SHAPING FUTURE DUNEDIN TRANSPORT PROGRAMME BUSINESS CASE

PREPARED FOR Waka Kotahi NZ Transport Agency

August 2021



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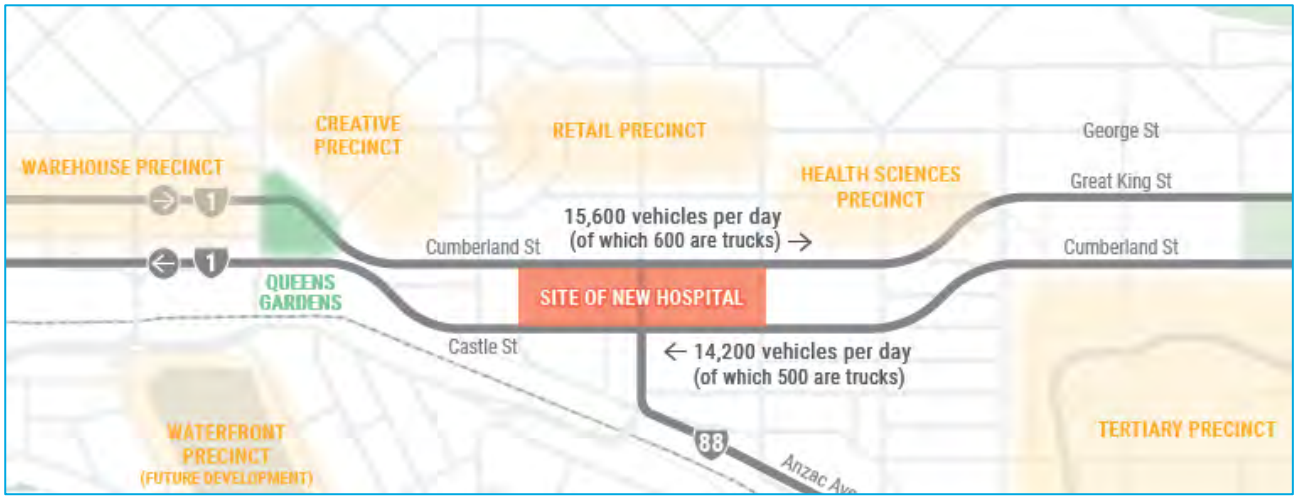
Executive Summary

Context

Dunedin is the second largest city in the South Island. The city is considered one of the four main cities of NZ for historic, cultural and geographic reasons. Population growth means Dunedin is a 'medium growth' city. Dunedin has a diverse economy, with significant tertiary education and health sectors. The city is home to around 25,000 tertiary students and staff, and Dunedin hosts the primary hospital for the Southern Region, a teaching hospital with strong links to the University.

In 2018, the government announced the central city location for the $1.4B New Dunedin Hospital (NDH). This once in a lifetime opportunity was the impetus for MOH to ask Waka Kotahi and DCC to look at a change to the roads to improve access and integration between the hospital and the city, including considering a change to the configuration of SH1 through Dunedin. This was the catalyst to progress work DCC started in 2013, looking at the benefits a change to the configuration of SH1, including making it a two-way system, could bring.

The SH1 one-way system and SH88 are nationally important transport routes, providing key north-south connections and the route to Port Otago. However, high traffic volumes and dominant north-south traffic flows along the SH1 one way pair divide Dunedin's geographically constrained city centre, leading to reduced pedestrian connectivity and poor amenity issues (air and noise pollution). The New Dunedin Hospital site has six of the proposed seven road frontages on the state highway network, which will exacerbate these issues.



Business case work started immediately and quickly confirmed that the scope of this Programme Business Case should be broadened to include access to the city by all transport modes.

The Connecting Dunedin partners, Waka Kotahi NZ Transport Agency, Dunedin City Council and Otago Regional Council, committed to this PBC as a way to establish the best long-term transport and urban mobility system for Dunedin to:

- Enable integration of the new hospital with the city.
- Stimulate economic growth and regeneration.
- Provide for safe and accessible people friendly streets.
- Improve city liveability.

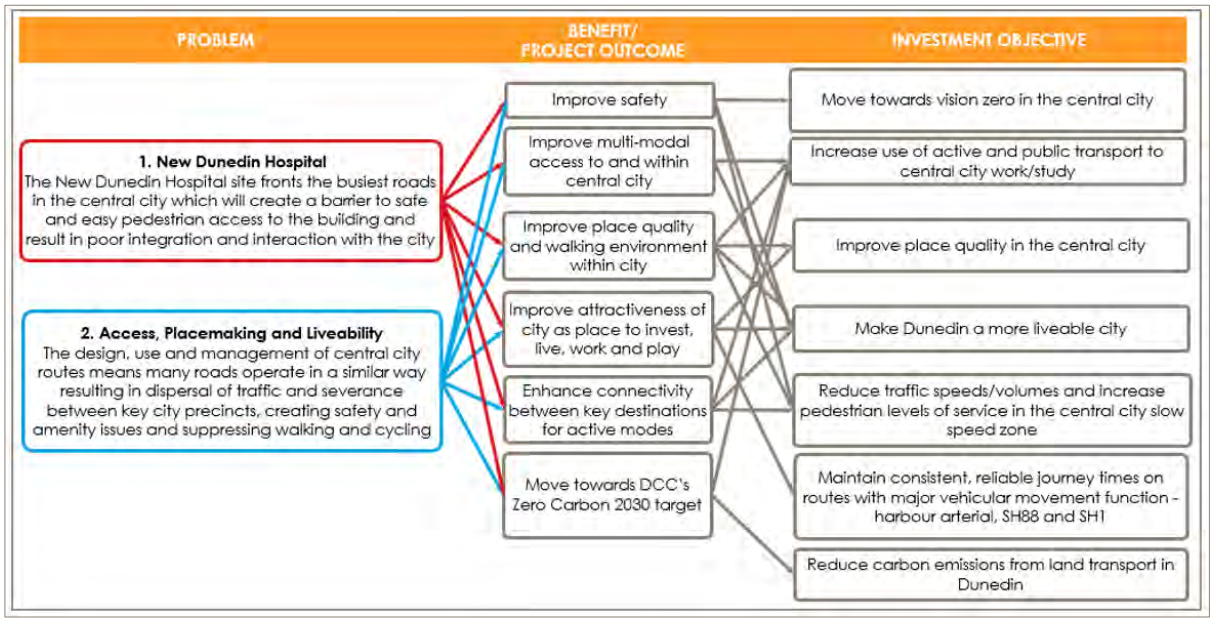
Problems and Benefits

The two problems this PBC aims to solve relate to:

New Dunedin Hospital - The NDH site fronts the busiest roads in the central city which will create a barrier to safe and easy pedestrian access to the building and result in poor integration and interaction with the city.

Access, Placemaking and Liveability - The design, use and management of central city routes means many roads operate in a similar way resulting in dispersal of traffic and severance between key city precincts, creating safety and amenity issues and suppressing walking and cycling.

In addition, there are six benefits this PBC aims to realise, as shown in the Investment Logic Map:



Investigation of the problems found:

- Delays, risk-taking and jaywalking contribute to a High Collective risk on SH1 on either side of the NDH site.
- Six of the seven NDH frontages are on state highways, including St Andrew Street, which is part of the SH88 route to Port Otago.
- The severing effect of the SH1 one way system, with 15,000 vehicles per day in each direction (of which 5-600 are trucks) and long delays at signals, will reduce the ability for the Ministry of Health (MoH) to integrate the hospital with the city and tertiary area, and is likely to create issues for safe and easy pedestrian access to the hospital.
- The pedestrian environment around the hospital rates low for quality of environment and permeability, with noise and air pollution reducing amenity.
- There is low public satisfaction with the flow of traffic through Dunedin's central city at peak times and increasing concerns about congestion on the one-way system.
- The DCC's Central City Plan and University's Masterplan recognise that severance caused by the one-way system is a challenge to fully realising aspirations for placemaking and accessibility to enable economic growth/regeneration and a quality experience for visitors and residents.
- Car trips make up 74% of the journey to work or education (2018), which reduces efficiency, amenity, parking availability, and the potential to achieve carbon reduction targets. Construction of the new hospital in 2022 will cause disruption and delays for people driving on SH1, and there is an opportunity to encourage people to change to a different mode during this period.

Option and Programme Development

Stakeholder engagement has been ongoing and programme development iterative since 2018. Importantly, city leaders and place-makers have shared their plans and vision for Dunedin to help the Connecting Dunedin partners understand the role that transport could play in supporting the hospital development and realising benefits for the wider city.

Through stakeholder workshop participation, review of background documents and feedback from project partners, 81 interventions were identified. Interventions were then consolidated and packaged, initially into six programmes and, through an ongoing process of stakeholder feedback, community engagement and detailed technical assessment, refined down to two.

The single, constant differentiator between the programmes, since business case work began in 2018, was whether to retain the one-way system or consolidates SH1 onto a single two-way arterial road (the existing southbound one-way). The project partners were keen to further test the options associated with these scenarios through detailed technical assessments and stakeholder engagement to better understand the issues and opportunities associated with each.

The two shortlisted programmes both featured a selection of common projects focused on improving the level of service for public transport and active travel such as walking and cycling, as well as improvements to the harbour arterial. Other differences between the programmes related to the layout, speed, amenity level and parking provision along the two arterial corridors.

The Programme 2 option, to consolidate SH1 onto a single two-way arterial road, was tested multiple times through technical assessment and traffic modelling, with the third version (v3) finally being shortlisted.

Programme 1



- Retains the one-way system in an upgraded form:
  - SH1 speed limit is reviewed
  - Extends the existing separated cycle facilities south to the Oval
- Maintains existing parking along the one-way system
- Targeted amenity improvements on the one-way system around Queens Gardens, the NDH, and the University

Programme 2v3



- Consolidates SH1 onto a single two-way arterial road (the existing southbound one-way), with:
  - two lanes in each direction south of Queens Gardens
  - one lane northbound and two lanes southbound between Queens Gardens and Albany Street
  - one lane in each direction north of Albany Street
- 50kph speed limit on SH1 is retained
- Transforms the existing northbound one-way into a two-way local road with slow speeds and a focus on amenity
- Relocates the existing separated cycle facilities from SH1 arterial to the new local road and extends them south to the Oval
- Relocates most parking from SH1 to the new local road

The technical assessment of P1 and P2v3 resulted in the scores for each programme being very close. When weightings were applied to these criteria the gap between the options increased. However, during sensitivity assessments this resulted in the highest score alternating between each of the programmes depending on what criteria was valued most. From this it is possible to conclude two things:

1. Both programmes deliver significant benefits and achieve many of the outcomes sought
2. The relatively close scoring of the programmes in comparison to one another has made it difficult for stakeholders to accept that either one of the programmes is preferable to the other.

With respect to point 2 above, this also resonates with the feedback heard from the general public. Whilst there was strong support for amenity enhancements, walking and cycling upgrades and public transport improvements from some of the submitters, there were many who favoured improvements to travel time and network operation.

Although P2v3 was scored higher by the technical team when weighted to the project outcomes sought, this is shown to come with additional risk, complexity and cost. Ultimately, the close scoring of the options combined with the public and stakeholder sentiment means it is not appropriate to progress this option at this time.

However, the work completed to date clearly demonstrates that the common elements of both P1 and P2v3 deliver significant benefits and will go a considerable way to achieving the outcomes sought of this project. As a result, the project team has reconsidered the feedback received and reassessed the programme options to determine a preferred programme and way forward.

Having the benefits of the stakeholder and public feedback alongside the technical assessments, the project team remoulded the programmes to achieve as many of the benefits sought whilst balancing the investment against traffic impacts, risk and cost. This resulted in an amended P1 programme being developed which retained the common programme, representing significant investment in improving access and providing travel choices, alongside focussed interventions on SH1 to reduce heavy vehicle movements in the central core, implement safe and appropriate speed and provide safer crossings for pedestrians and cyclists. The Partner Preferred Programme also includes a specific focus on managing disruption during the hospital build.

Preferred Programme

The Partner Preferred Programme is P1 with some minor amendments to incorporate evolving thinking around the treatment of the SH1 one-way system, and alignment, where possible, with existing Waka Kotahi programmes to achieve a safer route and better pedestrian connections.

The Partner Preferred Programme will achieve the following outcomes over the 10 next year period:



A summary of transport projects within the preferred programme is provided in the table below and shown on the map. Endorsement of these projects is sought through this business case process.

Activity	Elements
State Highway Works	Interim SH1 Safety Improvements Lower SH1 Speeds Relocate SH88 to Frederick Street Pine Hill Intersection Upgrade Targeted SH1 Amenity Improvements

Activity	Elements
	Queens Gardens to Oval Cycleway
Harbour Arterial Upgrade	Directional Signage and Wayfinding Major and Minor Intersection Upgrades Corridor Improvements Ward Street Overbridge Upgrade
Public Transport Improvements	Central Bus Hub and Superstop Upgrades Frequency and Fare Review Southern Bus Priority
Parking Management Improvements	Demand Responsive Pricing Smart Prioritisation of Parking Parking Wayfinding System Upgrade Payment Technologies Occupancy Sensors Consolidate Existing Off-Street Parking
Park and Ride	Mosgiel Park and Ride Burnside Park and Ride
Active Mode Improvements	Slow Speed Zone Princes Street Improvements Albany Street Cycleway St Andrew Street Improvements Bicycle Hubs Behaviour Change Programme Sustainable transport programme Demand management

Changes to the one-way system in the short–medium term will be provided by the Waka Kotahi speed management and safety programmes, and a business case in 2024–27 to determine any further improvements to hospital access and amenity around the NDH.

Changes to the one-way system are possible in the long term subject to triggers:

- Outcome focussed reviews, e.g., if P1 mode shift targets are not met alternative solutions could be explored.
- Changes in Government direction or law changes.
- Land use change through refresh of the Spatial Plan or 2GP.
- Safety trends.
- Effectiveness and satisfaction with pedestrian levels of service.

