Dunedin Central City

Cycling Options

Report prepared by

The joint Dunedin City Council /
New Zealand Transport Agency
Inner City Cycle Safety Working Group

ViaStrada Ltd

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Cover photo: SCL (separated cycle lane) in Hornby Street, Vancouver, Canada[1]

[1] Image credit: Flickr user Paul Krueger http://www.flickr.com/photos/pwkrueger/5973057250

Summary

This report examines a strategic approach to cycling in Dunedin's central city, focussing on north-south corridors.

Based on four cycle fatalities since 1998 on the State Highway 1 one-way pair, it is proposed to provide an improved strategic network of cycling infrastructure in the target area to physically separate motorised vehicles from bicycles. This will be done in a way so that cycling will become an attractive mode of transport for those who are currently not prepared to ride a bicycle because of safety concerns. This report documents the initial planning work that has been undertaken towards this aim. The work is high level with an objective to identify various options, highlights advantages and disadvantages of each option, and identifies those that warrant further detailed investigations to confirm the assumptions made in the report.

After defining key origins and destinations, various possible network links have been considered. There are a variety of options available, and the report defines two favoured north-south options for further investigation (the options called "**One-Way Pair Separated Cycle Lanes**" and "**Cumberland Street Separated Cycle Lane**"), and a further two north-south options that would serve the University of Otago.

Along the corridors where new cycling infrastructure is proposed, parking will have to be removed from one side of the road. Separated cycle lanes (SCLs), as per the report's cover photo, can achieve the desired physical separation from motorised traffic. There will be operational impact for all users on those corridors (e.g. turning drivers may be guided by red arrows at traffic lights, or turning restrictions might be introduced), but the detail can only be determined once options are developed.

There is a very large unmet demand for cycling in Dunedin. An increase in cycling does not necessarily have to mean that there will be an increase in the number of cycle crashes, but a substantial increase in cycling will result in reduced risk for individual cyclists. This can be achieved through the 'safety in numbers effect' and through well-engineered infrastructure. Strategically improving cycling infrastructure can make economic sense due to reduced congestion, reduced road capacity expenditure, reduced demand for parking, a healthier community, and reduced economic drain from petrol costs.

This report is for a technical audience. A separate summary report has been prepared that avoids technical terms as much as possible.

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1 Introduction

This strategic assessment outlines the context for improved cycling facilities in central Dunedin. It seeks approval to develop an indicative business case to further investigate the network linkages described in this report.

This strategic assessment:

- Outlines the strategic context and fit for the proposed investment
- Identifies the key problem or rationale for investing; and
- Identifies the potential benefits of investing.

The work is high level with the objective of comparing possible options, and identifies those that warrant further detailed investigations to confirm the assumptions made in the report. This report has been written for a technical audience documenting the work that has been undertaken. A summary report has also been prepared that avoids technical terms as much as possible.

1.1 Background

Dunedin's central city has a history of fatal cyclist crashes. A fatality occurred outside the University Bookstore in 1998 and in response, cycle lanes were progressively installed on the State Highway one-way pair through Dunedin from 2001. Further fatal cyclist crashes in central Dunedin happened in 2005, 2011, and 2012. Following the last two fatalities, there was strong public desire to 'do better'. The Dunedin City Council (DCC) resolved in November 2012 to write to the NZ Transport Agency (NZTA) requesting "the development of a high level plan for enhanced cyclist and pedestrian safety on the one way pair, noting that the Council would like to see consideration of separated cycle facilities".

The cycle lanes represent best Australasian practice of the time, and Austroads[2] guidelines have not fundamentally changed since then. The project team has looked overseas for guidance that would bring a step change in safety and comfort for cycling.

It has been decided to deal with pedestrian safety issues in a separate report.

1.2 Project team

The Transport Agency and the DCC set up a working group in partnership for this project. Dunedin's cycling advocacy group, Spokes, and ViaStrada Ltd as a consultant were then added to the project team, which comprised the following individuals:

- Sarah Connolly, Transportation Planning Manager, DCC
- Roy Johnston, Senior Safety Engineer, Transport Agency
- Ron Minnema, Senior Traffic Engineer, DCC
- Robert Thompson, Spokes Dunedin
- Simon Underwood, Projects Team Manager, Transport Agency
- Hank Weiss, Spokes Dunedin
- Axel Wilke, Senior Traffic Engineer & Transport Planner, ViaStrada Ltd

[2] Austroads is the association of Australian and New Zealand road transport and traffic authorities. Austroads promote improved Australian and New Zealand transport outcomes by providing expert technical input to national policy development on road and road transport issues.

1.3 Problem definition

The four fatal crashes mentioned in Section 1.1 were on the State Highway network, with Table 1 giving further details as recorded in the CAS (Crash Analysis System) database maintained by the Transport Agency on behalf of the Ministry of Transport.

Table 1: Central city cyclist fatalities

Date	Street	Location	Cause
11 May 98	Great King Street	40 m north of Albany Street	Cyclist hit by opening car door
29 Jan 05	Great King Street	50 m north of Union Place	Motorist driving wrong way on one-way
14 Nov 11	Castle Street	intersection with Anzac Avenue	Truck driver failed to give way
19 Nov 12	Cumberland Street	50 m south of Frederick Street	Cyclist swerved in front of truck to avoid opening car door[3]

Crash records from the CAS database have been reviewed for central Dunedin for the 10-year period from 2003 to 2012. The tables below show those crashes recorded as either fatal or resulting in serious injury (i.e. resulting in hospitalisation). Table 2 shows the number of crashes in central Dunedin, and Table 3 shows the number of casualties that resulted from these crashes (i.e. some crashes resulted in more than one serious injury). As can be seen, the highest numbers are recorded for pedestrians, with cyclists also appearing in large numbers. Serious injuries sustained by cyclists are roughly one quarter of those happening to motorists; whilst three cyclists died, no motorists were killed in any of these crashes.

When user numbers are taken into account, it is clear that both pedestrians and cyclists are over-represented compared to motorists.

Table 2: Total recorded crashes – Dunedin central area, 2003–2012

Crash severity	Pedestrians	Cyclists	All other	Total recorded crashes
Fatal	5	3	0	8
Serious	65	13	56	134
Sum	70	16	56	142

Table 3: Total recorded injuries – Dunedin central area, 2003–2012

Crash severity	Pedestrians	Cyclists	All other	Total recorded casualties
Fatal	5	3	0	8
Serious	65	13	67	145
Sum	70	16	67	153

None of the cyclists killed since 1998 involved error by the cyclist. The road environment for cycling, especially on the State Highway, is challenging, with cyclists having to accommodate doors of parked cars that may be suddenly opening in front of them, but at

[3] This cause is as per the CAS database, but we note that media reporting of the court case mentions the handlebars of the bike being struck by the opening car door: http://www.odt.co.nz/news/dunedin/251962/driver-admits-liability-cycle-death

the same time wanting to have a buffer to moving traffic on their right, and all this with limited width being available. Drivers, in turn, may have limited ability to see cyclists, and that is particularly true for those who want to leave a parked vehicle. Nonetheless, there are few if any practical north-south alternatives available for cycling, and existing cyclists willing to cycle in this environment are drawn to the State Highway thoroughfare. Like other road users, most cyclists prefer to minimise travel distance.

The project team identified a number of challenges:

- There is a safety problem for cycling on the one-way pair.
- Whilst the 2004 Dunedin Cycling Strategy already intended to cater for 'people of all ages', understanding of how to cater for this broader target audience has only recently been gained in New Zealand.
- Origins and destinations have to be linked to form a strategic cycle network.

The geographic scope for the planning work is as shown in Figure 1.

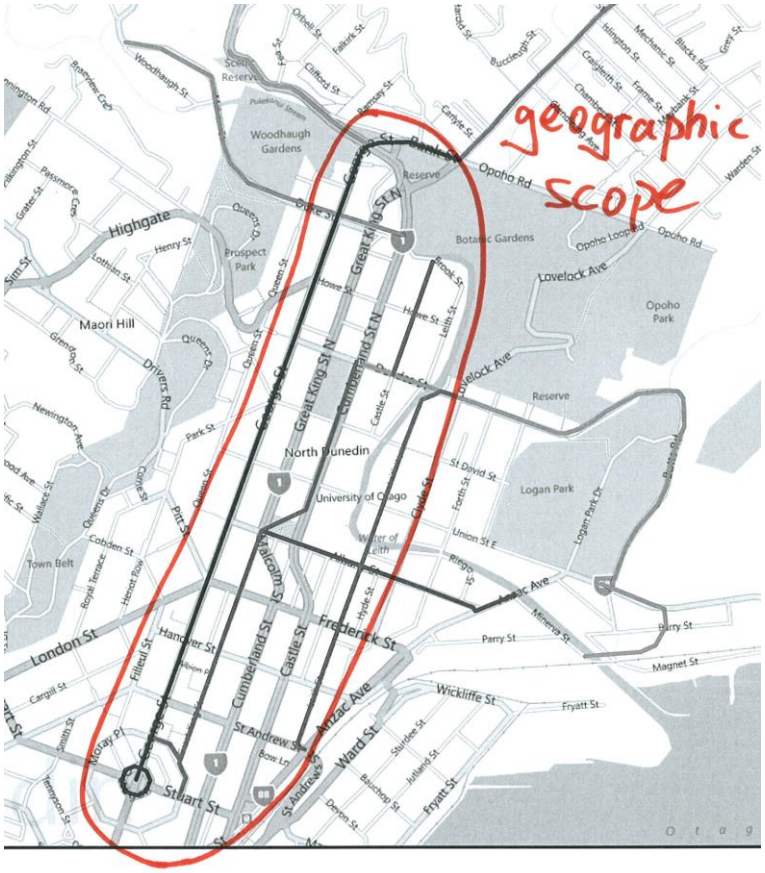

Figure 1: Geographic scope of the planning project

1.4 Short-term improvements

It was decided to respond to the first problem, the safety issue, in two ways; with short-term improvements that can address some immediate concerns, and a longer-term planning approach that provides a more holistic view of how to provide for cycling. The focus of this report is the longer-term planning approach.

