traffic flows demonstrate that the Boyd Road extension and bridge option does not attract significant traffic volumes in the base year, however up to one third of the cross-river traffic uses the Boyd Road bridge in 2026 when the Eastern Access Road is built and more development has occurred. By 2041 when Remarkables Park and other greenfield areas in Frankton are fully developed approximately 55% of cross-river traffic uses the Boyd Road bridge with the remainder continuing to use the existing one-lane facility.

The continued attractiveness of the existing facility particularly for traffic travelling to/from Queenstown is explained by the relative distances and travel times along each corridor. The current route between the SH6/Boyd Road and SH6/Lucas Place intersections is approximately 3.1km and the alternative route (based on the indicative alignment modelled) via a Boyd Rd extension would be 3.5 km. Most of the current route has a speed limit of 70 km/h with approximately 1.2 km having an open road 100 km/h speed limit. The alternative route would most likely be posted at 70 km/h across the river but is then likely to be 50 km/h for the remaining approximately 2.5 km as it travels through an existing and future urban area. Subsequently the additional travel distance and slower speed environment on the alternative route offsets any time savings as a result of reduced delays at the existing bridge.

This relative attractiveness was confirmed by a modelling select link analysis which found that in 2041 none of the traffic using the Boyd Rd option bridge continued north along Frankton Rd via Lucas Place. Instead the SH6 traffic travelling to/from Queenstown continue to use the existing bridge and Kawarau Road (SH6) corridor.

4. Economic Analysis Assumptions

The economic analysis has been completed using the full procedures methodology in accordance with the NZTA EEM (2013) including a default 6% discount rate and 40 year evaluation period. Network operating costs are calculated using the values published in the EEM and assume the Urban Arterial road category with 'all periods' value of time. An update factor of 1.07 has been used to adjust the Vehicle Operating Cost values, and 1.42 to adjust the Travel time cost savings from a base date of July 2008 to July 2014 as per Table A12.2 of the EEM.

Table 4.1 provides a summary of the key road user cost input variables used in the calculation of network costs, and **Table 4.2** outlines vehicle operating costs in cents per kilometre for each of the listed free-flow speed environments. Costs from both Table 4.1 and Table 4.2 have been included in the evaluation.

Table 4.1 *Summary of key road user costs*

Key Road User Cost Variables (July 2014 value)		EEM reference
In Vehicle Time Cost	$23.10 per hour	Table A4.3
Additional Congestion Cost	$5.61 per hour	Table A4.3
Fuel Idle costs	3.40 cents per minute	Table A5.23
Speed Change Cost (55km/hr to 10km/hr)	3.10 cents per speed cycle	Table A5.37

Table 4.2 *Vehicle operating costs at 0% gradient by speed*

Urban Arterial Vehicle Operating Costs at 0% gradient – EEM Table A5.7 (July 2014 value)							
Speed (km/hr)	**VOC**	**Speed (km/hr)**	**VOC**	**Speed (km/hr)**	**VOC**	**Speed (km/hr)**	**VOC**
10	53.4	40	33.2	70	31.9	100	35.8
15	47.0	45	32.3	75	32.3	105	36.7
20	42.3	50	31.8	80	32.8	110	37.7
25	38.7	55	31.5	85	33.5	115	38.6
30	36.3	60	31.5	90	34.2	120	39.6
35	34.5	65	31.7	95	35.0		

Benefits associated with Carbon Dioxide emissions have also been included in the assessment and are calculated as 4% of Vehicle Operating Costs (VOC) in accordance with EEM guidelines. The high-level evaluation has focused on road user costs and emissions as noted above, and therefore accident costs, travel time reliability and wider economic benefits have not been considered as part of this analysis.

The NZTA have supplied estimated construction costs for the Boyd Road indicative alignment as detailed in section 5 which includes property acquisition costs. For the purposes of this evaluation, the assumed construction year is 2016 with two years to construct the project such that the benefit stream starts in 2018 and the end of the 40 year evaluation period is 2055.