Shaping Future Dunedin Transport **Partner Preferred Programme**

PROGRAMME OVERVIEW



1 State Highway Works

- 1a SH1 Safety Improvements — WAKA KOTAHI
- 1b SH1 Speed Management
- 1c Relocate SH88 to Frederick Street
- 1d Pine Hill Intersection Upgrade
- 1e Additional Access and Safety Improvements
- 1f Queens Gardens to Oval Cycleway

2 Harbour Arterial Upgrade

- 2a Directional Signage and Wayfinding — DCC
- 2b Major and Minor Intersection Upgrades
- 2c Corridor Improvements
- 2d Ward Street Overbridge Upgrade

3 Public Transport Improvements

- 3a Central Bus Hub and Superstop Upgrades — ORC, DCC
- 3b Frequency and Fare Review
- 3c Southern Bus Priority

4 Parking Management Improvements

- 4a Demand Responsive Pricing — DCC
- 4b Smart Prioritisation of Parking
- 4c Parking Wayfinding System
- 4d Upgrade Payment Technologies
- 4e Occupancy Sensors
- 4f Consolidate Existing Off-Street Parking

5 Park and Ride

- 5a Mosgiel Park and Ride — DCC
- 5b Burnside Park and Ride

6 Active Mode Improvements

- 6a Slow Speed Zone — DCC
- 6b Princes Street Improvements
- 6c Albany Street Cycleway
- 6d St Andrew Street Improvements
- 6e Bicycle Hubs *indicative locations only*

7 Behaviour Change Programme

- 7a Sustainable transport programme — ORC, DCC, MOH
- 7b Demand management

Delivery partners

- WAKA KOTAHI — *Waka Kotahi NZ Transport Agency*
- DCC — *Dunedin City Council*
- ORC — *Otago Regional Council*
- MOH — *Ministry of Health*

Assessment Profile

The Partner Preferred Programme has a BCR of 3.2 and an overall priority of Priority 1.

The highest expected contribution to the GPS Strategic Alignment is to:

Strategic Priority: Better Travel Options and Climate Change

Benefit: Impact on Mode Choice

Criterion: change in share of private passenger vehicle-based trips to other modes.

Rating: Very High

The highest expected contribution to Scheduling is to:

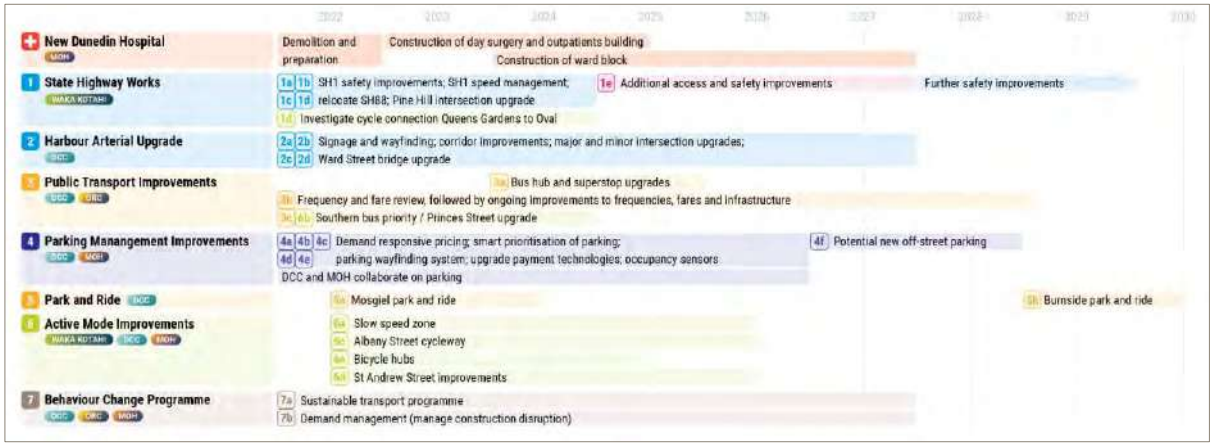
Scheduling Factor: Interdependency

Criterion: impact of non-delivery on realising the estimated benefits of the programme ie one or more benefits will not be achieved or will be delayed for more than 3 years.

Rating: High

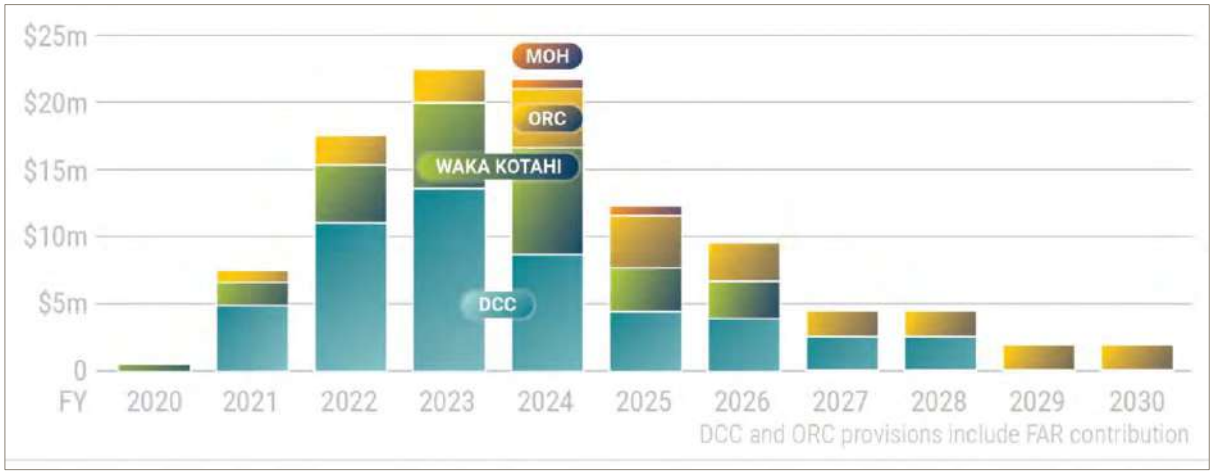
Implementation Plan

The implementation timeline is shown below. The Partner Preferred Programme has a specific focus on managing disruption during the new hospital build. The Connecting Dunedin partner organisations agreed that the elements common to both programmes should proceed as soon as possible.



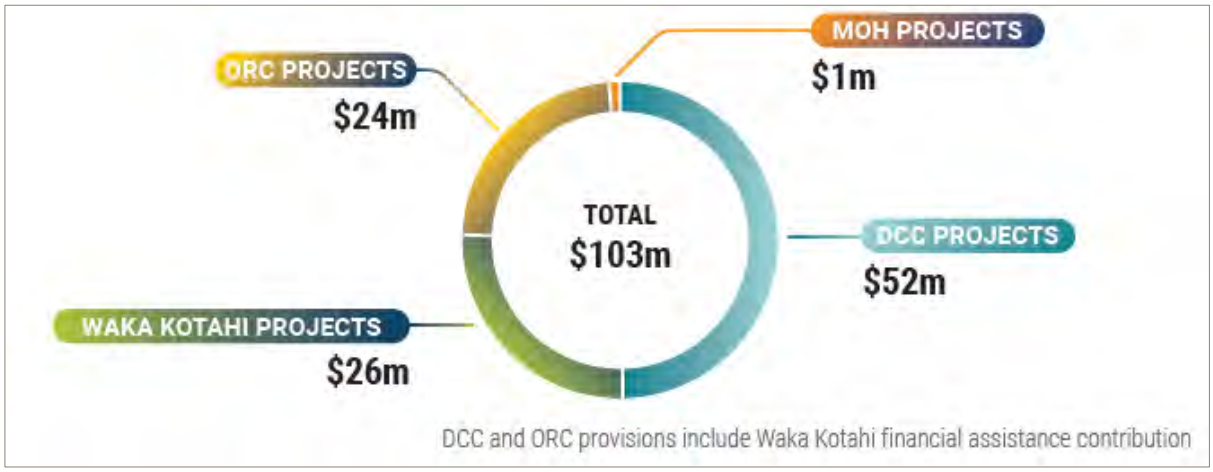
Funding

The high-level cost estimate for Programme 1 is $103m. The funding profile over the next ten-year period is shown below.



ORC and DCC budget lines in their respective LTPs for their activities were confirmed, when the Councils adopted their final LTPs at the end of June 2021. The project is awaiting NLTP funding

Some activities will involve collaboration between partners and projects identifies as ORC or DCC Partner projects will also attract Waka Kotahi's relevant funding assistance rate.



Note: MoH funding is currently unconfirmed and indicative only.

Risks

Speed management may be challenging to achieve on SH1 without some or all of the following: signal phasing to slow traffic and prevent green wave, raised platforms, or speed cameras to enforce the speed limit. Safety outcomes may take longer to achieve and travel times may increase as a result.

Slowing the speed on northbound and southbound SH1 routes through the city may result in a greater than expected increase in traffic on the Harbour Arterial or other local roads, and the proposed Harbour Arterial improvements may not be sufficient to manage the additional traffic.

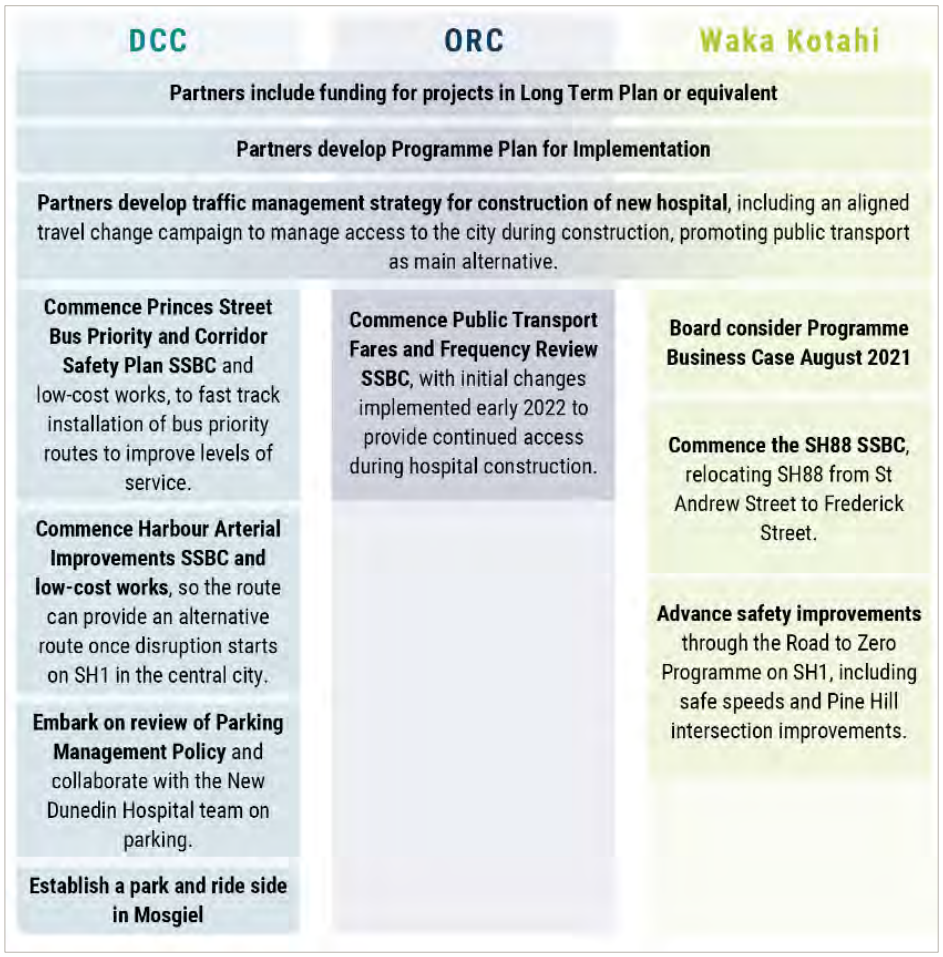
If implementation of public transport and Harbour Arterial improvements cannot be commenced by early 2022, disruption and loss of access caused by hospital construction will be more significant than currently anticipated.

Multi-partner programmes can be challenging to co-ordinate and deliver, and there is a constrained funding environment. The programme must compete for funding nationally against other projects which may be of an equal or higher priority.

Achieving public transport, walking and cycling targets may be difficult and may result in increased disruption and delay on the network and put the DCC's Zero Carbon 2030 target at risk. Parking changes may be needed to help achieve the targets.

Next Steps

The Connecting Dunedin partners will continue to work together, with the immediate next steps of each partner shown below:



Abbreviations

DSIs	Deaths and serious injuries
Council/DCC	Dunedin City Council
GDP	Gross Domestic Product
GPS	Government Policy Statement
MoH	Ministry of Health
NDH	New Dunedin Hospital
NPS-UD	National Policy Statement on Urban Development
NPV	Net Present Value
ONRC	One Network Road Classification
ONF	One Network Framework
ORC	Otago Regional Council
PERS	Pedestrian Environment Review System
PBC	Programme Business Case
RIT	Regional Investment Tool
RPTI	Real-time Passenger Information
RPTP	Regional Public Transport Plan
2GP	Second Generation District Plan
SSBC	Single Stage Business Case
SH	State Highway
SDHB	Southern District Health Board
VURT	Valuing Urban Realm Toolkit
Waka Kotahi	Waka Kotahi NZ Transport Agency

Waka Kotahi NZ Transport Agency

Shaping Future Dunedin Transport

Programme Business Case

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Part A – The Case for Investment

1. Introduction

1.1 Purpose

The purpose of the Shaping Future Dunedin Transport Programme Business Case (PBC) is to identify changes to the Dunedin transport network which would best support the location of the New Dunedin Hospital (NDH), whilst at the same time providing a future focussed, accessible transport system enabling placemaking and liveability outcomes for the city. The project goal is that by mid-2020 the partners (DCC, Waka Kotahi and ORC) have confirmed and committed to the best long-term transport and urban mobility system for central Dunedin to:

- Enable integration of the new hospital with the city.
- Stimulate economic growth and regeneration.
- Improve city liveability.
- Provide for safe and accessible people friendly streets.