In the short term, the Transport Agency asked for feedback on issues that cyclists have when using the State Highway network in Dunedin. Fifty responses were received and analysed, and this formed the basis for a series of short-term improvements, which included:

- Installation of flexible bollards in various locations where cyclists felt particularly vulnerable in cycle lanes (see, for example, Figure 2),
- Widening of cycle lanes (generally to 2.4 m north of Stuart Street),
- Other adjustments of lane widths (especially the widening of the lane leading onto the Jetty Street bridge, as many motorists were driving along the cycle lane),
- Narrowing of parking lanes and the removal of high lips at the edge of the drainage channel to achieve better parking discipline, which will lower the risk of cyclists of being struck by opening car doors,
- Removal of some parking so that intervisibility between cyclists and drivers leaving busier driveways is increased,
- Altering short-term parking to minimise the time that drivers spend in the cycle lane while trying to manoeuvre, and also to reduce the potential conflicts between cyclists using the cycle lanes, and the numbers of motorists wishing to access short-term parking. and
- Lengthening bus stops to allow buses to stop clear of the cycle lanes, so that cyclists can pass a stationary bus without having to intrude into the adjacent traffic lane.

Further short-term improvements are possible.

Figure 2: Short term measure utilising flexible bollards

1.5 Widened cycle lanes – formal trial

The existing cycle lanes along the one-way pair have been widened considerably (see Figure 3). It is proposed to install hatched markings within the cycle lane, creating a buffer between moving motor vehicles and cyclists. As these markings are non-standard, they are subject to a formal trial, which was gazetted in June 2013 and for which data gathering started in April.

The purpose of the research is to determine the proportion of cyclists who ride within the door opening zone as a proxy for risk. Variables that are being measured include cyclist positioning on the carriageway, parking discipline, and width of parked vehicles. The aim is to change road markings in such a way that the proportion of cyclists riding within one metre of parked vehicles is minimised.

Figure 3: Cycle lane markings on Cumberland Street before and after widening

2 Planning Approach

2.1 Project target

The Draft Dunedin City Transport Strategy 2013 gives an overall vision for transport in Dunedin, and it is stated that this will mean that "active modes are popular, well-utilised and safe". The Draft defines the following goal:

"The percentage of Dunedin census respondents who cycle, walk or take a bus to work, school or study, doubles in 10 years, from 16% at the 2006 census to 30% by 2024."

In 2006, cycling, walking, and public transport contributed 3%, 11%, and 2%, respectively. The above goal has been further refined for this project:

"Achieving 10% bicycle trip to work mode share in Dunedin by 2024."

2.2 Strategic approach

The project team's strategy was as follows:

"Develop a safe network for the project area comprising a range of infrastructural treatments, which together form a cycle network that can become more comprehensive over time."

It is important to understand that the work is carried out for the people of Dunedin as a whole, and not for that subset of the population that is currently using a bicycle for transport. There are a number of strategy premises, as the following sections explain.

2.2.1 Target audience

The DCC has South Dunedin defined as its first priority for cycle network implementation. This work is in progress (to be delivered by June 2015) and the scope includes making connections to the central city. As part of the planning work, a target audience approach was agreed on (explained below, also see Figure 4), with most of the defined South Dunedin network catering for the *Interested but Concerned*. Only some of the routes target the *Enthused & Confident*, for example through the removal of pinch points or the provision of cycle lanes. The two routes that go into the central city both cater for the *Interested but Concerned*. The same planning approach has been adopted for this project.

Figure 4: Four types of transportation cyclists

A strategic network map for all of Dunedin was produced in 2011, recognising it may need to be refined following further development and consultation. This was done with a target audience of ordinary people going about everyday tasks in mind, but the thinking in terms of facilities that would be needed to cater for that group was not there at that time. As it might not be possible to apply the target audience planning approach described above to

the corridors chosen in 2011, this network review for north-south routes has now been undertaken as part of the scope of the current project. Appendix D reproduces the previous work.

Figure 4 gives a graphic presentation of the proportions of the population that fall into the various target audience categories (Geller, 2009). The four groups shown in the figure can be explained as follows:

> **Strong & Fearless:** A group of people who will travel by bicycle regardless of the conditions. The cities that provide the most hostile cycling environments still see around 0.8% of all trips made by bicycle, and the users in that group can aptly be named as strong and fearless.
>
> **Enthused & Confident:** The next group of the population requires some space on the carriageway, and where that is made available either informally (for example by wide kerbside lanes) or formally (for example by painted cycle lanes), they will be prepared to travel by bicycle. People in this group may be prepared to mix with motorised traffic to some extent. Where a bicycle network is aimed at the enthused & confident, the maximum uptake of cycling may result in a cycling mode share of 8% to 10%.
>
> **Interested but Concerned:** The next group of the population requires physical separation from motorised traffic before they are prepared to travel by bicycle, or allow their children to go by bicycle. People in this group may only be prepared to mix with motorised traffic where both volumes and speeds are low. Where a bicycle network caters for the *Interested but Concerned*, maybe two thirds of the population are prepared to go by bicycle, at least some of the time. Some of the people in this group may not think of themselves as cyclists, but would take up cycling if the conditions are right (the physical environment) and when they see other 'non-cyclists' starting to use bicycles for some trips (the social environment).
>
> **No way No how:** The remainder of the population would not use a bicycle; it is simply not something they would entertain. No efforts need to be spent to convince this group to take up cycling, as they are not receptive to it.

2.2.2 Roads for cycling

All roads, with the exception of motorways, are legally available for cycling, and contribute to some extent towards the total network available for this mode of transport. This is complemented by pathways away from roads, for example the shared path towards Ravensbourne that is parallel to State Highway 88. Not all roads can cater for all groups of cyclists, as defined in the previous section, and the creation of a cycle network does not mean that all roads will cater for the *Interested but Concerned*. Rather, it is assumed that a cycle network should provide a number of different strategic connections between key origins and destinations, as explained in the next section. Those roads chosen for emphasis by the cycle network may receive different levels of treatment; this is mainly a function of what other functions those corridors provide (e.g. whether they form part of the strategic public transport, or the strategic freight network), and how busy they are. The busier the roads, the higher the level of provision for cycling needs to be. Those roads with little traffic may lend themselves for Quiet Streets, which are streets where traffic speeds and volumes are controlled so that the remaining motorised traffic can share the road space with those who fall into the *Interested but Concerned* audience, and that it feels safe and convenient to those cyclists to do so.

Appendices A to C contain detailed descriptions of the types of network elements that are suitable either for the *Enthused & Confident* or the *Interested but Concerned*.

2.2.3 Critical network linkages

There are a number of critical network linkages that need to be achieved, so that various key origins and destinations are linked together. Some network elements have already been built or are underway, for example the SH88 Shared Path, and those elements give access to key origins and destinations outside of the project area (e.g. the SH88 Shared Path establishes a connection to Ravensbourne and eventually Port Chalmers). Some network elements are already planned through the South Dunedin network plan (e.g. central city to Oval and beyond).

The following is a list of key origins and destinations that have been considered; also refer to Figure 5:

a) North East Valley (NEV)
b) University of Otago / Otago Polytechnic
c) Hospital
d) North city
e) Central city
f) The Octagon
g) Ravensbourne (via SH88 Shared Path)
h) Oval / South Dunedin
i) Andersons Bay area (via Portsmouth Drive pathway)

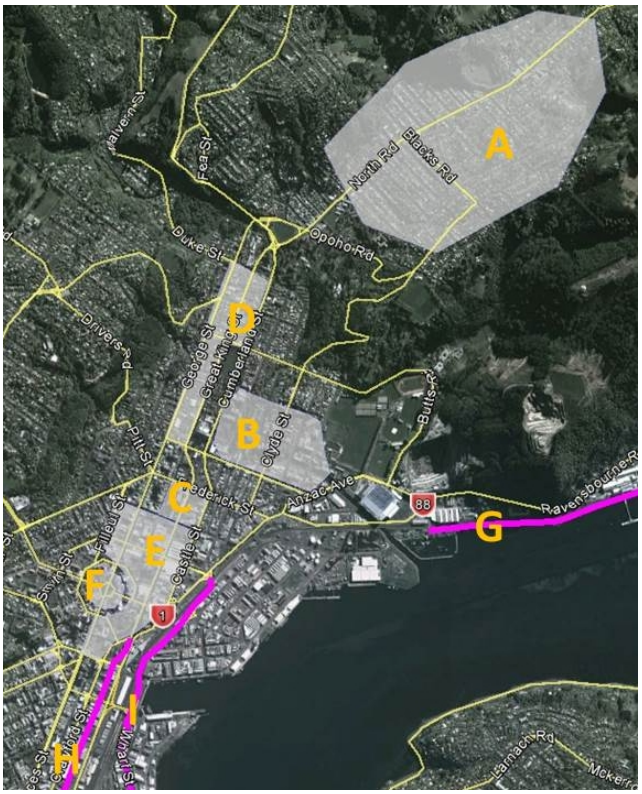

Figure 5: Key origins and destinations

This list can then be analysed for critical linkages that need to be achieved. These could be grouped as follows:

i. NEV to University / Otago Polytechnic
ii. University / Otago Polytechnic to Portsmouth pathway
iii. NEV to Hospital
iv. NEV to north city and central city
v. North city and central city to Oval
vi. Cross link to SH88 Shared Path
vii. Cross link to The Octagon

Co-ordination with the South Dunedin project must be achieved, as it will already create part of some of the linkages. These include:

- the southern part of linkage ii towards the Portsmouth Drive pathway (St Andrew St, Thomas Burns St, and Wharf St are used for that),
- the southern part of linkage v towards the Oval, and
- the cross link to The Octagon, which is listed as linkage vii above.