5. Economic Evaluation Results

The economic analysis of the Boyd Road bridge alignment and comparison against the proposed Kawarau Falls replacement bridge has been undertaken using the following assumptions:

- Construction date: 2016-17
- Benefit stream: 2018-55
- Discount rate: 6% assuming July 2014 update values.
- Construction cost: $25m Kawarau Falls Bridge, $36m Boyd Rd alignment
- Benefits include: Travel time, Vehicle Operating Costs (including fuel idle time and speed change cycles), emissions, additional congestion benefits
- Benefits exclude: Road safety benefits, travel time reliability, wider economic benefits

Table 5.1 provides a summary of the transport economic costs and benefits as well as a calculated Benefit Cost Ration (BCR) to demonstrate the efficiency of each option.

Table 5.1
Summary of BCR for options

Option	BCR	Total NPV[1] Benefits	Total NPV Costs
Boyd Road Extension and Bridge	1.0	$30,887,249	$32,053,471
Kawarau Falls Replacement Bridge	2.8	$61,840,051	$22,259,355

The results show that the Kawarau Falls Bridge option provides 50% more economic benefits for 44% less cost. The Benefit-Cost Ratio (BCR) for the proposed Kawarau Falls replacement bridge is 2.8 while the Boyd Road alignment produced a BCR of 1.0. A BCR of 2.8 means the benefits realised will be nearly 3 times greater than the costs creating a positive return on the investment. By contrast a BCR of 1.0 means that the benefits are approximately equal to the costs and there is little or no return on investment.

The high level approach of this modelling and economic evaluation assessment means that less emphasis should be placed on the quantum of benefits, and more should be placed on the relativity between the proposed Kawarau Falls replacement bridge and the indicative Boyd Rd alignment. The modelling and subsequent economic assessment indicates that it is the Kawarau Falls replacement bridge which is likely to produce a greater economic return in terms of travel time savings, reduced vehicle operating costs, emissions and additional congestion benefits.

[1] NPV is the Net Present Value in July 2014 dollars using the discounting procedures stipulated in the NZ Transport Agency Economic Evaluation Manual