This PBC completes the Draft Central Dunedin Transport Network Planning PBC (2019) which represented the first stage of work. The initial stage focussed on identifying an arterial network that would allow better integration of the NDH within the central city and achieve placemaking outcomes. Two possible arterial network programmes were short-listed.

The purpose of this PBC is to build on those programmes by including the full spectrum of interventions which could materially influence mode choice and traffic volumes within the central city.

Dunedin City Council's (Council) overarching vision, reflected in the Spatial Plan, is for a liveable city, with a strong network of accessible and connected communities that are designed to promote psychological and physical wellbeing. For the purpose of this study, a liveable Dunedin city is described in the Liveability Framework[1] as:

> 'A place that is for people – comfortable, future-facing and safe, presenting a strong sense of local cultural and natural heritage; a place where people want to live and visit. This is enabled by a movement system that encourages everyone's participation in a prosperous society, providing access to work, education, healthcare, recreation, arts and our destinations of choice from wherever it is that we come '.

This PBC presents an opportunity for reframing Central Dunedin given the pending, large scale, anchor investment projects being undertaken by the partners and by other investors such as the Ministry of Health and University of Otago. The PBC:

- Considers multi-modal access to central Dunedin.
- Looks at ways in which travel demand could be managed considering population growth and significant construction projects which will create disruption.
- Further investigates the two short listed network options and confirms the most suitable layout, in conjunction with a full package of travel demand management activities to reduce demand for single occupant vehicle trips.
- Considers how to address safety issues at the Great King Street/Pine Hill Road/Cumberland Street intersection as part of any network changes.

1.2 Project Area

The project area is focussed on the central city between the Oval and the Botanic Gardens. It also includes consideration of the way in which people travel to the city. The main flows in and out of the city are therefore also important. The project area is shown in Figure 1-1.

[1] Liveability Framework developed by Boffa Miskell for the Shaping Future Dunedin Transport PBC

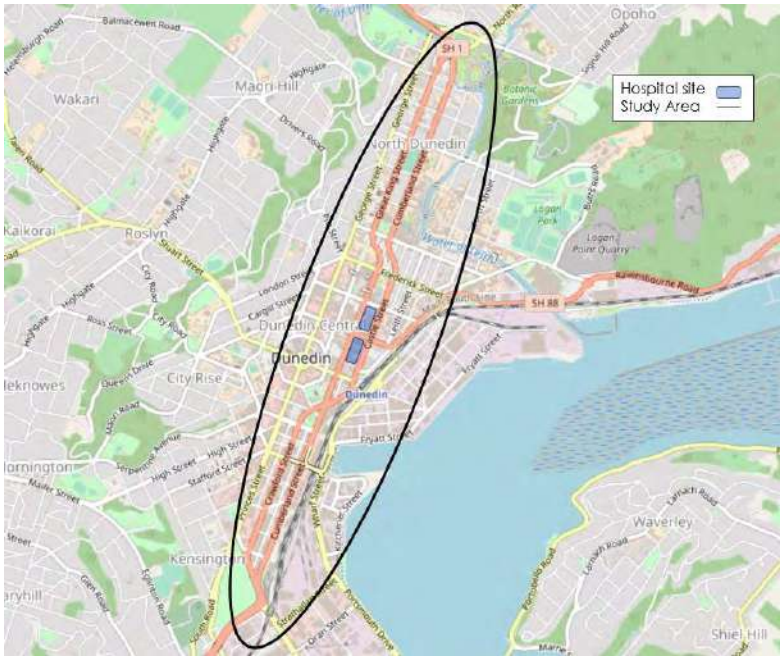


Figure 1-1: Project Area

Whilst the focus of the project is the urban core of Dunedin, there is also a need to consider the role that arterial routes in to and out of the central city will play. Of key importance to the Dunedin urban area are the levels of service provided for public transport and cycling to/from the central city, and how this is influencing mode choice.

1.3 Background

Dunedin's one-way system was introduced in 1970-71, to futureproof the network for growth. Since 2003 several arterial network studies have investigated severance caused by the one-way system and the railway line, and ways to achieve better access to the waterfront whilst maintaining efficient movement of traffic. However, no substantive changes have proceeded because of a lack of compelling benefits and/or agreement on the need for or impacts of change.

Following the adoption of Dunedin**'s Integrated Transport Strategy** in 2013, the Council completed a Strategic Case for City Centre Access, Mobility and Safety, which was followed in 2014 by a Programme Business Case (PBC). The PBC identified long standing issues of severance created by arterial routes through areas of high place value in Dunedin, such as the Tertiary Precinct, Warehouse Precinct and Queens Gardens.

The PBC recommended the Liveability Programme, which is broad and includes multiple workstreams aimed at improving pedestrian, cycle and public transport networks. The intention of the Liveability Programme was to facilitate mode shift and safety, urban amenity improvements focused on placemaking and providing a quality experience, parking changes and safety interventions. This work is ongoing for Council, ORC and Waka Kotahi.

In January 2019, the Central Dunedin Transport Network Planning PBC was completed, as an addendum to the original City Centre Access, Mobility and Safety PBC. The catalyst for the PBC was the confirmation of the site for the NDH, to be located between SH1 northbound and southbound (the one-way pair) either side of St Andrew Street (SH88). The PBC short listed two options for the Dunedin arterial network, which required further investigation:

- Scenario B
  - The one-way system is retained.
  - Speeds slowed to create a more comfortable pedestrian environment.
  - The harbour arterial and Frederick Street act as the key connections between the city and port.
  - Amenity improvements implemented in line with the Council's draft *Place and Movement Framework (2019)*[2]. This would help unlock development opportunities and improve pedestrian connectivity at key strategic locations – including the NDH, Queens Gardens and the waterfront.

[2] The Place and Movement Framework has not been adopted for use by the Council.

- Cost estimate (+/- 50%): $180 million (for the full programme).

- Scenario C
  - One-way system replaced with a two-way system.
  - A two-way, two-lane arterial is provided along Castle Street/Cumberland Street.
  - The harbour arterial and Frederick Street act as the key connections between the city and port.
  - A dedicated active mode corridor with high amenity value is provided on Great King/Cumberland Street/Crawford Street.
  - Amenity improvements as per Scenario B, but with added scope for placemaking on the active mode corridor.
  - Cost estimate (+/- 50%): $230 million (for the full programme).

The Central Dunedin Transport Network Planning PBC was completed and provided to Waka Kotahi as a draft in January 2019. This work was focussed on providing assurance to the New Dunedin Hospital team that safe and accessible access could be provided to the site which ensured integration with the central city. Funding for the Shaping Future Dunedin Transport PBC was approved under delegation mid-2019. The scope was widened to take account of the wider developments and changes expected in the central city. The intersections at each end of the current one-way system were also included in the scope as they provide linkages into the city from the north and south. A Great King Pine Hill Intersection Draft Strategic Case had been prepared in 2017 by Waka Kotahi, but not endorsed at the time.

1.4 New Dunedin Hospital

The NDH will occupy two blocks separated by St Andrew Street (SH88), in between SH1 northbound and SH1 southbound. At this location St Andrew Street is part of SH88, providing the connection between SH1 and SH88 to the port. The Hospital will have seven street frontages, six of which are National[3] state highways and routes which carry the highest volumes of heavy commercial vehicles (HCVs) and traffic. In central Dunedin they serve an arterial function, providing access to the CBD. The new hospital site and surrounding One Network Road Classification (ONRC) is shown in Figure 1-2, with the immediate local roads surrounding this site shown as Figure 1-3. In addition to the NDH site shown, there is a small site planned adjacent to Bow Lane.

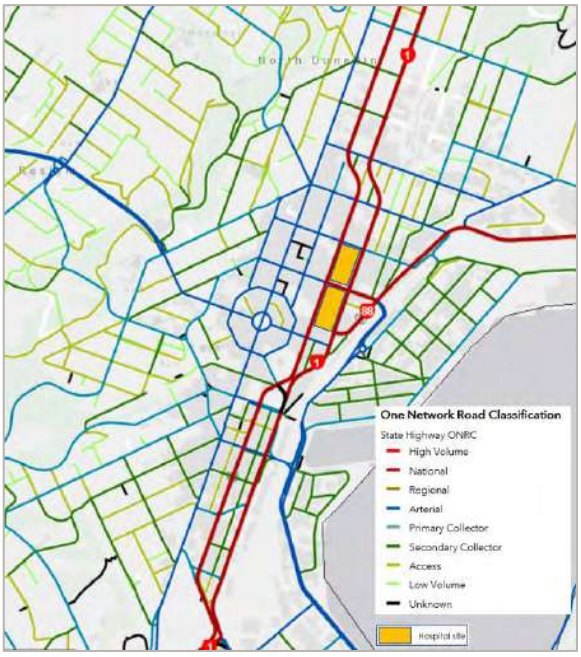


Figure 1-2: Hospital Site and ONRC Classification[4]



Figure 1-3: Streets near the Dunedin Hospital Site[5]

The new hospital is being developed by the Ministry of Health (MOH) for operation by the Southern District Health Board. Regarding access, the MOH presented their objectives to the stakeholder workshop in 2018. The objectives at that time were for an active interface and strong pedestrian links between the hospital

[3] One Network Road Classification (ONRC)
[4] Base map from http://nzta.maps.arcgis.com
[5] Base map: Openstreetmap.com

and the wider city to enable the hospital to make a broader contribution to city liveability and economic growth beyond the benefits of providing healthcare services. The access strategy would also incorporate intuitive wayfinding and obvious points of entry, locating car drop off near points of entry, and ensuring connections to public transport are near points of entry. The design of the new hospital is intended to 'celebrate the built environment' by providing active edges, publicly accessible green space, visual interest, a porous campus to enhance connections with the city and a built response that sits well as part of the urban fabric[6].

In 2018, representatives from the Ministry of Health (MOH) asked Waka Kotahi and DCC whether it would be possible to make changes to the road network in order to deliver better access and integration between the new hospital and the city. The hospital build presents a clear opportunity for change, as construction will last 6-8 years which will cause travel disruption. This could provide a stimulus for travel behaviour change. In addition, if adjustments to the transport network are sought it would be more efficient to progress these in parallel with the hospital work.

One option recommended by MOH, and being considered as part of this PBC, is for two-way roads around the hospital which could potentially improve accessibility, connectivity, safety and amenity, and by applying a shared-space concept to St Andrew Street.

Discussions with MOH, Southern DHB and the NDH project team have continued through the development of this PBC. More detail is provided in Section 15: Engagement.

The latest design for the NDH layout is shown in Figure 1-4.

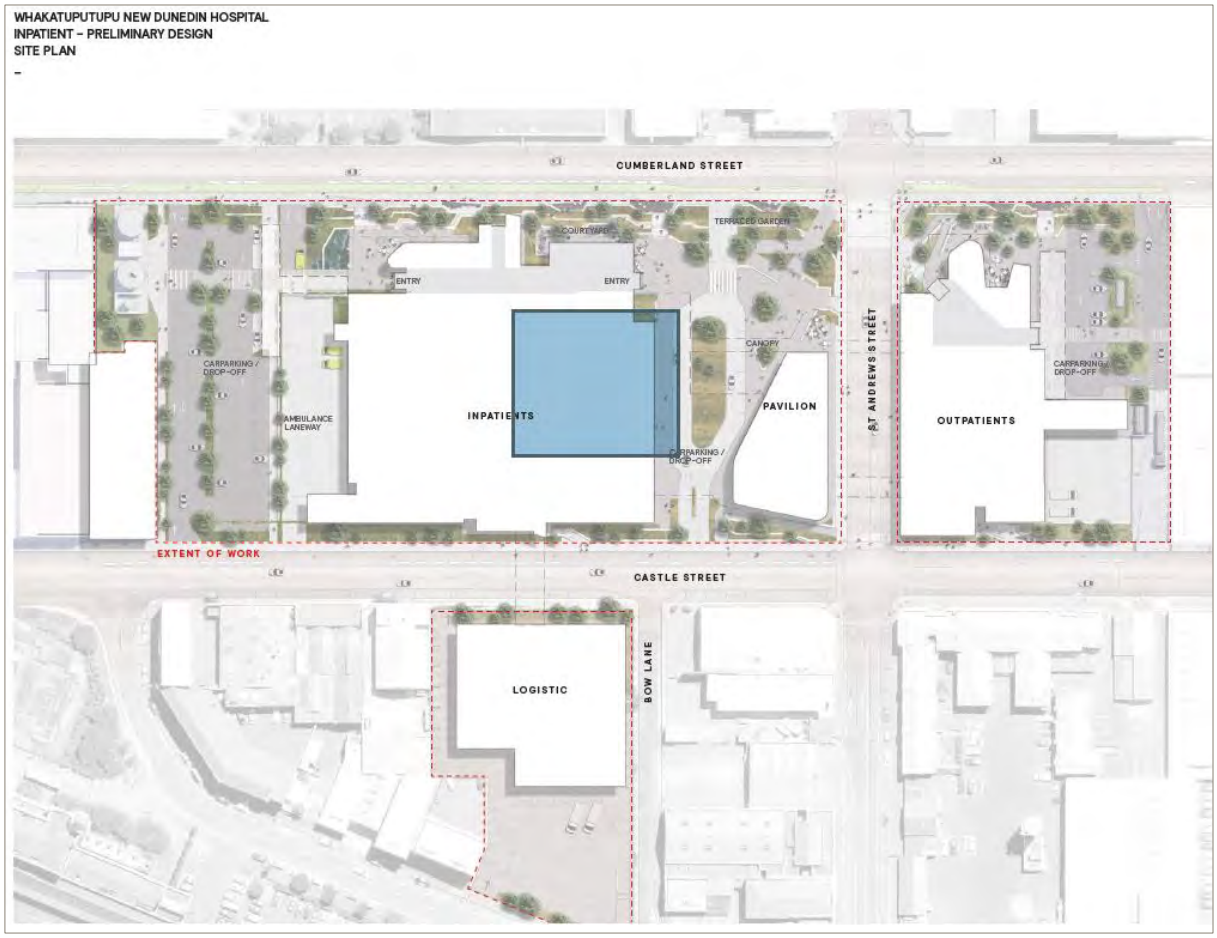


Figure 1-4: New Dunedin Hospital Preliminary Design (June 2021 Land Lab)

[6] Presentation by SDHB to Stakeholder Workshop 5 November 2018

2. Prior Studies, Strategies and Business Cases

2.1 Studies and Strategies

2.1.1 Strategic Corridor Study - 2003 Summary Report (DCC)

This comprehensive study assessed Dunedin City's long-term strategic corridor requirements regarding:

- Existing and future movement of goods, services and people.
- Corridor demands by major traffic generators.
- Revitalisation of the waterfront area.
- Permeability across the rail corridor from the waterfront area to the central city.