These linkages can be seen in Figure 6 in more detail.

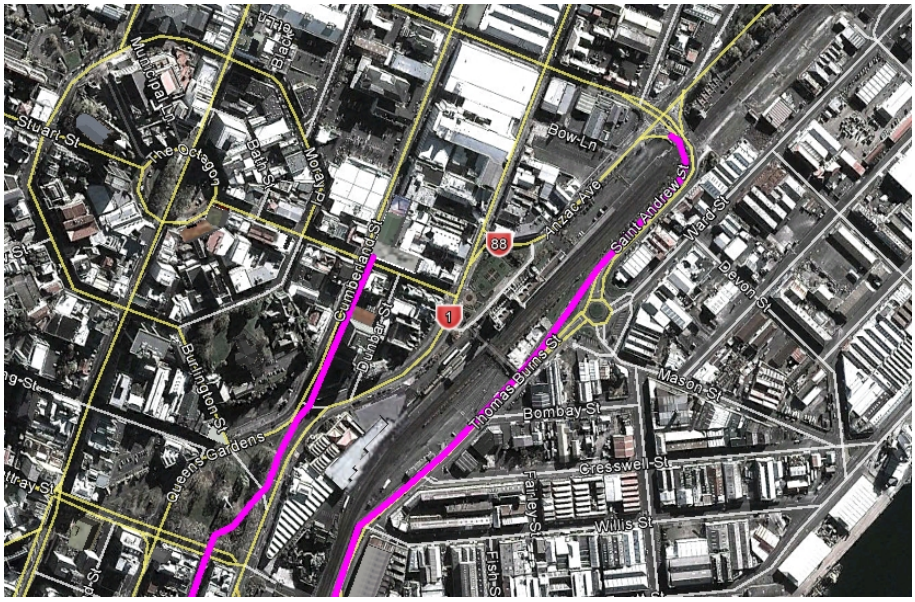

Figure 6: Linkages defined by the South Dunedin project

South of Queens Garden

A long term strategy for the area between Queens Garden and the Oval is not able to be defined now, as it will be influenced largely by the strategic approach taken for the cycle network north of Queens Garden. Further, the DCC has been exploring the possibility of two-waying the one-way system south of Queens Garden (refer Draft Dunedin City Transport Strategy). Further investigations and consultation are required before a decision is made on this matter. However, there are options available should this project proceed, and alternative options should it not go ahead:

- If the one-way pair arrangement south of Queens Garden is to remain, then whatever cycle option is adopted elsewhere on the one-way system can be applied between Queens Garden and the Oval as well. In addition, Vogel Street is similarly able to be developed as a Quiet Street, as per the South Dunedin study.
- If, south of Queens Garden, consolidation of the highway function onto Cumberland Street is to proceed, then the primary linkage to the cycle infrastructure north of Queens Garden will need to be either via Crawford Street (which will then be a local road), or Vogel Street (as per the South Dunedin study). Provision for cyclists on Cumberland Street will be via a shared path, which will need to pass across private land where the Jetty Street Bridge creates a pinch point.

It is very likely that as implementation of the cycle option north of Queens Garden is substantively progressed, that a decision will have been reached as to the conversion/retention of the one-way layout south of Queens Garden. Should this not be the case, however, there is also an improvement option to provide further separation of the existing cycle lane on Cumberland Street, through a reduction in the number of traffic lanes from three to two (between Stuart Street and Gordon Street, with each lane then 'pairing out' back to four lanes on approach to the Andersons Bay intersection.

The option of building the Rattray Street Bridge for cyclists and pedestrians, which would link the Wharf Street pathway with Queens Garden, is to be further investigated. This proposal is included in the Draft Dunedin City Transport Strategy, but not included in DCC's Long Term Plan (LTP).

2.3 Alignment with other initiatives

This planning work has to be co-ordinated with other initiatives, both at a planning level and subsequently during the implementation phase with operational matters.

At the time of writing this report, significant changes to the public transport network were under discussion, which, if implemented, would see the number of buses using George Street reduced significantly. Further planning for the cycle network will have to be taken into consideration with the eventual bus network changes.

During the implementation phase of the cycle network, existing known safety issues for other transport users should be addressed.

3 Network Links

3.1 Existing network

A two-stage planning approach is suggested for the central city. In the first instance, the existing network can be considered as one that caters mostly for the *Enthused & Confident*. In this context, some minor gaps exist, which could be addressed in order to make the network safer and more complete. In a second stage, the critical linkages defined above should be addressed, and the existing network can then be overlaid with some corridors that enable the *Interested but Concerned*.

Appendix E shows a map of the existing network and gaps. One missing link that is not shown on the map is the connection from the SH88 Shared Path to the cycle lanes in Fryatt Street; DCC is in the process of securing the land to establish this link.

As noted above, the existing network mostly has the group of the *Enthused & Confident* as the target audience. Users in this group are assumed to be resilient enough to share the lane with traffic if traffic volumes are not too high (assumed to be up to 5,000 veh/day), and above that would use corridors where at least a cycle lane is provided. The following corridors cater for this target audience already through the provision of either cycle lanes or shared paths:

- One-way northbound (cycle lanes; recently widened for improved safety)
- One-way southbound (mostly cycle lanes that were recently widened; pathway at the northern end)
- North Road cycle lanes
- St Andrew Street (south of Anzac Avenue; shared pathway)
- Anzac Avenue (Castle Street to Ravensbourne Road)
- Continuation of the Anzac Avenue link via Parry Street, Minerva Street, Magnet Street to the harbour-side pathway towards Port Chalmers
- Pathway along Union Street in front of the stadium (roundabout to Logan Park Drive)
- Fryatt Street cycle lanes

The following minor gaps exist in the network:

- The Anzac Avenue cycle lanes are discontinuous in the vicinity of Frederick Street.
- The Anzac / St Andrew intersection creates a barrier along St Andrew Street.
- There is no off-street connectivity from the St Andrew pathway finishing at the intersection with Anzac Avenue to The Octagon (cycle lanes go up to Castle Street from here).
- There is no connectivity from the St Andrew pathway finishing at the intersection with Anzac Avenue to the cycle lanes on the northbound one-way street.

The following major gaps exist in the network:

- There are formal cycling restrictions in place on land controlled by the University of Otago.
- There is a formal cycling ban in place through the Botanic Gardens.

Where future links are away from corridors that have cycle lanes already, those may or may not remain in place.

Figure 7: Formal cycling restriction area at Otago University

3.2 Ranking of north-south options

Five main north-south options have been developed, and these are discussed in Section 3.3. Route options utilise George Street, Great King Street, Cumberland Street, and that part of Castle Street that is part of State Highway 1. In addition, Castle and Leith corridor options are discussed in Section 3.3.6. Table 4 lists the five main north-south options against a range of criteria:

- Safety – How safe the option is overall, for all users, e.g. how many potential conflicts are there and how serious are they;
- Quality of service cycling – The level of service that the option offers for cyclists, e.g. how attractive the facility will be to cyclists, how direct it is, how easy it is to use, how safe it feels, how much delay there is;
- Delay to drivers – The level of service that the option offers for motor vehicles, e.g. does it create additional delays at intersections for motorists / freight?
- Parking loss – The overall effect on parking of the option e.g. will parking need to be removed? How much parking will need to be removed?
- Cost – The cost of the option, e.g. construction cost and loss of revenue from parking meters;
- Alignment with Transport Agency priorities – how well does the option align with Transport Agency priorities of improving safety and providing efficient freight routes?

The table below shows the five options ranked relative to one another against the range of criteria. The table is sorted to show options in descending preference. It is recommended that the **One-Way Pair Separated Cycle Lanes** and the **Cumberland Street Separated Cycle Lane** options be investigated further and be consulted on. Note that this work is a high-level assessment, and much more detailed work on the options is necessary. One key issue is the necessary removal of parking that would generate the room for the infrastructure. Important issues needing further assessment are how many of the available parking spaces are occupied at any one time, whether drivers would have alternative parking available, and how much parking demand would be freed up or not be needed any longer by people choosing to ride rather than drive.

Table 4: Matrix of central city cycling options

Option description[4]	Safety[5]	Quality of service cycling[6]	Delay to drivers	Parking loss[7]	Cost [8]	Alignment with Transport Agency priorities
One-Way Pair Separated Cycle Lanes	★★ ★	🚲🚲 🚲	⏳⏳	🚗🚗	$$ $	✓✓✓
Cumberland Street SCL bi-directional	★★	🚲🚲	⏳	🚗	$$	✓✓✓
Great King Street SCL bi-directional	★★	🚲	⏳	🚗🚗	$$	✓✓
One-Way Pair SCLs (left)	★	🚲	⏳⏳	🚗🚗	$$ $	X
George Street SCL (with shared space at southern end)	★	🚲	⏳⏳⏳	🚗🚗 🚗	$$ $$	X

3.3 North-south network links

The analysis has been done for various route options. Where SCLs are considered, parking would generally have to be removed adjacent to the SCL. The north-south network links achieve critical linkages as shown in Table 5.