Appendix One – All Day Traffic Volume Plots

Figure A1 *2012 All Day Traffic Volumes*

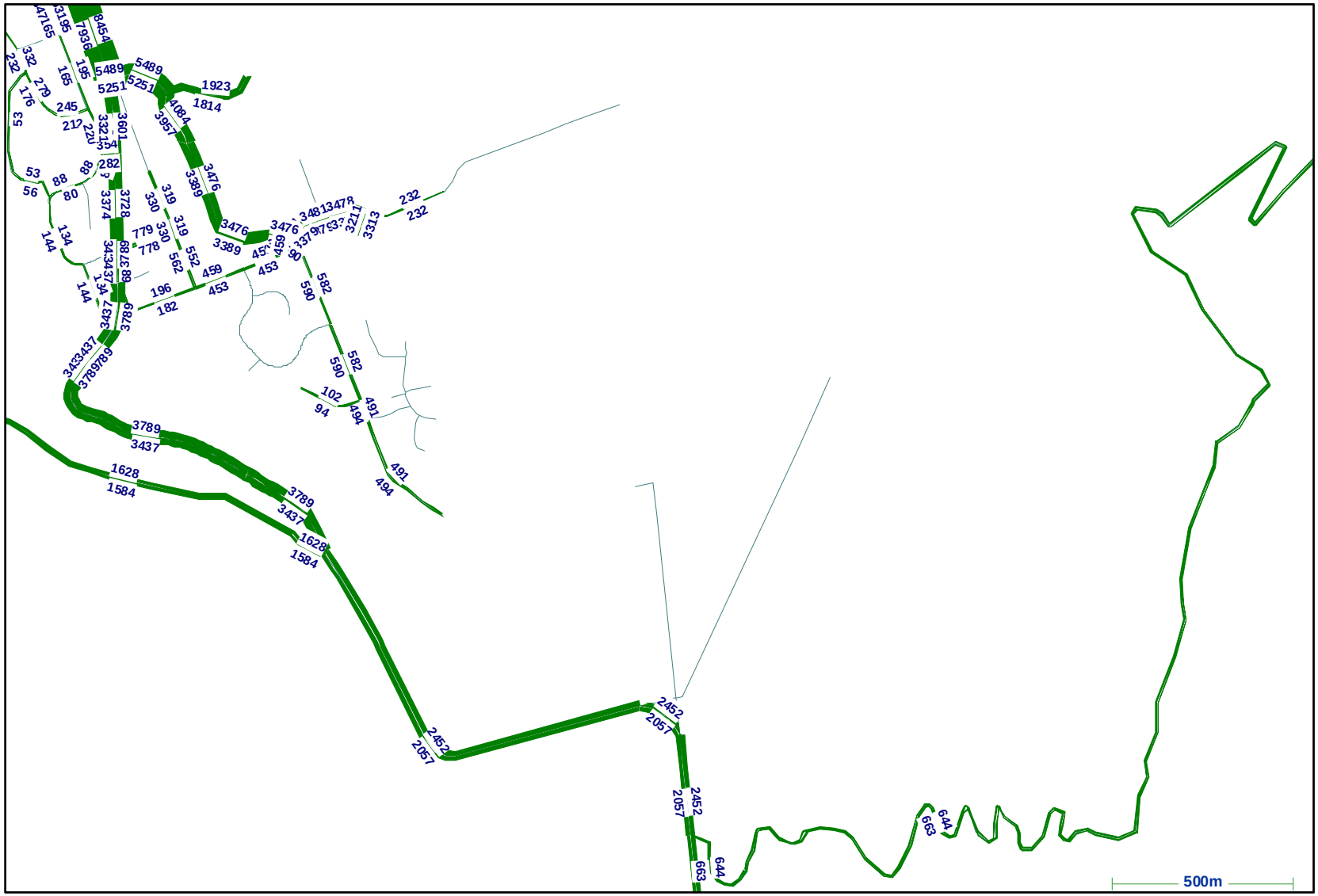