At the time, catering for a new hospital in Dunedin was not on the planning horizon, so accommodating this major land use change was not part of the scope.

The study found that the existing strategic corridors can cater for projected traffic volumes to 2030 without widespread or extended periods of congestion, but with some localised pressure points. Severance of the waterfront by the railway line, one-way state highway pair and harbour arterial was noted.

23 alternative corridor options were identified and rationalised, resulting in 12 options which were tested. The major components of the recommended alternative corridor option were:

- Conversion of one-way pair to two-way over entire length. SH1 transfers to Great King-Cumberland Street (existing SH1 northbound) as two-lane two-way roads with north end interchange at Pine Hill intersection, with grade separated on and off ramps.
- Upgrade the harbour arterial to form a restricted access arterial with a gyratory interchange to replace the Jetty Street overbridge.

2.1.2 Future Strategic Network - Summary Report 2010 (DCC)

This report summarised the results of work completed on the Strategic Corridor Study between 2003 and 2009. The recommended option was for the creation of a Harbour Arterial route and two-waying of the one-way system south of Queens Gardens[7]. Five sections were identified (Table 2-1), and a priority order for completion identified. Costs are out of date but provide a guide to relative investment.

Table 2-1: Future Strategic Network (2010) - Recommended Option

No.	Section	Main Components	Cost (2008)	Priority
1	SH88 Realignment (Ravensbourne Road - Frederick Street)	Realign SH88 to follow the rail line between Frederick Street and Ravensbourne Road, involving a new bridge and roundabout.	-	The realignment was completed in 2011 to enable construction of the Forsyth Barr Stadium and in time for the Rugby World Cup
2	Harbour Arterial (Frederick Street - St Andrew Street)	Construct a raised, signalised gyratory at Frederick Street to cross the rail corridor and an extension to St Andrew Street	$12.6m	4 – increases efficiency of Harbour Arterial
3	Harbour Arterial (St Andrew Street - Fryatt Street)	Use existing alignment of Thomas Burns and Wharf Streets. Upgrade to provide two lanes in each direction. Close Willis Street intersection and modify Fryatt Street intersection by banning right turn out.	$3.2m	2 – mitigates congestion in evening peak and improves access to waterfront

[7] Two waying SH1 north of Queens Gardens was discounted at this time as it offered fewer benefits in a time of low growth/investment

No.	Section	Main Components	Cost (2008)	Priority
4	Harbour Arterial (Fryatt Street - Anderson Bay Road)	Use Wharf Street and Strathallan Street. Replace two signalised intersections at Andersons Bay with at-grade double roundabout. A new rail underpass is required.	$10.8m	3 – offers significant efficiency benefits and challenges
5	Two-way the one-way pair (Andersons Bay Road - Queens Gardens)	Convert Cumberland Street to a four-lane median divided arterial route, and Crawford Street to a two lane, two-way road, with a lower speed environment, wide central median and improved walking and cycling facilities. Remove link through Queens Gardens between Burlington and Cumberland Streets.	$4.5m	1 – addresses congestion at overbridge and offers urban design/active mode benefits without property purchase or complex consenting

A 2008 economic evaluation for the project identified a BCR of > 2. At that time, all sections showed a significant reduction in road user costs with the largest efficiency gain coming from the Andersons Bay Road roundabout in 2021. No walking or cycling benefits were included in the analysis.

The report also summarised the following issues/actions that would need to be addressed prior to implementation, and may add significant cost (not covered by the economics):

- The need to relocate KiwiRail shunting yards.
- Consultation with Waka Kotahi.
- Impact of completing the Caversham motorway
- Port Otago access requirements.
- Waterfront redevelopment project.
- Property acquisition.

The report concluded that the lower cost sections (3 and 5) are most effective in providing some initial benefit. Section 5 could be completed in isolation and would relieve congestion at the Jetty Street overbridge in the morning peak and offer opportunities for enhancement of the urban environment. Sections 2 and 4 are only likely to be required when the traffic demand increases and puts pressure on the existing network.

The NDH presents a major change in land use and travel demand from what was considered in the 2003 study and subsequent planning work.

2.1.3 Dunedin Integrated Transport Strategy 2013

In 2013 Council developed the Integrated Transport Strategy, with community input provided through stakeholder workshops, community consultation and hearings. The City Centre emerged as an area of focus due to its poor safety record and overarching objectives to encourage mode shift and enhancing access to and within the city centre. The strategy identified that freight will be given priority on the harbour arterial, SH88, and Frederick Street. The one-way pair is identified as a strategic freight route, but the strategy proposes that on this route freight vehicles will be provided for in a way which also recognises the needs of other road users and adjacent land use (e.g. through speed management).

2.1.4 Dunedin Central City Plan 2015

Council developed the Central City Plan to guide development of the central city until 2030. There is close alignment between this document, the Dunedin Spatial Plan, Dunedin Integrated Transport Strategy and the Central City Safety, Access and Mobility business cases.

Council's vision for the central city is *'a place focussed on people. It will be vibrant, safe and attractive and a compelling destination to live, work, play, visit, learn and invest'*. To enable this, the Plan focused on creating a quality street network and pedestrian experience to encourage people to walk around the city. The focus would be on creating safe, inclusive, welcoming streets where people want to spend their time.

To assist in the process a *Place and Movement Framework* was applied to the central city, which recognised that different streets fit on a place and movement spectrum. This Framework is in draft and is

currently being extended to all Dunedin roads as part of Council's implementation of the One Network Framework (ONF).

Streets which are a destination, where people are encouraged to spend time, have a high place value and a low movement function. Streets which are for movement and designed for users to pass through as quickly and conveniently as possible to minimise travel time have a high movement function. Other streets have a mix of functions. This approach has been used as part of the option development process in this PBC.

2.2 Previous Business Cases

The Council developed two business cases following the adoption of the Dunedin Integrated Transport Strategy in 2013, to take forward the projects proposed in the strategy.

2.2.1 Dunedin City Centre – Access, Mobility and Safety Strategic Case (2013)

This Strategic Case focused on how transport can enable a more liveable and safer central city by reducing severance created by SH1, the railway and north-south arterials, and through travel demand management and safety improvements. A standard Strategic Case process was followed, with Problem Definition and Benefits workshops well attended by a range of stakeholders. Four problems were identified relating to: severance; safety; car parking and public transport. The benefits of investment were: reduced severance; improved safety; Central City is a 'nice place to be'; and greater resilience (focussing on the role active and public transport play in a resilient network).

2.2.2 Dunedin City Centre – Access, Mobility and Safety Programme Business Case (2014) (PBC)

The Programme Business Case evaluated five programmes, and the liveability programme was recommended. A standard process was followed with well attended stakeholder workshops. The recommended programme has a strong placemaking theme, which reflects the Council's vision for Dunedin identified in all strategic documents; 'Dunedin is one of the world's great small cities'. The liveability programme delivered all the benefits identified in the Strategic Case. The core elements of this programme are listed below.

Arterial network planning and changes	Wider liveability programme
• Review network efficiency and capacity • Analyse network flow patterns • Reduce bisecting routes (including conversion of one-way system to two way south of Queens Gardens) • Define link between SH1 and SH88 to limit dispersal of freight through network • Improve freight bypass (harbour arterial) • Restrict permeability of motor vehicles through areas with high pedestrian activity	• Reduce speed limits in key areas/precincts • Improve safety at high-risk intersections • Improve pedestrian network • Parking review • Central city bus hub • ORC PT review • Expand and integrate cycle network • Cycle parking • Urban asset upgrades and renewals • Open space/landscaping • Pedestrianised areas/shared spaces • Community spaces

2.2.3 Implementing the Liveability Programme

Arterial Network Planning and Changes: Dunedin Central Transport Network Planning PBC (2019)

The catalyst for the PBC was the request from the MoH design team for Waka Kotahi and DCC to consider whether it was possible to change the road network to enable better access to the NDH. The PBC progressed investigations into the 'arterial network planning and changes' package identified in the Liveability Programme (shown on right hand side of table above).

The Council's draft Place and Movement Framework was used to develop a set of five network scenario options. A two-day stakeholder workshop was held, attended by 45-50 senior representatives of 20 key organisations. The stakeholders provided feedback, which allowed a short list of two to be carried forward:

- Scenario B: Provides change from the status quo, primarily focussed on slowing speeds on key routes, supported by amenity/placemaking improvements. The one-way system is retained but both corridors are slowed. Improved pedestrian crossing facilities are provided. An arterial function is provided by the harbour arterial and Frederick Street.

- Scenario C: Provides transformational change by replacing the one-way system with a two-way system. The existing southbound SH1 corridor provides the arterial function, supported by the harbour arterial and Frederick Street. The existing northbound SH1 corridor is downgraded to provide an active mode boulevard and placemaking improvements ensuring high place value, slow speeds and pedestrian permeability.

The analysis showed that C performed best against the Project Outcomes but also has the greatest risks due to the radical change from a one-way to a two-way system. However, it may lead to more congestion than B, based on strategic traffic modelling completed. It was recommended that more detailed modelling be completed to fully understand the likely impact on traffic flows. The PBC recommended that due to the risks and uncertainties, further investigation be completed for B and C to develop an expanded PBC (Shaping Future Dunedin Transport PBC) integrating travel demand management, public transport and active modes into the programme, and completing public engagement.

Wider Liveability Programme

Programme elements under the wider Liveability Programme are being managed under the Connecting Dunedin Steering Group, which is a collaboration between DCC, ORC and Waka Kotahi as follows:

Pedestrians: Barnes Dance crossings were introduced at key intersections in 2017. The 2018-28 Long Term Plan (LTP) included $60 million to deliver street improvements in the Retail Quarter to improve pedestrian facilities, accessibility, safety and amenity. The 2018-28 LTP also included $20 million for a city to waterfront connection (pedestrian/cycle bridge), and $20 million to improve Tertiary Precinct streetscape, safety and accessibility. The waterfront connection is currently undergoing a redesign and the 2021-31 LTP retained the Retail Quarter funding but suspended the Tertiary Precinct work until 2030.

Parking: A staged approach is being taken to parking management, rather than a wholesale review of the parking strategy. Incremental changes are planned. The paid parking area has been extended to the Exchange/Warehouse Precinct and towards the Tertiary Precinct, and a Parking Roadmap was endorsed by Council in 2021.

Public Transport: A review of the public transport network was completed in 2016 and changes were made to increase patronage. These included direct and legible routes, more frequent services, simpler fare structure, a new central bus hub, a new ticketing system, and a review of the Regional Public Transport Plan (RPTP). In the 2019/20 annual plan the Council included $150k to progress options for a free central city bus loop service and using rates or parking charges to make city bus fares cheaper. Both ideas were strongly supported by the public.

Cycling: Cycle network improvements are underway and the separated cycleway on SH1, which provides a corridor for cycling, is complete. Other cycle improvements have been completed such as new bike parking stands, sharrows on George Street and improvements to the harbourside cycle route and connection to the city. Council allocated $23 million in its 2018-28 LTP to improve urban cycleways and $44 million for the Peninsula connection, which is a wider safety and sea wall replacement project but incorporates a shared path which provides an important feeder route for the urban cycle network.

Safe and sustainable transport programme: a coordinated programme of activities to influence travel choices and behaviour is underway, led by DCC. This had $660k funding over the 2018-21 NLTP period and aligns and coordinates activity across DCC, ORC and Waka Kotahi to encourage mode shift. The programme has now been further funded.

Amenity: There are planned streetscape upgrades across the central city, starting with the upgrade of George Street in 2021-22.

2.2.4 Relationship Between Key Council/Waka Kotahi Documents

Figure 2-1 shows how the overarching PBC, PBC addendum and Shaping Future Dunedin Transport PBC link to other key documents as well as work underway to progress the wider liveability interventions.