Table 5: Critical linkages for corridors considered so far

Link	Description	Castle	Leith	George	Great King	One-way	Cumberland
i.	NEV to University / Otago Polytechnic	✓	✓				
ii.	University / Otago Polytechnic to Portsmouth pathway	✓	✓				
iii.	NEV to Hospital				✓	✓	✓
iv.	NEV to North city and central city			✓	✓	✓	✓
v.	North city and central city to Oval			✓	✓	✓	✓
vi.	Cross link to SH88 Shared Path						
vii.	Cross link to The Octagon						

3.3.1 One-Way Pair Separated Cycle Lanes

Appendix F shows a north-south option that would establish critical linkages iii, iv, and v (Table 6). This option is based on uni-directional SCLs along the whole length of the State

[4] SCL = separated cycle lane
[5] More stars means a network link that is safer for cycling
[6] More bikes means a higher quality of service for cycling
[7] The more cars are shown, the greater the parking loss
[8] The more dollar signs are shown, the more expensive the option

Highway one-way pair north of Rattray Street, with the SCLs located on the right side of the road as seen in the direction of travel. This option would replace the existing cycle lanes over the whole length of the links. This option would require the removal of parking from the right hand sides of the one-way streets. A typical mid-block layout is shown in Figure 8, while Figure 9 shows a typical intersection approach.

Table 6: Critical linkages assessment for one-way corridors

link	Description	One-way
i.	NEV to University / Otago Polytechnic	
ii.	University / Otago Polytechnic to Portsmouth pathway	
iii.	NEV to Hospital	✓
iv.	NEV to North city and central city	✓
v.	North city and central city to Oval	✓
vi.	Cross link to SH88 Shared Path	
vii.	Cross link to The Octagon	

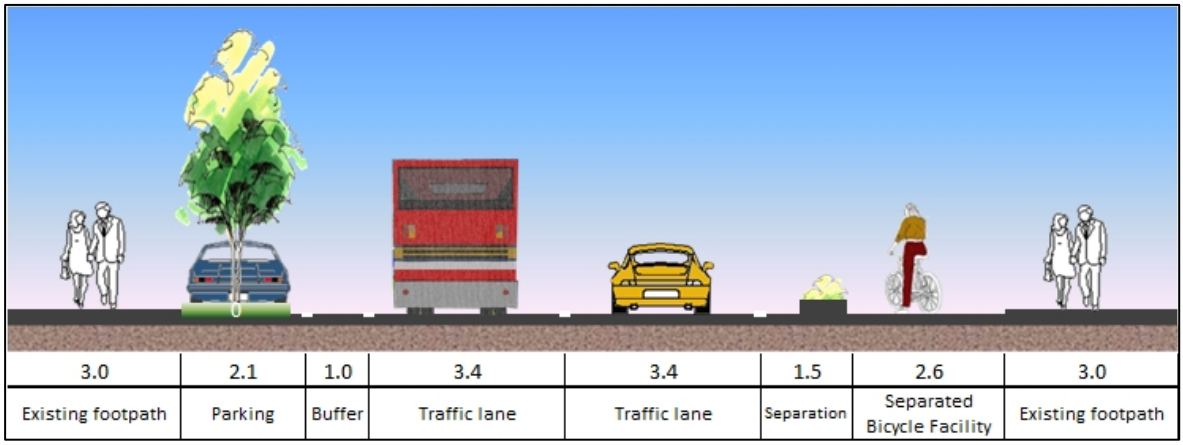

Figure 8: Typical mid-block layout of the One-Way Pair SCL option

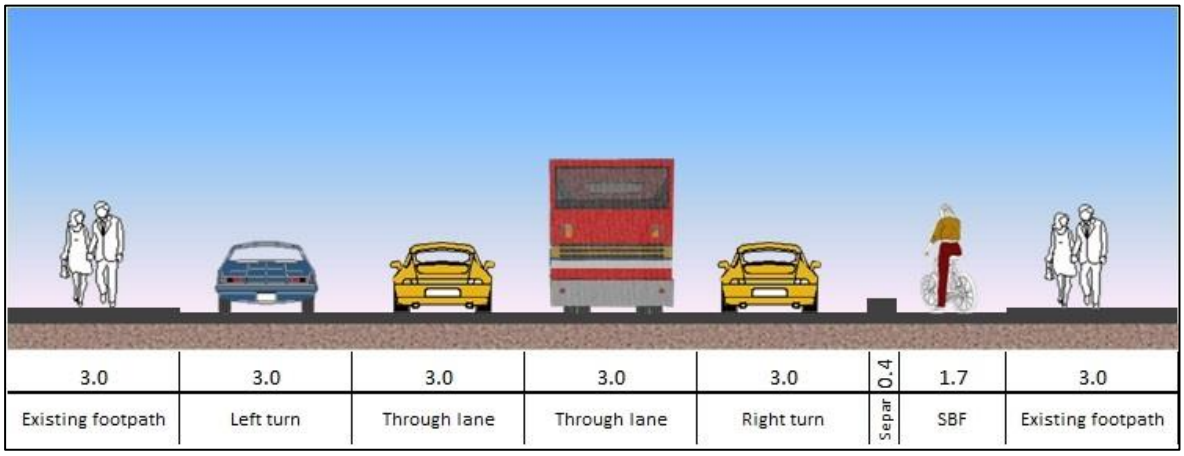

Figure 9: Typical intersection approach layout of the One-Way Pair SCL option

Strengths

- The SCLs would replace the cycle lanes that are already in place and as such follow the well-known route of existing cycle network elements.
- The carriageway widths are generally generous (the northernmost section of Cumberland Street is the exception) so travel lane widths will not be impacted.

- None of the driveways are overly busy. This option avoids the Castle / Anzac intersection.
- The links are direct and without any detours.
- At the southern end, the SCLs could link up with Queens Gardens, which could make a convenient connection to or from Vogel Street (the likely network link coming from South Dunedin).
- Of all the options considered here, this one is considered to have the best safety outcomes for cyclists, as there are few if any locations where issues are likely to arise. It is also considered useful that right turning drivers have an improved visual connection with the RHS facility and its users.
- Of all the options considered here, this one is considered to provide the best level of service for cyclists.
- This option would provide a reasonable level of service for motorists and only impact those who turn right off the SH pair, while removing the current conflict to left hand turners.

Weaknesses

- The uni-directional SCLs would place cyclists on the right side of the road, i.e. the side that they are not used to travelling on. This may well not be a weakness any longer once people get used to this, though.
- On Great King Street, there is some localised parking demand north of Dundas Street through a commercial area.
- Some of the driveways have high numbers of heavy traffic, e.g. Cadbury.
- There are localised traffic engineering challenges at Moat and Dunbar Streets, and the Leviathan u-turn.
- North of Duke Street, it is unclear how much room there is on the right hand side of Cumberland Street.
- There are numerous kerb extensions, many of which hold trees. On Cumberland Street between Duke and Howe Streets, the trees are reasonably mature.

Discussion

Placing the SCLs on the right hand side of the one-way pair creates an option that is certainly feasible. There are no particular problems at driveways that could not be overcome, and the localised traffic engineering challenges would also appear manageable. The exact location of the legal road boundary in the northernmost section of Cumberland Street needs further investigation. This option should be further investigated.

3.3.2 Cumberland Street Separated Cycle Lane

Appendix G shows a north-south option that would also establish critical linkages iii, iv, and v (Table 7). This option is based on a bi-directional SCL along the whole length of Cumberland Street, including the local road link that connects the opposing directions of the one-way streets (Emily Siedeberg Place); this short stretch is suitable for a Quiet Street treatment. Therefore, the southern part of this SCL would be placed on the northbound one-way link, and the northern part would be placed on the southbound link. The right hand side of the road (seen in the direction of one-way flow) has been chosen for the SCL as this is the side that links up with Emily Siedeberg Place, avoiding the need to cross the one-way streets. This option would replace the existing cycle lanes in Cumberland Street. This option would require the removal of parking from that side of

Cumberland Street for which the SCL is proposed. A typical mid-block layout is shown in Figure 10, while Figure 11 shows a typical intersection approach.