Figure A2 *2012 Boyd Rd Option All Day Traffic Volumes*

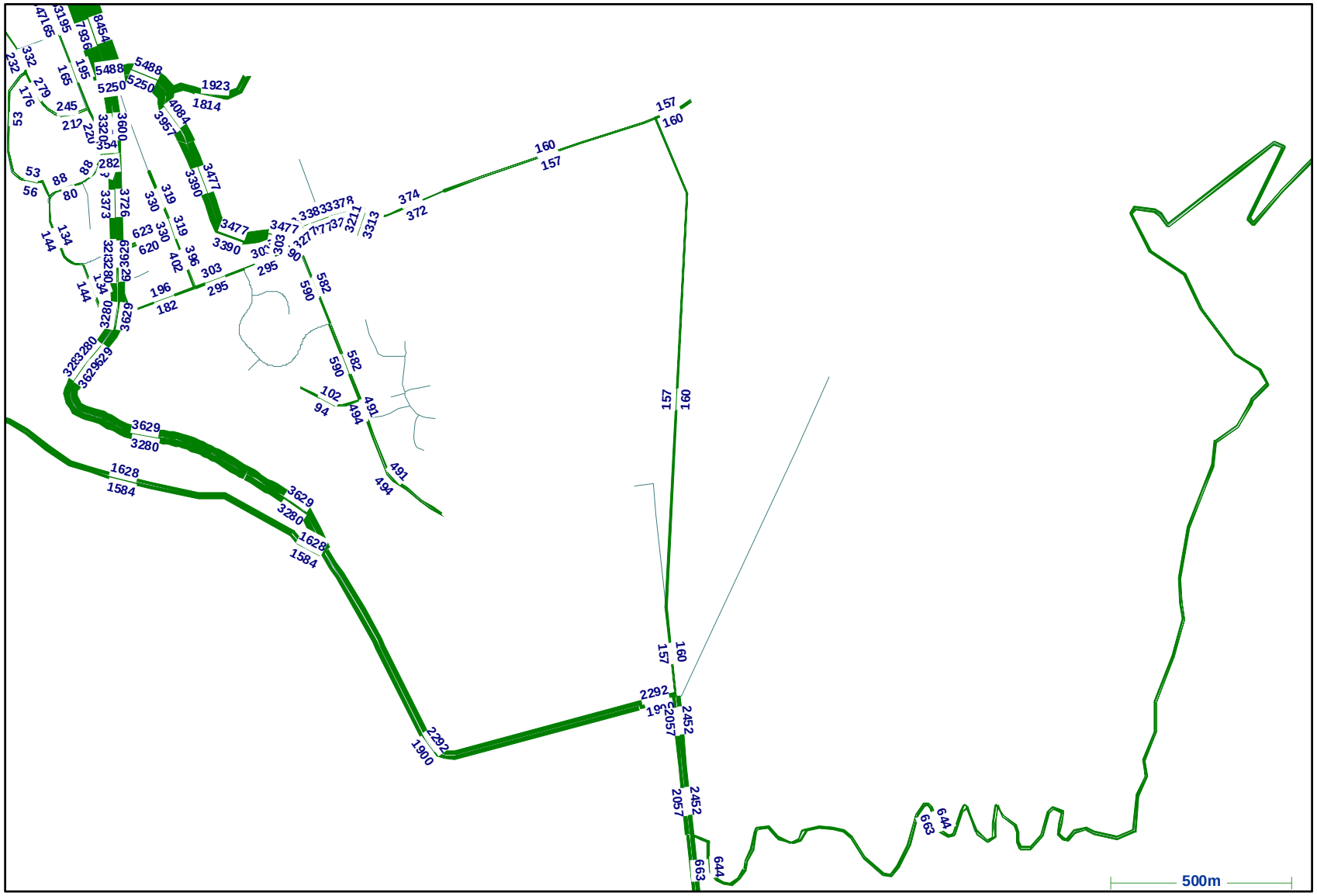

Figure A3 *2026 All Day Traffic Volumes*