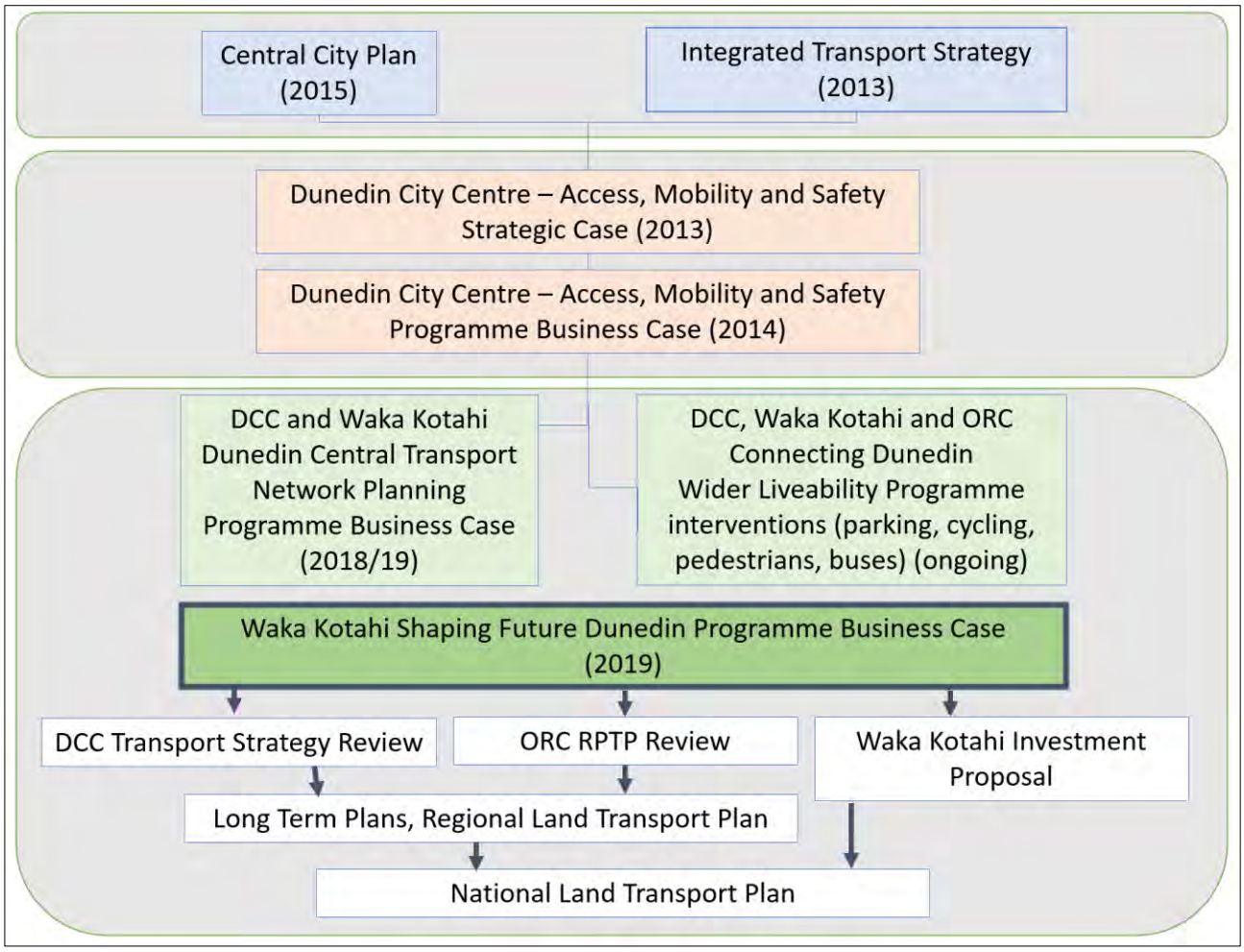


Figure 2-1: Links between key transport planning documents and workstreams

2.2.5 Great King Pine Hill Intersection Strategic Case (draft) (2017)

This intersection has been of interest to Waka Kotahi for many years. The Strategic Case outlined the need for change centred on safety issues at the intersection resulting from vertical and horizontal alignment on approaches and lack of formal provision for pedestrians and cyclists, despite the intersection being located in the midst of a number of local activity nodes. The evidence showed a historic truck crash problem due to brake fade and roll over due to poor alignment. However, despite a number of risk factors and the attention-grabbing nature of the roll over crashes, there had only been one serious injury crash in the 2012-16 period. However, a pedestrian fatality in 2017 led Waka Kotahi to add a review of this intersection to the current PBC.

3. Programme Context

3.1 Geographic and Environmental Context

The urban area of Dunedin city lies on the central-eastern coast of Otago, surrounding the head of Otago Harbour. Archaeological evidence points to lengthy occupation of the area by Maori prior to the arrival of Europeans. The city suburbs extend into the surrounding valleys and hills, onto the Otago Peninsula, and along the shores of the Otago Harbour and the Pacific Ocean.

The city centre is constrained to the north by steep topography, to the east by the harbour, and to the west by the town belt. To the west of the Octagon the land ascends steeply up to the west and north. However, the suburbs of South Dunedin through the centre to North East Valley form a relatively flat arc across the city, with ideal distances for active transport. There is significant growth occurring in Mosgiel and other localities west of the city. These areas are connected to the main Dunedin urban area primarily by SH1 (the Southern Motorway).

3.2 Social and Economic Context

Dunedin is the second largest city in the South Island, and the principal city of the Otago Region. The Stats NZ provisional estimated resident population for 2020 is 134,100. It is the seventh-largest urban area in NZ.

Dunedin has a diverse economy which includes manufacturing, publishing and technology-based industries as well as education, research, tourism and health. The city's most important activity centres around tertiary education – Dunedin is home to the University of Otago, NZ's oldest university, and the Otago Polytechnic. The tertiary sector attracts over 20,000 local and international students and teaching/research staff and is renowned for its scientific research and partnerships. As a result, students account for around 20% of the population.

The University of Otago and Otago Polytechnic are significant property owners and investors in the city. The University has a significant planned capital spend including a new college, new Health Sciences Building, Food Sciences Development and various compliance upgrades.

Dunedin offers large scale health services in the form of Dunedin hospital, which is a 388-bed tertiary facility employing over 3000 staff and servicing an Otago and Southland catchment of 289,000 people. The hospital is in the city centre and is a teaching and clinical training hospital with strong links to the University of Otago Dunedin School of Medicine and the Otago Polytechnic Schools of Nursing, Midwifery and Health Sciences. In 2018 the Ministry of Health announced that the NDH would be built on a new site in the central city, to replace the existing hospital.

The city is considered one of the four main cities of NZ for historic, cultural and geographic reasons. It is a designated UNESCO City of Literature, and is a popular tourist destination, offering a range of attractions such as the iconic railway station, Otago Museum, Toitu Early Settlers Museum, Art Gallery and Chinese Gardens as well as heritage buildings, wildlife viewing opportunities on the Otago Peninsula, Larnach Castle and the Taieri Gorge Railway. In recent years Port Chalmers has been a regular fixture on cruise ship itineraries, with year-on-year growth shown in Table 3-1. These visits have brought significant increases in foot traffic in the central city. Tourists wanting to visit the city are predominantly transported from Port Chalmers by buses using SH88 to a drop off and pick up point in the Octagon, although this will likely be relocated elsewhere in future.

Table 3-1: Growth in cruise ship visits to Dunedin[8]

	2016-2017 (actual)	2017-2018 (actual)	2018-2019 (actual)	2019-2020 (forecast)
Cruise ship arrivals	79	89	115	130
Estimated passenger numbers (at least 90% disembark)	162,300	179,000	229,000	250,000

Cruise ship visits ceased from April 2020 as a result of travel restrictions imposed to limit the impact of the COVID-19 pandemic on NZ. At the time of writing there are still no cruise ships, and the borders are closed except to returning residents and locations where travel bubbles have been established. It is not certain

[8] Figures from Port Otago Annual Report and Otago Daily Times 13/4/19 *Record Cruise Ship Season Comes to End*

how long this situation will continue. There have been some negative impacts on the Dunedin economy, but the economy is diverse and growth continues.

2011 saw the opening of the Forsyth Barr Stadium, which is NZ's largest indoor events arena with a maximum capacity of 36,000. Music and sporting events have brought influxes of visitors to the city.

In recent years the Council has focussed on attracting knowledge-based industries to the city. In the Council's Central City Plan, the Warehouse Precinct was identified as a brownfield 'tech park', with retrofitted heritage buildings and warehouses providing for a high concentration of IT, research and science-based industries, as well as high density housing. This was supported by Dunedin winning the Gigatown competition in 2014, beating 49 towns to be named NZ's first Gigatown. Since then, the Government has established the Centre of Digital Excellence (CODE) in Dunedin.

The 2018 census shows the median household income in Dunedin was $62,000, well below the national median of $75,700.

Dunedin's usually resident population declined between 1996 and 2001, and in 2006 returned to 1996 levels. However, this was followed by a period of sustained growth, as shown in Figure 3-1. The 2020 estimated resident population was 134,100. Dunedin's population has increased by around 10,600 people since 2013 (1.2% p.a.). This has been reflected in the National Policy Statement on Urban Development Capacity, which in 2019 classified Dunedin (Otago Region and Dunedin City) as a 'newly defined medium-growth urban area'. Estimates show that the population continued to grow in 2020.

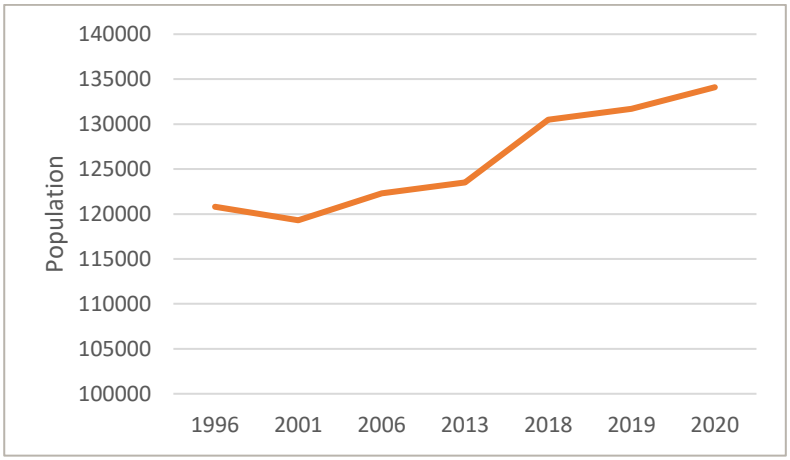


Figure 3-1: Dunedin: Usually Resident Population 1996-2020 (Source: NZ Census)

Population growth is driving demand for housing. As a result, the Council have started work on a variation to the District Plan to address a shortfall in housing capacity in the medium term based on the latest requirements of the National Policy Statement on Urban Development. The variation will consider and include both intensification and greenfield residential zone changes. A range of areas will be included to ensure housing choice, as required by the NPS-UDC. All options are being assessed in accordance with the strategic direction policies of the 2GP. The 2GP policies guide the Council to identify suitable sites that meet the overarching objective, which is that Dunedin stays a compact and accessible city with resilient townships based on sustainably managed urban expansion. Urban expansion only occurs if required and in the most appropriate form and locations. The 2GP policies of relevance are that the area proposed for residential development must meet all or a majority of the following characteristics:

- A topography that is not too steep.
- Being close to the main urban area or townships that have a shortage of capacity.
- Currently serviced, or likely to be easily serviced, by frequent public transport services.
- Close to centres.
- Close to other existing community facilities such as schools, public green space and recreational facilities, health services, and libraries or other community centres.

In the central city, the main changes in the last five years have been around the Warehouse Precinct and the University. The Warehouse Precinct was once a thriving area of commerce and industry and contains many buildings of significant heritage value. Many of these sites have been abandoned or neglected. Some buildings have now been restored and this revitalisation has been supported by Council's heritage grant scheme and urban amenity improvements, such as street planting, increased pedestrian space, new lighting and furniture.

The Council is progressing the Dunedin waterfront redevelopment project, although progress has slowed as a result of concerns about economic uncertainty as a result of COVID-19 travel restrictions. The project will revitalise the waterfront to create a mixed-use development. Redevelopment will be delivered in stages, as the local economy and demand develop, allowing the waterfront to become an integrated part of the city. To support the development, the Council committed $20 million over the period 2024/25-2027/28 for a new pedestrian/cycle bridge from Queens Gardens to the Steamer Basin.

4. Strategic Alignment

Efforts to improve pedestrian permeability, urban integration and placemaking align closely with national, regional and local strategies, policies and plans. Realising the benefits of a new hospital that is integrated with the city and reducing overall severance across the central city to enable placemaking outcomes, is closely aligned with the Government's commitment to creating more liveable cities and thriving regions. This project aligns very closely with the GPS – most notably in terms of the focus on improving city liveability as well as the support for creating inviting public spaces, efficient access and providing transport choice. It aligns closely with Council plans and those of the Southern District Health Board and tertiary institutions.