Table 7: Critical linkages assessment for Cumberland Street

link	Description	Cumberland
i.	NEV to University / Otago Polytechnic	
ii.	University / Otago Polytechnic to Portsmouth pathway	
iii.	NEV to Hospital	✓
iv.	NEV to North city and central city	✓
v.	North city and central city to Oval	✓
vi.	Cross link to SH88 Shared Path	
vii.	Cross link to The Octagon	

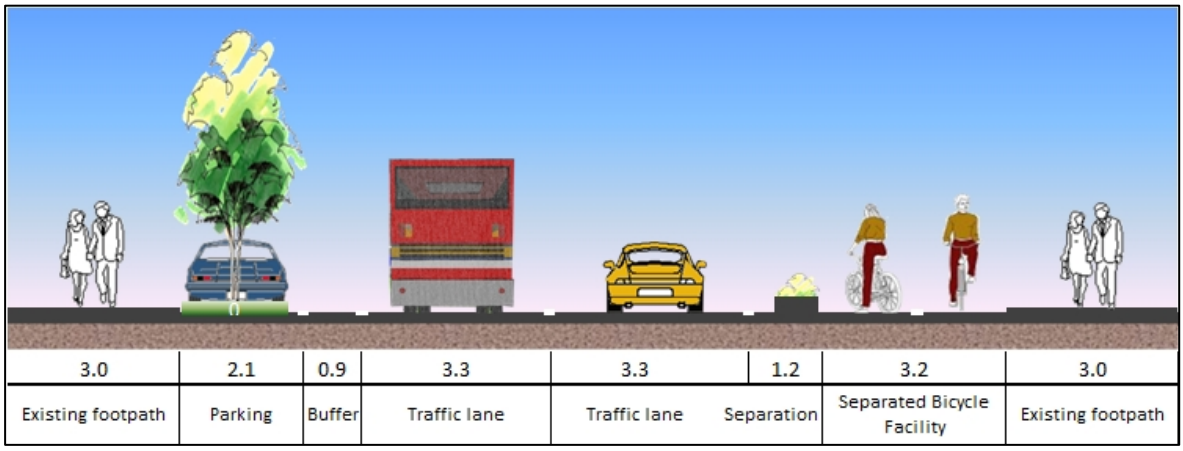

Figure 10: Typical mid-block layout of the Cumberland Street SCL option

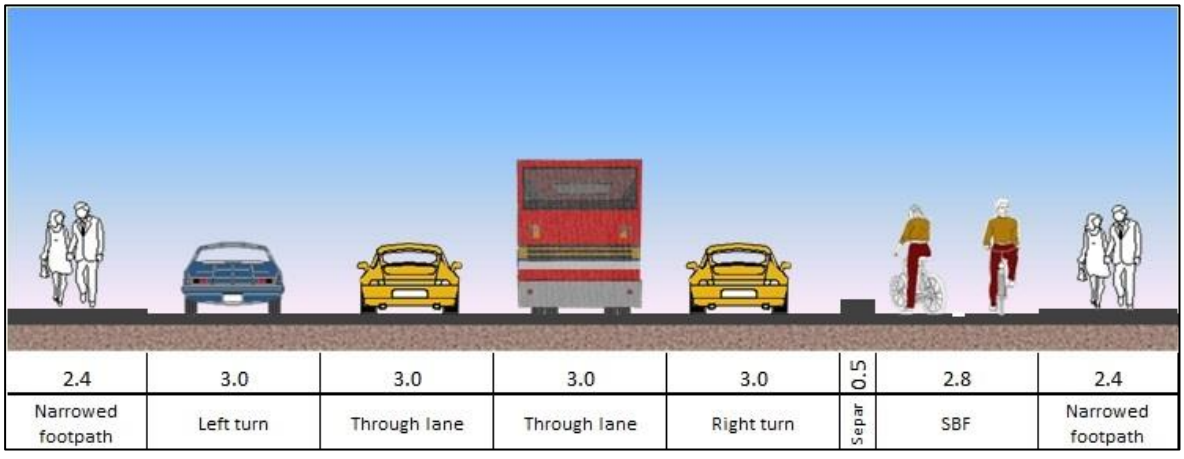

Figure 11: Typical intersection approach layout of the Cumberland Street SCL option

Strengths

- The carriageway widths are generally generous (the northernmost section of Cumberland Street is the exception).
- None of the driveways are overly busy.
- The link is direct and without any detours.
- Parking demand should not be a critical issue anywhere along this link.
- At the southern end, the SCL could link up with Queens Gardens, which could make a convenient connection to Vogel Street (the likely network link coming from South Dunedin).

- In terms of safety for cyclists, the project team considers this option second-best only to the previous option (uni-directional SCLs on the right side of the one-way pair). It is also considered useful that right turning drivers have a good visual connection with the RHS facility and its users.
- In terms of level of service for cyclists, the project team considers this option second-best only to the previous option.
- In terms of level of service for motorists, this option may impact more on right turning traffic at individual intersections, but only one link is affected compared to the two links in the previous option. Overall, the network-wide impact on motorists might be the same as with the previous option.

Weaknesses

- The SCL would place cyclists travelling in the direction of other traffic on the right side of the road, i.e. the side that they are not used to travelling on. This may well not be a weakness any longer once people get used to this. In addition, these cyclists have to deal with contra-flow cycle traffic.
- Cycling in a contra-flow direction to other traffic is known to have an elevated crash risk.
- Some of the driveways have high numbers of heavy traffic, e.g. Cadbury.
- There is a localised traffic engineering challenge at the Leviathon u-turn.
- North of Duke Street, it is unclear how much room there is on the right hand side of Cumberland Street.
- There are numerous kerb extensions, many of which hold trees, that would have to be removed to make way for the SCLs. Between Duke and Howe Streets, the trees are reasonably mature.

Discussion

Placing bi-directional SCLs on the right hand side of Cumberland Street creates a feasible option. There are no particular problems at driveways that couldn't be overcome, and the localised traffic engineering challenge would also appear manageable. Due to the contra-flow movement, the safety of this option is not as good as the previous option. The exact location of the legal road boundary in the northernmost section of Cumberland Street needs further investigation. This option should be further investigated.

3.3.3 Great King Street SCL

Appendix H shows a north-south option that would also establish critical linkages iii, iv, and v (Table 8). This option is based mostly on SCLs along the whole length of Great King Street, with a short link on Moray Place making a connection to the proposed link on Stuart Street. On the section of Great King Street that is part of the northbound State Highway, the SCL would be bi-directional on the harbour (east) side of the road. The block immediately to the south of Albany Street may become a Quiet Street due to its low traffic volume. An option exists to reduce the traffic volume in the next block to the south by forming cul-de-sac ends between the entrance to the New World car park, and the entry to the Great King Street car parking building. The remainder of the corridor may be uni-directional or bi-directional SCLs. North of Albany Street, this option would require the removal of parking from the east side of Great King Street. South of Frederick Street (or South of St Andrew Street if the cul-de-sac is proceeded with), parking would need to be removed from at least one side of the road, depending on the final concept chosen.

Table 8: Critical linkages assessment for the Great King Street corridor

link	Description	Great King
i.	NEV to University / Otago Polytechnic	
ii.	University / Otago Polytechnic to Portsmouth pathway	
iii.	NEV to Hospital	✓
iv.	NEV to North city and central city	✓
v.	North city and central city to Oval	✓
vi.	Cross link to SH88 Shared Path	
vii.	Cross link to The Octagon	

Strengths (south of Albany)

- This part of Great King Street is a local road.
- There are medium traffic volumes (4800 south of Frederick; 7500 south of Hanover), and low traffic volumes north of Frederick (1500).
- The carriageway widths are mostly generous.
- Great King Street links into Moray Place, which connects to Stuart Street, and thus could form a reasonable north-south link that is not too circuitous.

Weaknesses (south of Albany)

- Some of the driveways are rather busy (e.g. Countdown, multi-storey parking building, hospital). In those locations, safety of cyclists might be compromised.
- Parking would be affected south of Frederick Street in locations where a reasonable number of adjacent businesses would be impacted.
- A complication exists in the St Andrew – Hanover block, where there is a central median in one location, and a narrow raised crossing nearby.
- North of Hanover Street, the corridor is narrower (but this might be acceptable if a Quiet Street can be achieved).
- Could affect drop-off parking immediately outside the hospital's main entrance.

Strengths (north of Albany)

- The parking demand is generally low.
- The carriageway is generally quite wide.
- There are few kerb extensions or trees on the east side of the road.

Weaknesses (north of Albany)

- At the Albany Street intersection, a diagonal crossing is required. This would best be done by a new traffic signal phase, which would reduce the existing level of service for motorists at this site, and would provide a compromised level of service for cyclists.
- There is some localised parking demand:
    - West side: bookshop & post office, north of Dundas Street
    - East side: north of Dundas Street through a commercial area.
- There is a localised traffic engineering challenge at Moat Street.

Discussion

A link along Great King Street is one of the feasible network options. Where the road is administered by DCC, the volumes are mostly too high for anything other than SCLs for the chosen target audience. There are options for uni-directional and bi-directional facilities here. The parking outside the main entrance of the hospital could be affected by the provision of these facilities. Where the road is administered by the Transport Agency, a bi-directional facility is proposed on the east side of the road, and the only substantial issue is the parking demand outside commercial premises north of Dundas Street. Where the SCL is installed on the State Highway, the existing cycle lanes would have to be removed. Overall, the route is slightly less direct than other options and users would switch between different treatment styles more frequently; overall, this lowers the level of service experienced by cyclists.

3.3.4 One-Way Pair SCLs (left)

Appendix I shows a north-south option that would also establish critical linkages iii, iv, and v. The critical linkages assessment is the same as shown in Table 6 above. This option is based on uni-directional SCLs along the whole length of the State Highway one-way pair north of Queens Gardens, with the SCLs located on the left side of the road as seen in the direction of travel. This option would replace the existing cycle lanes over the whole length of the links. This option would require the removal of parking from the left hand sides of the one-way streets.

Strength

- The SCLs would replace the cycle lanes that are already in place and as such follow the well-known route of existing cycle network elements.
- The uni-directional SCLs would place cyclists on the left side of the road, i.e. the side that they are used to travelling on.
- The carriageway widths are generous.
- The links are direct and without any detours.
- This option would be one of the cheaper ones of the north-south considered here.