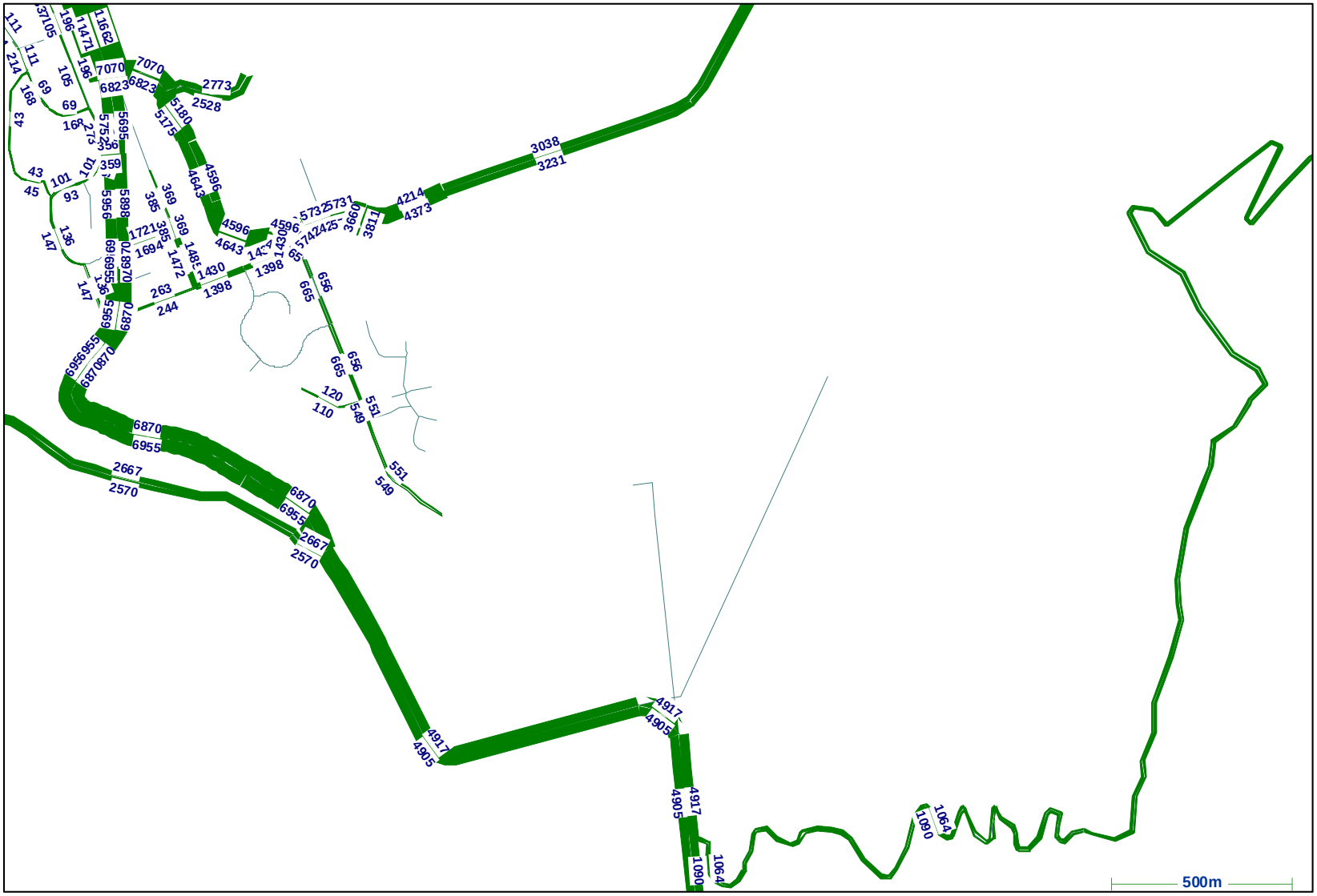

Figure A4 *2026 Boyd Rd Option All Day Traffic Volumes*

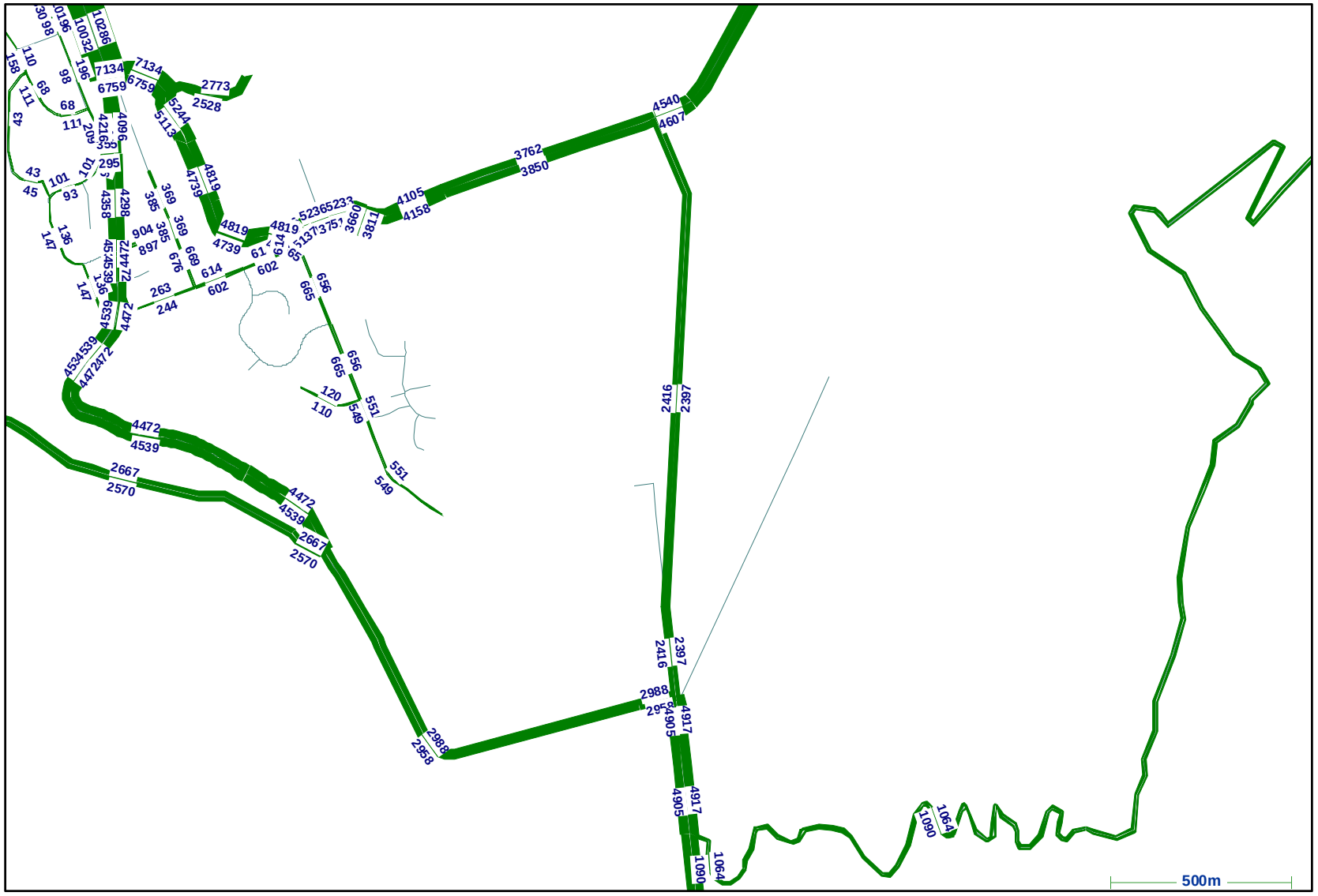