Table 4-1: Strategic Alignment

Document	Alignment
Government Policy Statement on Land Transport 2021 Strategic Priorities: Safety: Developing a transport system where no-one is killed or seriously injured. Better Travel Options: Providing people with better transport options to access social and economic opportunities. Improving Freight Connections: Improving freight connections for economic development. Climate Change: Developing a low carbon transport system that supports emission reductions while improving safety and inclusive access.	Waka Kotahi is responsible for giving effect to the GPS, which sets out the Government's strategic direction for investment in the land transport network. Very Strong alignment with the 'Better Travel Options' and 'Climate Change' priorities, by providing an urban area that is well connected, safe, accessible and liveable. Travel choice and mode shift will be supported by considering access needs for the journey to/from the city and centre, and by removing severance for active modes between the hospital and key origins such as the bus hub, central city parking areas, and residential areas within or close to the city centre. Improving travel options will reduce greenhouse gas emissions. Improving placemaking and making the city more pedestrian-friendly should also lead to environmental benefits. A more effective strategic network will prevent the current dispersal of traffic and allow amenity improvements as well as noise and air pollution reduction on streets that have a place focus. Any move to a two-way system with a local road in place of a national highway will support reducing greenhouse gas emissions by reconfiguring the heart of the city and providing opportunities for car free, higher density residential development in the central city. Strong alignment with the 'Improving Freight Connections' and 'Safety' priorities. Although addressing a specific safety problem is not the purpose of this business case, KiwiRAP personal and collective risk maps show the one-way pair in Dunedin city centre has medium-high and high risk respectively. This means that there is scope to improve safety as part of this project. Speed management is likely to be used on certain city streets, and this should reduce crash likelihood and severity. Freight Connections will be specifically improved through Harbour Arterial upgrade.
Waka Kotahi Road To Zero Strategy 2020-2030 Target: 40% reduction from 2018 levels by 2030 Focus areas: Vehicle Safety, Infrastructure Improvements and Speed Management, System Management, Road User Choices, Work-Related Road Safety.	Very Strong alignment with focus area 'Infrastructure Improvements and Speed Management', Improving pedestrian and cycle safety is a priority for the project, as well as safety for all road users. Dunedin City features in the 2020 Communities at Risk register, with the following areas of where the number of crashes of this type demonstrate a 'High Concern': all deaths and serious casualties, urban intersections, all intersections, pedestrian involved, distraction and older road users (75 years and above). The preferred programme will be able to reduce risk in all these categories except 'distraction', within the study area. Neutral alignment with focus areas: Vehicle Safety, Work-Related Road Safety, Road User Choices, System Management.
Otago Southland RLTP 2015-21 (updated 2018, draft for 2021 currently in consultation period)	Strong alignment. Recognises that development in the central city will be shaped by the University of Otago's investment in infrastructure, the Southern District Health Board rebuild of Dunedin hospital, and the delivery of Council's Central City Plan. Construction of the new hospital will create opportunities for improving the state highway route through central Dunedin. Changes to the transport system to support the redevelopment of Dunedin hospital is identified as a new project for the 2018-21 RLTP, under the heading integrated transport and land use planning. The project is for

Document	Alignment
	planning of the transport work needed alongside the redevelopment of Dunedin Hospital.
DCC Integrated Transport Strategy	Strong alignment. Transport Objective 6 is 'Dunedin's urban form and design creates high levels of accessibility to key destinations such as healthcare, education, recreation and employment'. Scope to deliver on four of five areas of focus (Safety, travel choices, centres and freight). Three relevant projects are identified in the strategy which link to this PBC. The strategy identifies freight routes and identifies level of service E at peak times as a trigger for investment in the road network. The strategy includes a target of 40% active/public transport for the journey to work.
DCC Central City Plan	Strong alignment with aims to improve liveability, placemaking and streetscape. Includes George, Princes, Lower Stuart and Bath Street amenity and safety upgrade, upgrade of the Octagon, Exchange Square and Queens Gardens, a new city to harbour connection for pedestrians and cyclists and rationalising the state highway on Cumberland Street through the Warehouse Precinct. Aspirations for the central city have been progressed through a series of workshops applying a 'place and movement' framework to roads in the central city. This framework is explained in Part B and has been used to guide the development and assessment of options.
DCC Draft Long-Term Plan 2021-31	Strong alignment. Includes funding for the following projects: • $60m - Central City Upgrade (amenity and safety upgrades for George, Lower Stuart, Bath, Princes and Rattray Streets) • $20m - City to Waterfront connection • $1 million for Tertiary Precinct Upgrade (streetscape and safety improvements - Union Street, Albany Street, Harbour Terrace) Also included is funding for the projects that have emerged from this Shaping Future Dunedin Transport PBC: • $16.6m - Harbour Arterial Efficiency Improvements • $6.6m - Princes Street Bus Priority and Corridor Safety Plan • $9.5m - Central City Parking Management • $10m - Mosgiel and Burnside Park and Ride • $2.5m - Central City Bike Hubs • $4.8m - Central City Cycle and Pedestrian Improvements
DCC Second Generation District Plan 2017 (2GP)	Alignment with Objective 2.2.2 Energy Resilience b) Reduced reliance on private motor cars for transport. To achieve this the 2GP restricts the location of high trip generators to places which can be practically accessed by a range of transport modes. Dunedin Hospital is identified as a major facility and a high trip generator. Requires the hospital to provide a total of 184 car parking spaces within 250m of the Dunedin Hospital Zone of which 6 must be mobility parking spaces. The remainder may be used for car, cycle or motorcycle parking. Additional spaces are required if on-site early childhood education facilities are provided.

5. Partners and Key Stakeholders

The investment partners and key stakeholders for this project are outlined in Table 5-1. These organisations were invited to send representatives to a Network Planning workshop in November 2018, and to the Shaping Future Dunedin Transport workshop in November 2019. The partners provided review and feedback of the Investment Logic Map. There continues to be ongoing dialogue with the Ministry of Health hospital team. Further engagement with these stakeholders and the wider community will be undertaken in the next stage.

Table 5-1: Partners, key stakeholders and advocates

Organisation	Type	Responsibilities and area of interest for this project
Waka Kotahi NZ Transport Agency	Investment Partner	Investor in the land transport system. Responsible for provision and operation of the state highway network. Regulates access to and use of land transport system.
Dunedin City Council - Councillors and staff	Investment Partner	Provide strategic transport planning for the city and provide and operate the local road network. Responsible for civil defence emergency management.
Otago Regional Council - Councillors and staff	Key Stakeholder	Responsible for environmental management, land management, public transport planning, and Regional Land Transport Plan.
Southern District Health Board	Key Stakeholder Potential co-investor	Responsible for planning, funding and providing health and disability services to the lower South Island. Client lead on development of new hospital site (budget of $1.2-1.4 billion, largest new hospital build in NZ history). Significant landowner and employer in Dunedin
Ministry of Health	Key Stakeholder Potential co-investor	Responsible for public health provision and policy in NZ. Developing the new hospital on behalf of Southern District Health Board
Otago University	Key Stakeholder Potential co-investor	Tertiary education provider and landowner, employer and investor in Dunedin. Interested in reducing severance to improve access for students and staff through the wellness corridor[9] and maximising land development opportunities. Capital programme of $650m to 2030 Aiming to become achieve net carbon zero by 2030.
Otago Polytechnic	Stakeholder	Tertiary education provider, landowner, employer and investor in Dunedin. Interested in reducing severance to improve access for students and staff through the wellness corridor.
Otago Museum	Stakeholder	Interested in maintaining/improving access to the museum.
Port Otago	Stakeholder	Primary export port for the South Island region of New Zealand. Interested in arterial transport connections to the port for freight and cruise ship passengers. Aiming to create future Dunedin Bulk Port around Ward Street/Fryatt Street, west of Water of Leith. This will mean fewer trucks on SH88. Logs made up 65% of bulk product (2019).
KiwiRail	Stakeholder	Responsible for provision and operation of the rail network. Owns strategically located land adjacent to existing arterial routes and permits St Andrew Street (SH88) at-grade road crossing of rail corridor.

[9] Wellness Corridor: refer Figure 7-5

Organisation	Type	Responsibilities and area of interest for this project
Emergency Services - Fire, Police and St Johns Ambulance	Stakeholder	Responsible for emergency response. Have a strong interest in any changes to the road network and the impacts this can have on emergency response times. Fire and police stations within study area. Police also responsible for ensuring safety through enforcing speed limits, checking vehicle compliance, managing traffic/congestion associated with accidents and other unplanned stoppages.
Ngai Tahu	Treaty Partner	Have an interest in the protection of land, water and resources as they relate to the origin, history and tribal affiliations.
Heritage NZ	Stakeholder	Autonomous Crown Entity responsible for the conservation of heritage. Will have a view on any changes to heritage sites.
Tourism Industry Association	Advocate	Independent association representing all sectors of NZ's tourism industry, influencing policy and decision making.
Regional Tourism Organisation (Enterprise Dunedin)	Stakeholder	Regional Tourism Organisation promoting and marketing Dunedin City. Will have an interest in placemaking aspects that enhance the city, improvements to pedestrian desire lines to tourist attractions, changes to cruise ship passenger transport, and changes to parking.
Freight industry – Road Transport Association	Advocate	Represents interests of heavy transport industry. Will have a focus on arterial routes which ensure efficient freight movement and minimise conflict particularly with vulnerable users.
Chamber of Commerce	Advocate	Advocate for business concerns and submit on behalf of members on local and national government policy. Will have an interest in economic opportunities/regeneration that can be enabled.
CCS Disability Action	Advocate	CCS Disability Action's vision is to see every disabled person included in the life of their family and community. Focused on ensuring improvements to access by all modes for all ability types.
Spokes (Cycling)	Advocate	Focused on ensuring cycling in Dunedin is safe, practical and fun.
Automobile Association	Advocate	Promotes interests of motor vehicle owners. Focus on road safety.
Youth Council	Advocate	Focused on ensuring the needs and perspectives of young people in Dunedin are understood.
Supermarkets (New World, Countdown)	Landowner	Interested in changes to the road network and how that affects people accessing their location on SH1 northbound.
Allied Press	Landowner	Dunedin based media company that owns land on SH1 northbound adjacent to the new hospital site.
Heart of Dunedin	Advocate	Group with a vision to reinvigorate Dunedin's central city area. Focused on bringing people back to the heart of the city.
Generation Zero	Advocate	Non-partisan, youth-led organisation that champions solutions towards a carbon neutral Aotearoa. Focused on smarter transport, liveable cities and independence from fossil fuels.
Age Concern	Advocate	Promotes healthy, active and positive ageing for people over 65.
Otago University Students Association	Advocate	Represents Otago University students. Independent from the university and focused on student interests.
Blind Foundation	Advocate	Provides support services for blind people in Dunedin.

6. Problems, Benefits and Opportunities Update

The problem statements for this business case were developed by reviewing the problem statements from the Central Dunedin Transport Network Planning PBC (2019) and considering the broader focus of this PBC on the wider transport system and liveability. The original problem statements were subject to a Challenge Team[10] approach to test they were robust and appropriate. Table 6-1 shows the original problem statements, the revised problem statements and provides an explanation for changes.

Table 6-1: Evolution of problem statements

Dunedin Central Transport Network Planning PBC	Shaping Future Dunedin Transport PBC	Explanation of revised problem statements
Hospital Integration 1. The design and management of arterials will lead to severance of the hospital from the city centre, and between the hospital sites, negatively affecting accessibility and the hospital's integration and interaction with the city.	New Dunedin Hospital 1. The NDH site fronts the busiest roads in the central city which will create a barrier to safe and easy pedestrian access to the building and result in poor integration and interaction with the city.	• The effects of the problem focus specifically on pedestrians, who are the primary concern (previously part of problem 2). • The consequence is unchanged
Severance 2. SH1, the railway and arterial routes bisect the city resulting in poor pedestrian connectivity and limiting placemaking outcomes.		• The pedestrian connectivity aspects have been incorporated in problem 1 above, and placemaking in problem 2 below.
Ineffective Network and Conflict 3. The design, use and management of central city routes means many of the roads operate in a similar way resulting in dispersal of travel, intermodal conflict and safety issues.	Access, Placemaking and Liveability 2. The design, use and management of central city routes means many roads operate in a similar way resulting in dispersal of traffic and severance between key city precincts, creating safety and amenity issues and suppressing walking and cycling.	• Original problem focused on dispersal of traffic and the effect of this on safety. • Proposed problem expands the issue of traffic dispersal and links it to the negative effect on place function, safety and active mode use.

The project benefits were also reviewed and amended as shown in Table 6-2. The benefits were reworded to be more easily identified as 'project outcomes', to enable them to be used in option evaluation.

Table 6-2: Evolution of benefit statements

Dunedin Central Transport Network Planning PBC	Shaping Future Dunedin Transport PBC	Explanation for changes to benefits
Good hospital access and positive interface with city	Improved multi-modal access to and within central city	• Proposed benefit captures both original benefits and covers whole central city rather than hospital alone
Mode shift		
Improve amenity	Improved attractiveness of city as place to invest, live, work and play	• Proposed benefit is more specific and explains why it is important to improve amenity. Also reflects liveability aims.
Road hierarchy operating as intended	Enhanced connectivity between key	• Proposed benefit encompasses scope of original benefit as well as connectivity for

[10] Challenge Team: Marc Bailey (Boffa), Gavin O'Connor, Darren Davis and Sarah Connolly (Stantec)

Dunedin Central Transport Network Planning PBC	Shaping Future Dunedin Transport PBC	Explanation for changes to benefits
	destinations for all modes	other modes as well – reflecting broader transport system focus.
Improve safety	Improved safety	• No change
Reduce severance	Improved place quality and walking environment within city	• More specific about the benefit of reducing severance
	Improved environmental outcomes, moving towards carbon zero by 2030	• New benefit added to cover carbon neutral/zero goals of Council and University

The agreed opportunities were reviewed and amended as shown in Table 6-3.

Table 6-3: Evolution of opportunities

Dunedin Central Transport Network Planning PBC	Shaping Future Dunedin Transport PBC	Explanation for changes to opportunities
Integration of hospital with city	Integrate NDH with city	• Minor word change
Improving liveability of Dunedin		• This is now covered by specific problems and benefits.
More cycle-friendly streets		• This is now covered by specific problems and benefits.
Economic growth/regeneration	Stimulate economic growth/regeneration	• Minor word change
	Use risk free trials to enable easier travel behaviour change	• Added to reflect transport system and behaviour change focus
	Create Dunedin's future transport system	• Added to reflect transport system focus
	Utilise disruption due to construction to trigger travel behaviour change	• Added to reflect transport system and behaviour change focus

The proposed problems, benefits and opportunities are shown in the Investment Logic Map (Figure 6-1).