Weaknesses

- Some of the driveways are busy, and in those locations, safety of cyclists might be compromised:
    - Northbound: Countdown, New World, hospital.
    - Southbound: Mobil North Gate, University entrances.
- The short-term parking spaces outside the university bookshop and the post office have a very high turnover. On Great King Street, there is some localised parking demand north of Dundas Street.
- There are localised traffic engineering challenges at Willowbank, Frederick Street, and at Anzac Avenue.
    - Of those, the existing slip lane at Frederick Street is of concern, as it is used by many heavy vehicles going towards SH88.
- There are numerous kerb extensions, many of which hold trees.
- There are a large number of bus stops along the links. The higher the number of buses stopping at stops, and the higher the number of passengers boarding and alighting, the more problematic it is to provide a cycle facility for the *Interested but Concerned* that works for both cyclists and bus passengers. The high degree of interaction between cyclists and bus passengers would cause safety concerns.

- The high degree of interaction between cyclists and bus passengers would also result in a relatively poor level of service for cyclists, as stopping for passengers would be relatively frequent.

Discussion

The option has a number of weaknesses. The most significant of these is the interaction between cyclists and pedestrians at bus stops. Some of the bus stops are rather busy (e.g. outside the supermarkets), and the problems that can be foreseen there cannot readily be resolved. As such, the option is much weaker than many other options and should not be pursued any further.

3.3.5 George Street SCL

Appendix J shows a north-south option that would establish critical linkages iv and v (Table 9). In terms of potential infrastructure, this option is based on uni-directional SCLs along the whole length of George Street, linking into the SCL proposed for Stuart Street. This would allow the cycle lanes to remain on the one-way pair through the central city. This option would require the removal of parking from at least one side of George Street, depending on the final concept chosen.

Table 9: Critical linkages assessment for the George Street corridor

link	Description	George
i.	NEV to University / Otago Polytechnic	
ii.	University / Otago Polytechnic to Portsmouth pathway	
iii.	NEV to Hospital	
iv.	NEV to North city and central city	✓
v.	North city and central city to Oval	✓
vi.	Cross link to SH88 Shared Path	
vii.	Cross link to The Octagon	

Strength

- This link has the highest concentration of employment / shopping along it, which makes it a prime candidate for a cycle network link.

Weaknesses

- George Street is currently the main bus corridor in Dunedin. The higher the number of buses stopping at stops, and the higher the number of passengers boarding and alighting, the more problematic it is to provide a cycle facility for the *Interested but Concerned* that works for both cyclists and bus passengers. The high interaction between cyclists and bus passengers would cause safety concerns.
- The high interaction between cyclists and bus passengers would also result in a relatively poor level of service for cyclists, as stopping for passengers would be frequently required.
- The corridor has a high pedestrian density (ruling out shared path options).
- Near The Octagon, the carriageway is very narrow and has many kerb extensions with trees; this would be overcome where a shared space is established instead of an SCL.
- This option would cause parking loss right outside a large number of businesses.

- Due to the narrow carriageway and the large number of existing kerb extensions, plus the need for a block of 'shared space', this option would possibly be the most expensive to build.
- Events would have an effect on this route from time to time.

Discussion

The George Street option with SCLs does not appear to be a practical option solution, due to the extent of the physical works required, especially in those blocks closest to The Octagon, where the carriageway is very narrow. But even if this were done, there would be problems at the many bus stops along the route. It is thus recommended to not consider this option any further, even though it goes right through the heart of the business district.

There may well be other opportunities to improve the amenity of George Street for cyclists and pedestrians, as the environment on approach to and within The Octagon has all the qualities that make it a candidate for a shared space. To achieve this would, however, require a significant change in the management of traffic within these corridors. While here recognising the potential for such change, this is not an option that has been developed further within this report; as it has too much of an effect on the wider traffic, transportation and community interests.

3.3.6 Leith and Castle Streets

Refer to Figure 12 for the Leith and Castle Street options, which would achieve critical linkages i and ii (Table 10). Both options would utilise a mixture of Quiet Street treatments and shared paths. The Leith Street option would make use of the corridor over its full length. The alternative would be to use Castle Street from its northern end, then along the true right of the Leith River, which would then link into Leith Street within the university grounds. The former option has the advantage that this link is already available. The latter option is subject to formal cycling restrictions that are in place through the university (Figure 7), but the opportunity exists to put a purpose-built structure in place as part of the flood mitigation work that is to be carried out by the Otago Regional Council.

Table 10: Critical linkages assessment for the Castle and Leith corridors

link	Description	Castle	Leith
i.	NEV to University / Otago Polytechnic	✓	✓
ii.	University / Otago Polytechnic to Portsmouth pathway	✓	✓
iii.	NEV to Hospital		
iv.	NEV to North city and central city		
v.	North city and central city to Oval		
vi.	Cross link to SH88 Shared Path		
vii.	Cross link to The Octagon		

Figure 12 shows the Leith Street option in yellow, and the Castle Street option in red. From south of the bridge on Leith Street that crosses the Water of Leith, both options utilise Leith Street towards St Andrew Street; this part is shown in green.

On the north-south planning maps, the Leith Street link is commonly shown, and this does not indicate a preference to this option over the Castle Street link. Both options can achieve critical linkages i and ii, and both options should be investigated further. There is little loss of on-street parking anticipated with these options but substantial pedestrian conflict opportunity depending on the design and amount of bicycle traffic.

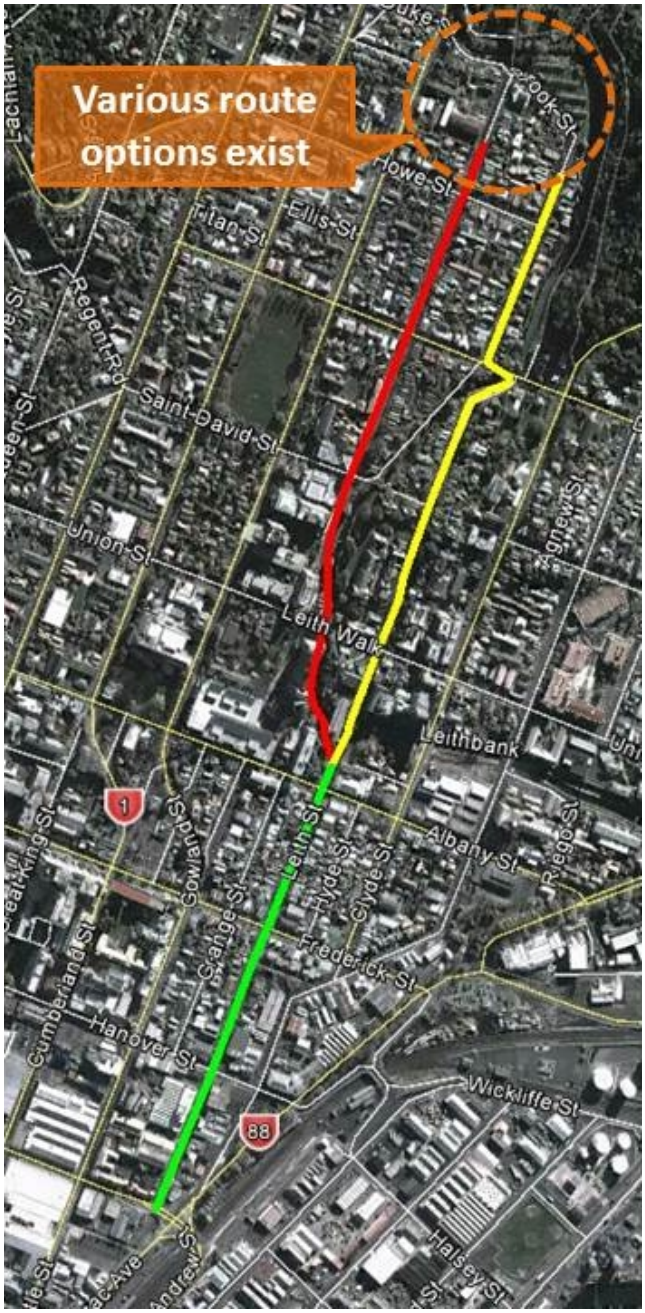

Figure 12: Castle and Leith Street options

4 Demonstrating the Opportunity from Investment

4.1 Opportunities

Latent demand

There is enormous latent demand for cycling in Dunedin. Appendix K shows the results of a recent People's Panel survey. 503 Dunedin adult residents from across the city were asked about their daily transport choices. 74% agreed or strongly agreed the DCC should spend money on constructing separated cycleways, with only 10% opposed. Although 75% of respondents currently use a car as their primary mode of transport, only 39% said that driving a car is their preferred option. This indicates that roughly half of the people who currently drive cars would prefer not to. The survey responses showed that while only 5% of people currently use a bicycle as their primary transport choice, 25% would prefer bicycling as their primary transport choice; so about a quarter of people in the car-primary category would prefer to be primarily on bicycles. But the usage of the proposed cycle network will not be limited to the 25% of residents who would like to cycle as their primary transport choice, as the survey results show that at least 60% of people would be encouraged to cycle at least some of the time if cycling infrastructure separated from motorised traffic were available. In general, the survey showed overwhelming support for the idea of separated cycleways, with broad agreement that separated cycleways of the kind proposed here would be better for both cyclists and motorists.