Figure A5 *2041 All Day Traffic Volumes*

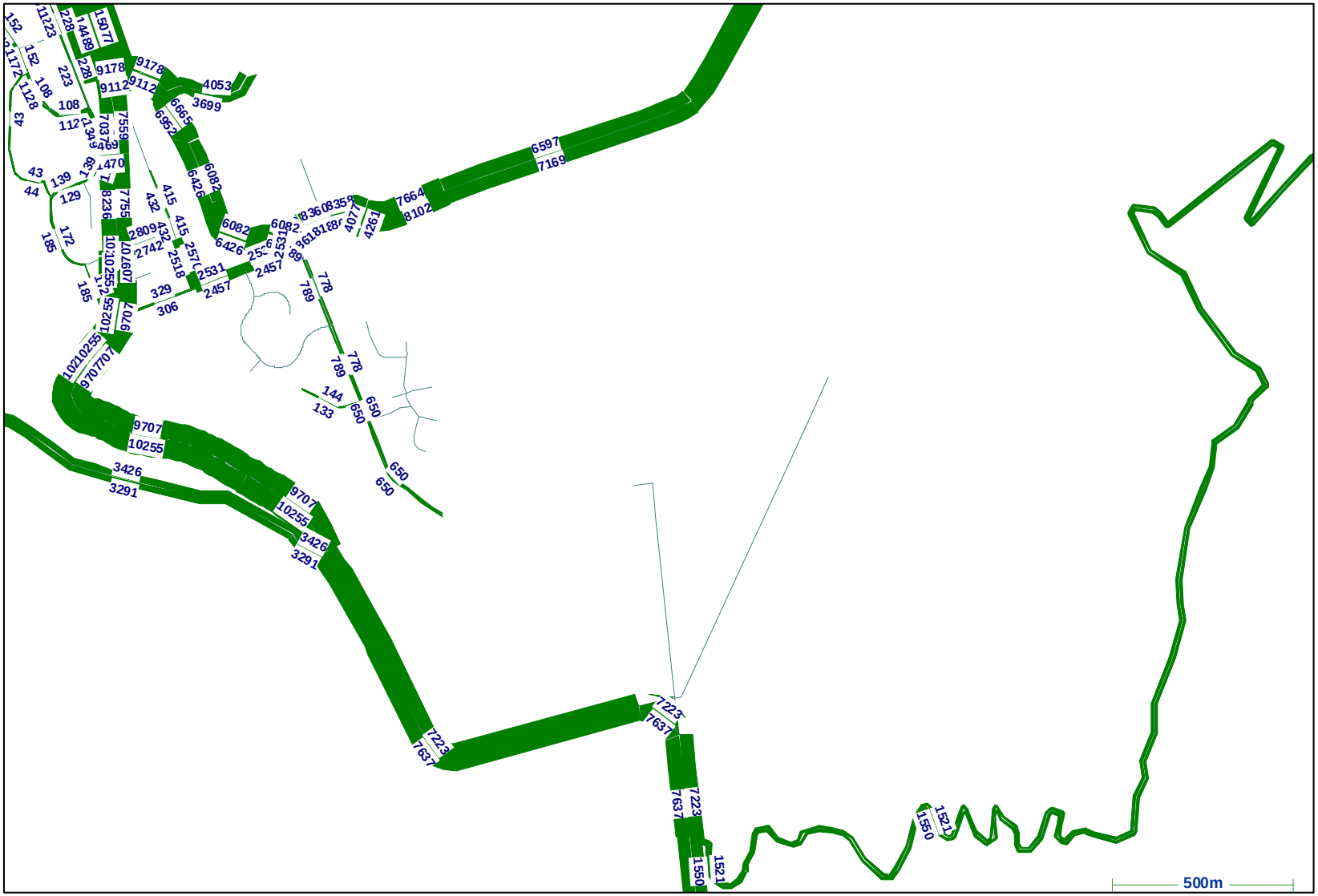

Figure A6 *2041 Boyd Rd Option All Day Traffic Volumes*