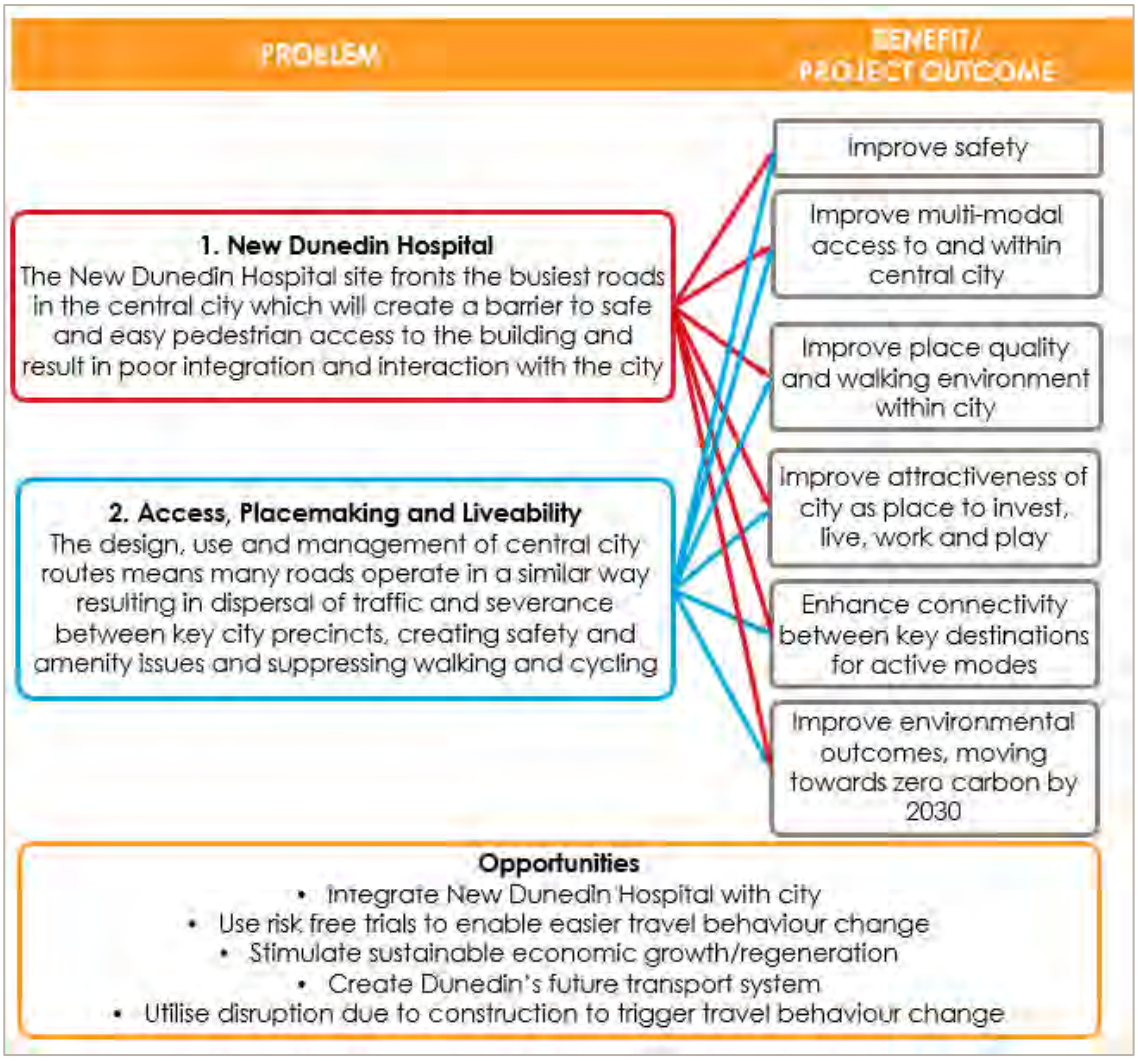


Figure 6-1: Updated Investment Logic Map

The subsequent sections explain the problems, benefits and opportunities. Each problem is assessed by considering the cause, effect and consequence and examining the evidence.

7. Problems and Evidence

7.1 Problem 1: New Dunedin Hospital Site

Problem: The New Dunedin Hospital site fronts the busiest roads in the central city, which will create a barrier to safe and easy pedestrian access to the building and result in poor integration and interaction with the city.	
Causes	• NDH planned frontage is on SH1 northbound which is a national highway with significant traffic volumes (15,000-18,000 vpd) • NDH will straddle St Andrew Street (SH88) which is a national highway with 11,000 vpd, providing connection between SH1 and the port for heavy vehicles. • No mid-block crossings on Cumberland Street or St Andrew Street to the NDH site currently. Midblock pedestrian crossings around the NDH site are currently LOS E.
Effect	• Variable pedestrian provision and strong pedestrian desire lines created by NDH conflict with heavily trafficked one-way arterial routes creating severance, potentially causing delays, risk taking, jaywalking, and suppressed walking trips.
Consequences	• Delays, risk-taking and jaywalking contributes to a High Collective risk on SH1 on either side of the NDH site. This risk will be exacerbated once the hospital opens and pedestrian volumes increase. • Severance will limit the ability for the Ministry of Health (MoH) to achieve the best outcomes for the hospital. Key MoH objectives are for 1. a hospital that is integrated with the city and with the tertiary area to create a health precinct; and 2. safe and easy access to the hospital for: pedestrians; connectivity with public transport; and separation of public/emergency/service traffic. • Severance will restrict the close links that are required between the University and the NDH, for full integration and success of the Health Sciences programme. The University's objective for safe and easy pedestrian access within the 'Wellness' corridor for pedestrians walking between the campus and hospital is threatened by severance.

7.1.1 New Dunedin Hospital Site Issues

The new hospital will be located between the northbound and southbound SH1 corridors as shown in Figure 7-1. It straddles St Andrew Street, which is also SH88 at this location. Both SH1 and SH88 are national state highways which is the highest functional classification. These roads make the largest contribution to the social and economic wellbeing of New Zealand by connecting major population centres, major ports and international airports, and have high volumes of heavy commercial vehicles and general traffic. In central Dunedin they serve an arterial function, providing access to the CBD.

At this point on SH1 continuous traffic counters consistently count around 15,000 vehicles per day on each of Cumberland Street (SH1 northbound) and Castle Street (SH1 southbound). The classification of the road is illustrated in Figure 7-2. On these two blocks, TomTom data shows that the 24hr average traffic speed is 15-30 km/h near intersections, and 30-40km/h midblock. Pedestrians can cross at the signals at Cumberland/Stuart Street, Cumberland/St Andrew Street and Cumberland Street/Hanover Street. However, jaywalking is frequently observed. This may be due to a desire to cross mid-block and the platooning effect caused by the signals creates this opportunity, as well as delay at signals.



Figure 7-1: Site of new hospital

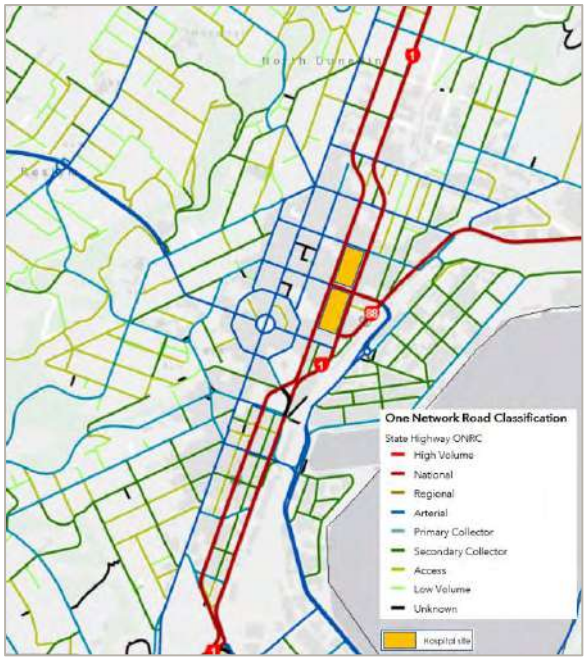


Figure 7-2: Hospital site and ONRC classification

7.1.2 Traffic Volumes and Freight

There are a number of traffic counters on SH1 through Dunedin. Traffic volumes on SH1 northbound and southbound recorded at the nearest continuous traffic counter to the new hospital site are shown in Figure 7-3. In 2019, the average daily traffic volume travelling south was 15,635 and travelling north was 14,167. The percentage of heavy vehicles recorded in the traffic stream was 3.7% southbound and 3.8% northbound. This equates to 500-600 heavy vehicles travelling in each direction per day which is high for a central city location and has a significant effect on amenity through noise, visual intrusion and air pollution.

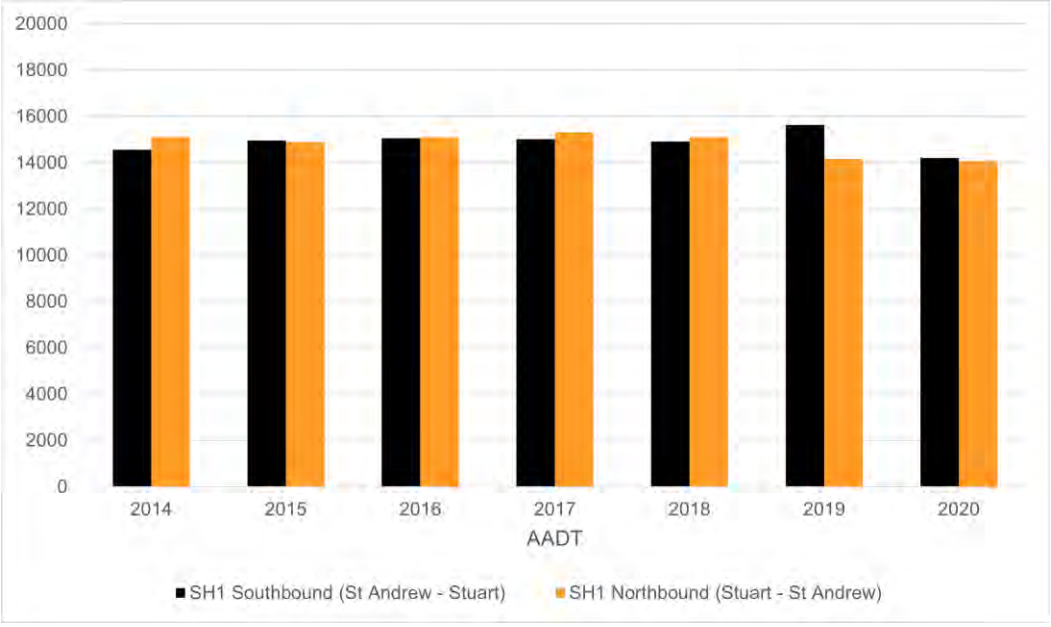


Figure 7-3: SH1 Northbound and Southbound Average Annual Daily Traffic Volumes, recorded at intersection with Rattray Street 2014-2018

7.1.3 Pedestrian Facilities and Access

Pedestrian crossing facilities to the NDH site are provided at signalised intersections. The signal timings change depending on traffic conditions, but typically pedestrians have 6 seconds of green man, followed

by around 12 seconds of flashing red man. If the pedestrian misses the green man, they must wait around 1 minute 45 seconds for the next green man phase.

The pedestrian crossing facilities at the signals provide Level of Service B (Austroads). Midblock, where there are no facilities, gives Level of Service E for pedestrians. A later assessment (see section 17.3) noted the block are particularly long and people with mobility issues may struggle to cross midblock.

The master planning phase for the NDH involved assessments to understand the key pedestrian routes from the bus hub on Great King Street, central city on and off-street carparks, retail area and University Medical School. There will be desire lines mid-block at Cumberland Street (Lower Stuart to St Andrew Streets), Cumberland Street (St Andrew Street to Hanover Street), St Andrew Street (Cumberland to Castle Streets) and Cumberland Street (Hanover to Frederick Street).

The master planning phase assumed that St Andrew Street between the two hospital sites would be a shared space with minimal traffic flow to allow for safe and easy pedestrian movements for all abilities moving between the two buildings. This is also envisaged as a drop off area. The other main drop off area will be outside the main hospital building (Cumberland Street mid-block).

7.1.4 Pedestrian Environment Review System (PERS) Assessments

PERS assessments were undertaken at nine sites in the study area. The assessments consider link and place attributes and allocate a score to 17 different attributes. More detail is provided in section 7.2.3. However, the lowest score was on the NDH frontage, Cumberland Street midblock (between St Andrews Street and Frederick Street). This section was affected by obstructions (e.g. bus shelter/phone box), lack of formal crossings/permeability, and poor-quality environment (noise), lack of comfort, unappealing sense of place and lack opportunity for activity given blank walls to street.

7.1.5 Safety

A review of the 384 reported crashes on the existing one-way system for the five-year period between 2015 and 2019 was undertaken. The crash data does not include the SH1/Pine Hill Road/Great King Street intersection. This intersection is not part of the overall analysis because it is the subject of a separate study.

209 crashes were at intersections (57 percent of total). One person died, 16 were seriously injured and 59 people received minor injuries in these crashes. 15 crashes involved pedestrians while six involved cyclists. Nearly one third of crashes at intersections involved a vehicle running a red light even though only half of the intersections are signalised.

In the 157 mid-block crashes, nine people were seriously injured and 46 received minor injuries. Ten crashes involved pedestrians while 13 involved cyclists. Two out of every five crashes were a rear end type movement.

A summary of the reported crash history between 2015 and 2019 is given in Table 7-1for both the SH1 One Way Pair and the Harbour Arterial.

Table 7-1: Reported Crash History for SH1 One Way Pair and Harbour Arterial (2015 to 2019)

Location	Crash Severity				Total Number of Crashes	Common Crash Movements		Vulnerable Road User Involvement	
	Fatal	Serious	Minor	Non-Injury		Rear End in Traffic	Run Red Light	Pedestrian	Cyclist
SH1 Northbound	1	13	64	113	191	49 (26%)	43 (23%)	14	9
SH1 Southbound	0	12	46	117	175	42 (24%)	27 (15%)	11	10
Combined SH1 Total	1	25	110	230	366	91 (25%)	70 (19%)	25	19

The Collective Risk is High on both northbound and southbound SH1 routes, and Medium on St Andrew Street, as shown in Figure 7-4. This indicates there are already safety issues on the SH1 routes. Adding more vulnerable users (pedestrians, cyclists, mobility impaired people) will increase the risk.



Figure 7-4: Collective Risk Mapping

7.1.6 Integration and interaction with wider city

The effect of these heavily trafficked and nationally important routes around the NDH site is expected to create a barrier or severance effect, making it difficult to access the site on foot, by bike or by car (except from the state highway itself), severely limiting the likely integration and interaction with the wider city, and reducing accessibility.