Dunedin energy costs economic gain

The recently released DCC energy strategy estimates the city's expenditures on petrol at $203 million per annum. A breakdown of the cost of petrol is shown in Figure 13. This graph shows that 41% of petrol costs are fuel excise taxes, GST, and emissions trading scheme levy. About 45% of the cost of fuel, $0.45 of every dollar or about $90 million per year for Dunedin, is the raw cost of petrol. This represents a $90 million per year drain on Dunedin's economy that does not get returned in any form, for example through the National Land Transport Programme (NLTP). Since this money goes overseas, it is not only a drain on Dunedin's economy but is a drain on the entire economy of New Zealand. For every 10% shift from cars to cycling or walking for personal transport, Dunedin would save $9 million per year that would otherwise end up overseas. Money not spent on petrol is available to be spent in the local economy. Hence, there are economic benefits from providing for cycling.

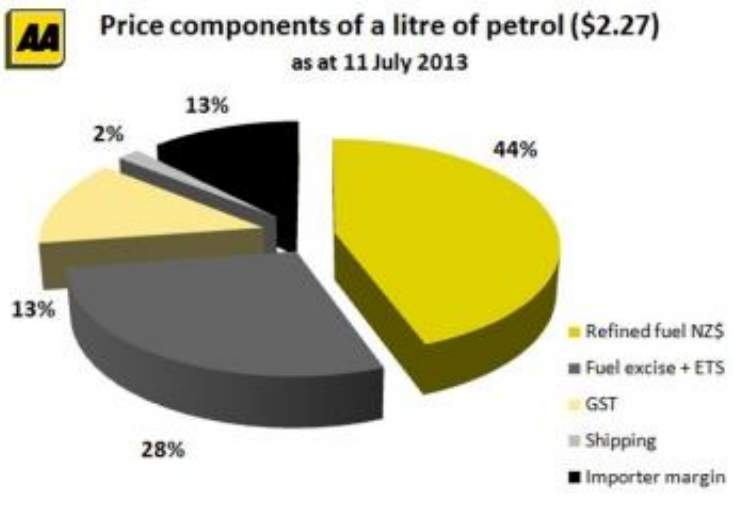

Figure 13: Price components of petrol in July 2013[9]

Note that although New Zealand is an oil producer, the oil produced in New Zealand is generally not fuel-grade, and 85% of total domestic production is exported (Ministry of

[9] Source: New Zealand Automobile Association

Business Innovation and Employment, 2013). Overall, domestic production accounts for less than 3% of total domestic consumption and is not refined as petrol, so it is fair to say that the entire raw cost of petrol ends up overseas. Note that about 24% of petrol cost, $48 million per year for Dunedin, goes into the NLTP, some (but not all) of which comes back to Dunedin through transport subsidies. Thus a 10% mode shift would reduce Dunedin's contribution to the NLTP by $4.8 million per year. However, the regional distribution of the NLTP is not strictly correlated to contributions, so it does not follow that a $4.8 million per year reduction in contributions to the NLTP would result in any reduction in NLTP transport subsidy to Dunedin.

Portland case study

Recent surveys around New Zealand, including Dunedin, Christchurch, and Auckland, indicate a large latent demand for cycling, but the ability to tap into that demand is hard to quantify using local case studies, as no city in this country has attempted to meet this demand. A well-documented case is the US city of Portland, Oregon. In Portland, cycling has been treated as a serious transport mode since 1990, and the slides below show comparisons between 1990 (Figure 14) and 2007 (Figure 15) in terms of the extent of the bicycle network, and the resulting mode split. Whilst Portland (city population of 600,000), like Dunedin, has tertiary education providers, it should not be mistakenly assumed that Portland's growth in cycling has come from the education sector. Rather, their experience is that when cycling becomes a mainstream activity, it is a mode of transport taken up by a broad cross section of society.

As can be seen in Figure 14, the 1990 bicycle network in Portland was rudimentary, and not many routes formed long corridors. There were only two census areas that achieved a mode share for cycling to work of between 6.1% and 8%; all other areas had lower mode shares.

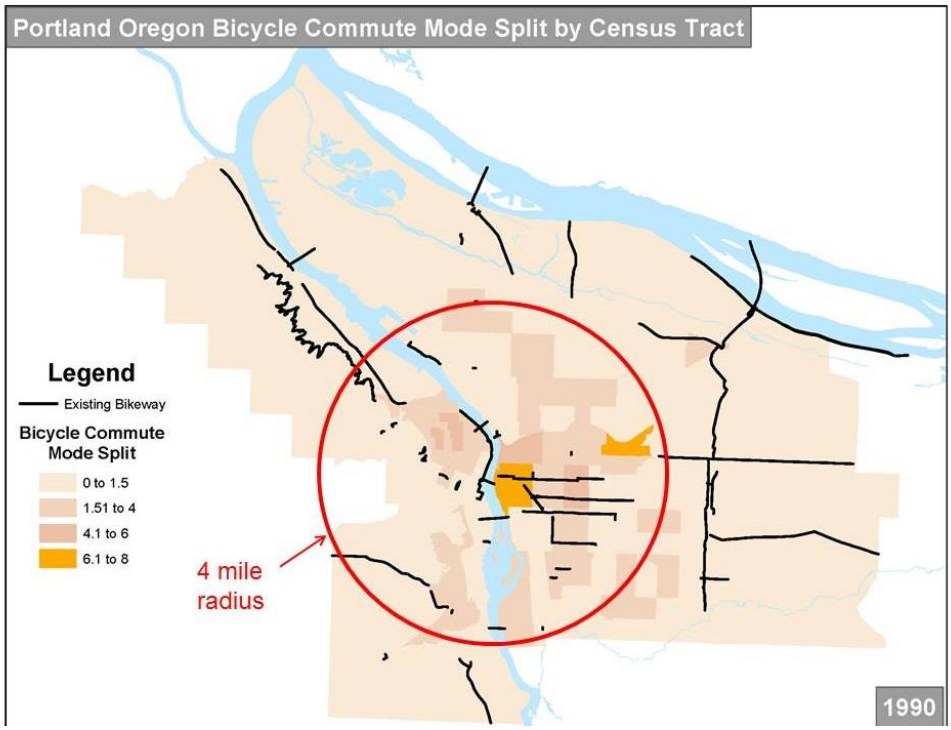

Figure 14: Portland bicycle network and mode split in 1990[10]

[10] Source: Roger Geller, Bicycle Coordinator of Portland, Oregon

In 2007, only 17 years later, Portland's bicycle network was comprehensive. Most gaps in the network had been filled by then. The areas with the highest cycling mode share register between 25.1% and 33%.

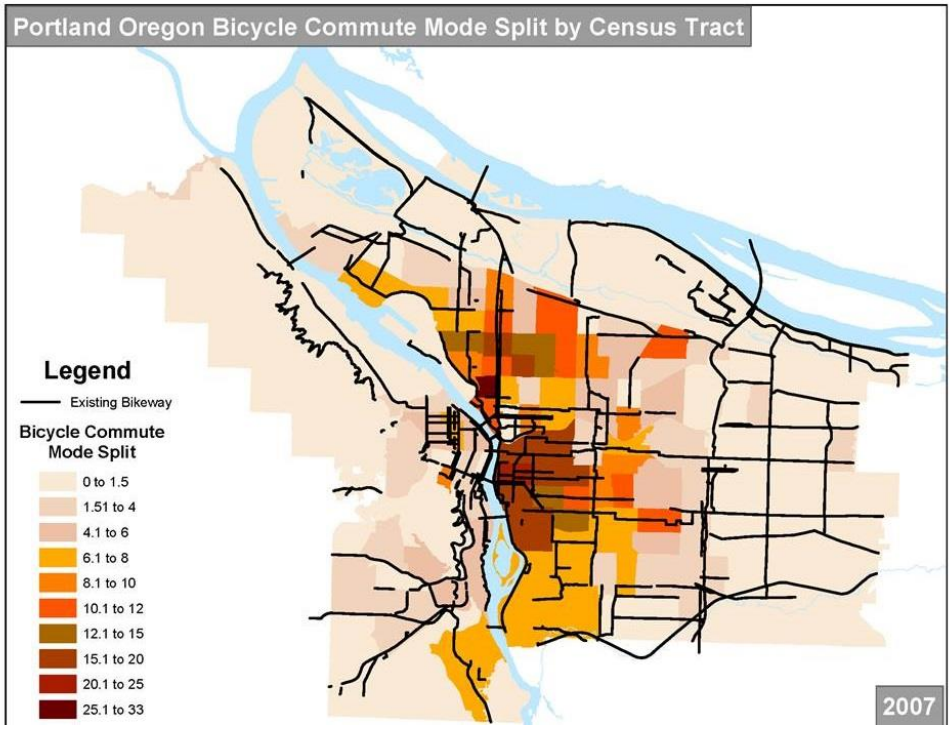

Figure 15: Portland bicycle network and mode split in 2007

Cycle crashes

Portland has four main bridges that are available for cycling across the Willamette River. Figure 16 shows daily cyclists crossing those bridges, and the number of reported cycle crashes in the whole city, and the resulting cycle crash rate.

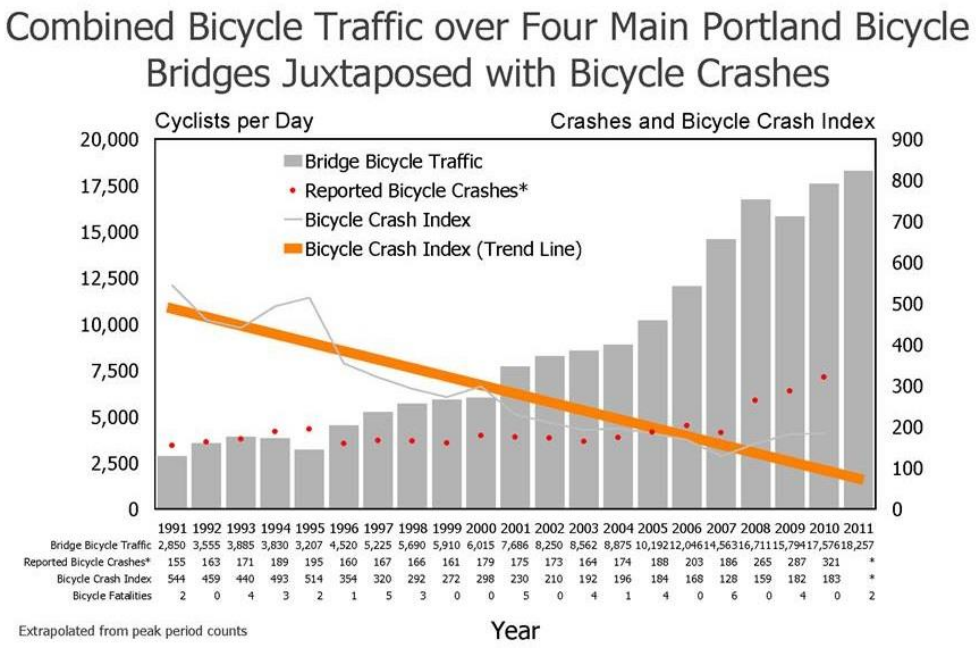

Figure 16: Portland cycling crash rates and bicycle volume across Willamette River

Figure 16 shows data from 1991 to 2011. It can be seen that there has been a significant growth in cycling between 1991 (2,850 cyclists/day) and 2011 (18,257); cycling numbers

have grown by a factor of 6.4. The number of reported crashes across the city has stayed constant until 2007, fluctuating between 155 and 203. The marked increase in reported crashes from 2008 does not reflect a sudden increase in cycle crashes, but

> "reflects a decision by the Portland Police Bureau to lower the threshold for reporting bicycle-involved crashes. This change, beginning in January 2008, means that crashes previously unreported by Portland Police are now entering the reporting system. There have been no indications in the operation of our system that leads the city to conclude that the increase in reported crashes is representative of changes in actual crash activity within the city."

Traffic growth

In the late 1980s, the four bridges had approached capacity, but have since experienced healthy traffic growth. All the growth has come from the increase in cycling, though; the number of motor vehicles going across these bridges has stayed constant. If the traffic growth had occurred through an increase in motorised traffic, Roger Geller, the city's Bicycle Coordinator, explains that drivers would either be sitting in congested traffic, or transport officials would have had to spend tens of millions of dollars to widen the bridges, and all the subsequent capacity improvement projects throughout the network. Portland has managed to grow healthily by providing for cycling, and by doing so, they have saved themselves tens of millions of dollars that they did not have to invest in roading infrastructure.

Lessons from Portland

The lessons from Portland are that there is a very large unmet demand across the entire population for cycling. People will take up cycling when they feel safe, and on all but the quietest streets, that requires physical protection from motor vehicles for the vast majority of the population. The *Interested but Concerned* are the audience from which most of the growth will come, and they make up close to two-thirds of the population. Under the current conditions in Dunedin, that target audience is not using bicycles for transport in the central city. Furthermore, this increase in cycling does not necessarily mean that there will be an increase in the actual number of cycle crashes. At least in the Portland case, cycle crash numbers stayed static whilst cycling grows several-fold; this can partly be explained through the 'safety in numbers effect' (Turner et al., 2009), and partly through the provision of safer infrastructure. Lastly, Portland has avoided congestion and saved tens of millions that it would otherwise have had to spend on roading infrastructure; their cycling-focussed transport policy made economic sense.

… there is a very large unmet demand across the entire population for cycling. People will take up cycling when they feel safe, and on all but the quietest streets, that requires physical protection from motor vehicles for the vast majority of the population.

… increase in cycling does not mean that there will necessarily be an increase in the actual number of cycle crashes. … cycle crash numbers may stay static whilst cycling grows several-fold.

Portland has avoided congestion and saved tens of millions…

4.2 Parking issues

The installation of SCLs will generally require the removal of parking from that side of the road for which the SCL is proposed, and it can be challenging to achieve community buy-in for parking removal or ignore those most impacted. There is a strong perception that

the provision of parking is tied to economic return, with the implication that removal of parking is bad for business. There are studies that dispute this relationship, though, and suggest that the opposite can be true.

The shopping complex Lygon Court in Carlton was instrumental for converting car parking to bicycle parking in Melbourne. Requested by the adjacent shop owners, but at the time opposed by the Carlton Business Association, two on-street parking spaces were converted to 24 bicycle parking spaces (two rows of bicycle hoops make partial use of the footpath). This was such an economic success that it has formed the basis of many other businesses having asked for the conversion of car parks to bicycle parks since, but it needed this first example to demonstrate the success. There is more business opportunity in 24 customers arriving by bicycle than 2 or 3 arriving by car.

The City of New York has researched the impacts of installing SCLs and compared it to other streets in the same borough that were not treated. They found that while borough-wide turnover with retailers had increased by 3%, those retailers on 9th Avenue where the first SCL was installed in the US in 2008 enjoyed an increase in turnover of up to 49%. Union Square North was heavily traffic-calmed and pedestrians were given more space and cycling provided for with an SCL, where commercial vacancies have consequently fallen by 49% compared with a 5% fall borough-wide (New York City Department of Transport, 2013).

Numerous studies show that generally, customers arriving on bicycle spend less than customers who have driven to a shop. But they also show that cycling customers arrive more frequently, with the difference in monthly spend not statistically significant. The Draft Dunedin City Transport Strategy 2013 suggests that a higher proportion of parking be shifted off-street. In a recent People's Panel survey of 503 Dunedin residents, 55% agreed or strongly agreed with and only 26% of respondents opposed the removal of on-street parking to make way for separated cycleways. The latest Dunedin Parking Study (Groundwater and Smith, 2012) found that “there is still capacity in off-street public and staff car parks to provide for more long-term parking, [and it is] therefore considered that no new commuter parking is required in Dunedin.”

The exact impacts on parking can only be determined when individual schemes are developed.

4.3 Next steps

This report supports the Programme Business Case step in the Transport Agency’s Business Case Approach.[11] The next steps are:

- DCC’s elected members will consider the recommendations from this report,
- The proposals would then go out for public consultation,
- Consultation feedback will be compiled and analysed, and this will inform further steps,
- The **Programme Business Case** (Transport Agency step 1) identifies an optimal mix of alternatives and options but doesn’t look at detailed solutions at this stage,
- The **Indicative Business Case** (Transport Agency step 2) further develops specific activities, provides a list of options, and recommends a preferred way forward as part of the short-listed alternatives, and
- The **Detailed Business Case** (Transport Agency step 3) confirms an activity that comes from the detailed programme of activities and confirms the overall assessment profile, and includes a more detailed reporting of economic, financial and commercial aspects of the activity.

[11] Refer to: http://hip.nzta.govt.nz/manuals/project-development

Please note that each of the Transport Agency's Business Case Approach steps include funding approval to the next step. For a series of projects to be implemented, the initiative must be included in Otago's Regional Land Transport Programme; the next RLTP covers the period from 2015 to 2018.

5 Conclusions

- Cycling in central Dunedin has a poor crash record, especially on the one-way pair, and is unattractive to much of the population. To respond to this situation quickly, short-term safety improvements are successively being implemented, and research is being conducted around a trial to install wider cycle lane with non-standard road markings.
- In order to be able to go forward, the working party resolved that the target audience for a future cycle network in the central city would be the *Interested but Concerned*. This forms the basis for the planning work undertaken that is documented in this report.
- The project team has refined the sustainable transport goal in the Draft Dunedin City Transport Strategy 2013 and formulated the target of "achieving 10% bicycle trip to work mode share in Dunedin by 2024."
- The agreed strategic approach was to "develop a safe network for the project area comprising a range of infrastructural treatments, which together form a cycle network that can become more comprehensive over time."
- A number of critical linkages between key origins and destinations were defined that the future network must serve. Some of the critical linkages will be catered for by the South Dunedin cycle network that is currently under implementation; this planning work must be cognisant of the South Dunedin network.
- There are a variety of mainly north-south running optional network links that would provide those critical linkages, and those have been ranked. Two of the options are suggested for further consideration in subsequent project stages; these are the **One-Way Pair Separated Cycle Lanes** and the **Cumberland Street Separated Cycle Lane** options.
- There are two optional network links that would provide linkage between NEV, the university, and the Portsmouth pathway. Both have merits, but one of them conflicts with the formal restrictions on cycling through the university grounds.
- There is a very large unmet demand across the entire population for cycling. People will take up cycling when they feel safe, and on all but the quietest streets, that requires physical protection from motor vehicles for the vast majority of the population.
- A substantial increase in cycling will result in reduced risk for individual cyclists due to the 'safety in numbers effect'. A case study from Portland, Oregon, United States showed the actual number of cycle crashes as constant although cycling grew several-fold; this was achieved through well-engineered infrastructure that lowered crash risk.
- Strategically catering for cycling can make economic sense due to reduced congestion, reduced road capacity expenditure, reduced parking demand allowing land to be used for more productive purposes, and reduced economic drain resulting from petrol costs.

6 References

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