Severance refers to the effect that some roads can have on adjacent land use and access, where the road acts as, or feels like, a barrier for pedestrians, cyclists, those turning into or out of side streets, and those using any mode of transport who want to cross the road.

Severance is more pronounced where:

- traffic volumes are high and flows are continuous
- speeds are higher
- there are many trucks in the traffic stream
- the road in question has priority over side roads and there is a long wait at signals for side roads
- facilities for crossing the road using any mode offer a poor level of service either due to long wait times or lack of protection when crossing
- amenity effects such as noise and air pollution from traffic, which can make the environment less attractive and create a psychological as well as physical barrier.

Table 7-2: summarises the factors leading to severance of the NDH sites.

Table 7-2: Severance Summary for the New Dunedin Hospital sites

Key origins and destinations	Bus hub on Great King Street Off street parking: Great King Street, Frederick Street, Moray Place, Railway Station N and S, Dowling Street, Filleul Street, St Andrew Street by railway. Retail area on George Street and surroundings, including the Octagon University Wellness corridor, connecting Health Sciences Precinct and Medical School to the NDH (Figure 7-5)
Key roads causing severance	Cumberland Street (SH1) between Stuart Street and Hanover Street causes barrier between bus hub, parking, retail and the new hospital Castle Street (SH1) between Stuart Street and Hanover Street creates barrier between off street parking areas and the new hospital St Andrew Street between Cumberland and Castle Streets: creates barrier between the two hospital sites Albany, Frederick, Hanover, St Andrew Streets and SH1 at S bends: create barrier between University, Health and Research Precinct, retail and new hospital site
Average Traffic Volumes	Cumberland Street: 15,635 vehicles per day in 2019 Castle Street: 14,167 vehicles per day in 2019 St Andrew Street: 9,501 (measured at a regional non-continuous site further east along SH88, at the Frederick Street intersection) in 2019
Average Freight Volumes	Cumberland Street: 560 trucks per day Castle Street: 525 trucks per day St Andrew Street: assumed to be 570 trucks per day (based on count site at the SH88/Frederick Street intersection)
ONRC status	Cumberland Street, Castle Street, St Andrew Street – National Highways Frederick Street: Arterial Hanover Street: Arterial
Safety (risk)	Cumberland Street and Castle Street: High Collective Risk St Andrew Street: Medium Collective Risk Frederick Street: Medium Collective Risk Hanover Street: Low/medium Collective Risk
Pedestrian provision on desire lines	LOS B at signals with around 1 minute 45 seconds delay if miss green man cycle LOS E midblock with jaywalking consistently observed
PERS assessment	Lowest score of all 9 sites surveyed (-25)

The severance effect and lack of integration is at odds with the MoH objectives for the hospital site, which are for an active interface and strong pedestrian links between the hospital and the wider city to enable the hospital to provide wider benefits beyond healthcare services. The design of the new hospital is intended to 'celebrate the built environment' by providing active edges, publicly accessible green space, visual interest, a porous campus to enhance connections with the city and a built response that sits well as part of the urban fabric[11].

The severance has negative impacts on the University's Wellness Corridor (Figure 7-5) and Health Precinct Master Plan (Figure 7-6). The Wellness Corridor illustrates the movements that are essential for a healthy campus, and for successful Health Sciences programmes, where much of the teaching takes places in a clinical setting. The University wants to create a strong physical connection across the campus, city and beyond. This is for students and for Health Science teaching and research staff, and thus includes a connection to the hospital. Currently the experience for pedestrians is mixed, with some areas of higher level of service and amenity but other areas of major severance caused by arterials. Continued

[11] Presentation by SDHB to Stakeholder Workshop 5 November 2018

investment by the University and ongoing popularity of the quality Health Sciences teaching programme at the University is likely to lead to exacerbation of existing access and safety issues for pedestrians.



Figure 7-5: Dunedin Health and Wellness 'Corridor' (Source: Otago University Presentation)

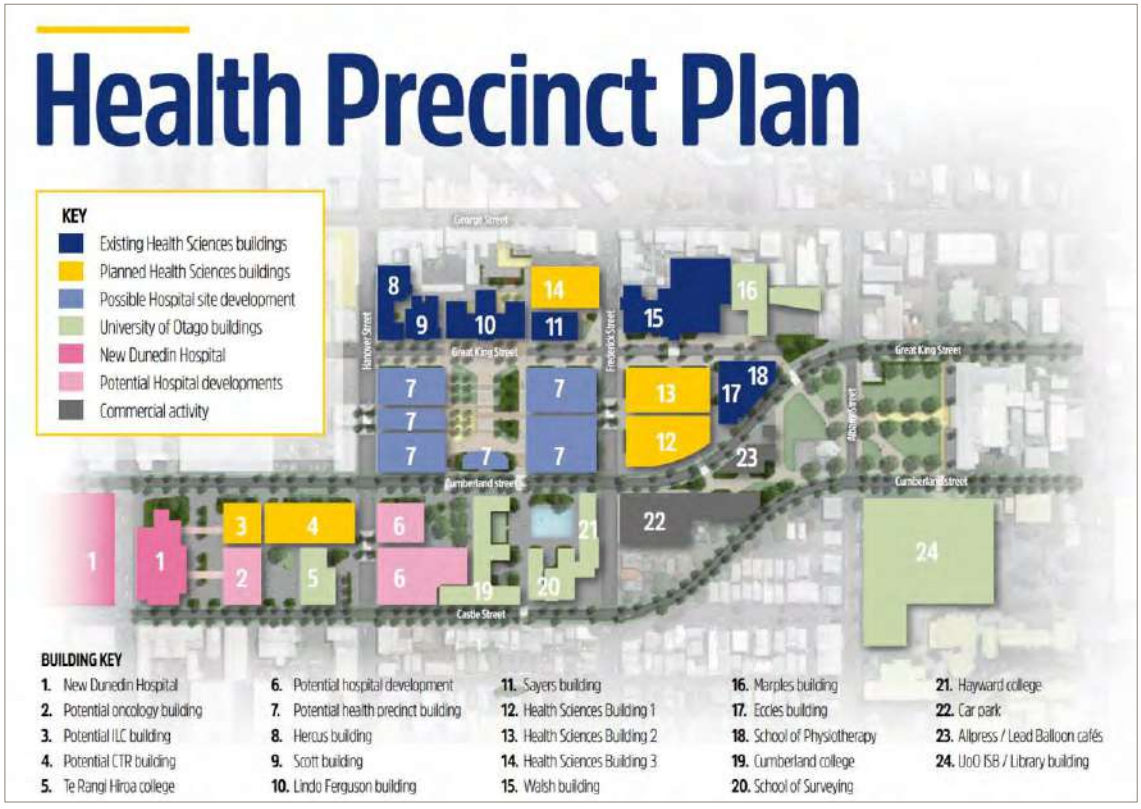


Figure 7-6: University of Otago Health Precinct Master Plan (Source: University of Otago)

7.2 Problem 2: Access, Placemaking and Liveability

Problem: The design, use and management of central city routes means many roads operate in a similar way resulting in dispersal of traffic and severance between key city precincts, creating safety and amenity issues and supressing walking and cycling.	
Cause(s)	• Management of arterials through the Road Hierarchy has led to dispersal of traffic through the network, including freight, meaning traffic volume, speed and traffic mix is similar on many central city streets • Current traffic volumes, impact of population growth and current mode share indicates traffic volumes are high and will continue to increase on central city streets
Effect	• Location, design and operation of three arterial routes and railway in relation to key central city destinations/places creates severance and safety issues • Pedestrian access is restricted to crossing at traffic signals where pedestrians wait up to around 1 minute 45 seconds if they miss the green man phase. • The Dunedin City Council Central City Plan focuses on placemaking and creating a liveable city, but severance and amenity issues caused by the transport network (and land use response) presents a challenge to achieving the vision and outcomes
Consequence	• Pedestrian Environment Rating Scores (PERS) at 9 sites range from +20 at Stuart Street with the 8 other sites achieving negative scores. Lowest scores were on Cumberland Street blocks (-25, -19, -11). All sites except Stuart Street achieved consistently low scores for Quality of Environment and Permeability, providing evidence of severance and low place value currently. Noise from traffic including heavy vehicles was noted as a significant issue by the observers. • 28% satisfied with flow of traffic through city at peak times (2019), down 10% from 2018 (DCC Residents' Opinion Survey 2019) • 71% satisfied with overall look and feel of central city retail area (DCC Residents' Opinion Survey 2019) • People's Panel Survey (2019) comments on one-way system showed issues with congestion, too many traffic lights, noise, pollution, heavy vehicles and being 'industrial', but some acceptance that poor place quality is the necessary by-product of arterial road network. Many felt Queens Gardens is isolated, difficult to access, noisy, surrounded by roads and difficult to navigate. • Not able to fully realise Council's Central City Plan aspirations for placemaking and accessibility to enable economic growth/regeneration and a quality experience for visitors and residents

7.2.1 Road Hierarchy (2GP)

The design and management of the existing road network has been influenced by the Council Road Hierarchy which was in place between 2006 and 2018 as part of the Operative District Plan and is shown in

Figure 7-7. This was reviewed during 2016-2019 for the Second-Generation District Plan (2GP) to give the updated hierarchy shown in Figure 7-8.

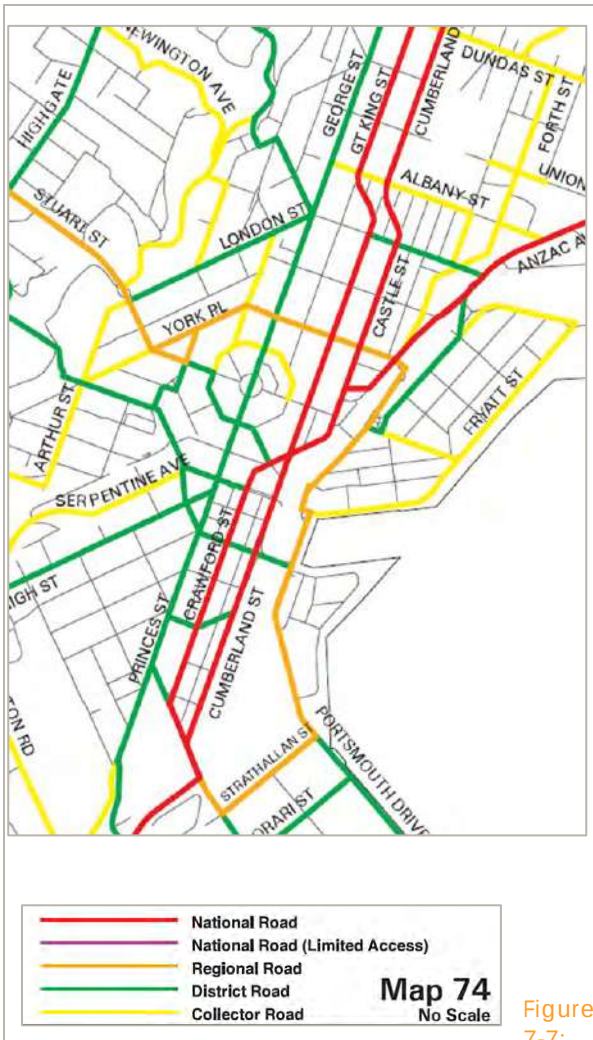


Figure 7-7: Road Hierarchy 2006 to 2018

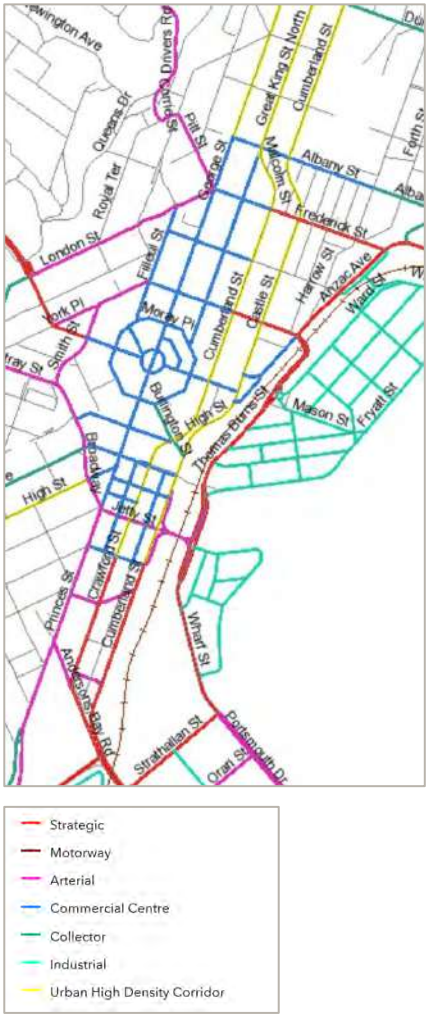


Figure 7-8: New Road Hierarchy 2GP

The 2006 hierarchy focuses on movement. Although roads such as St Andrew Street and Albany Street are identified as having an important movement function, to users they appear the same as Hanover and Stuart Street, with similar speed environment, road width and look and feel of the street. The 2GP hierarchy has a combined movement and land use focus, with categories such as 'Commercial Centre Street' used to denote roads where the place function is more important (roads within the shopping area), and 'Urban High-Density Corridor' for streets such as the one-way pair, which have an important movement and place function, resulting in a complex environment for users and needing careful management. This has only recently been adopted and changes to design and management of roads are not evident.

7.2.2 Traffic Volumes, Freight and Speeds on Arterial Routes

Because the updated road hierarchy has not been used to any great extent to guide traffic within the central city, apart from prioritising the one-way pair, and speed management has only been used on part of Princes – George Street, the result is the dispersal of traffic throughout the network. Figure 7-9 shows the daily total vehicles on each road in the study area, using varying line width to indicate the volume. This clearly demonstrates that most roads have roughly the same volume, except for George Street between the Octagon and Frederick Street, where the volume is much lower. Estimates of daily traffic volumes from the model are provided for 2018 in Table 7-3.

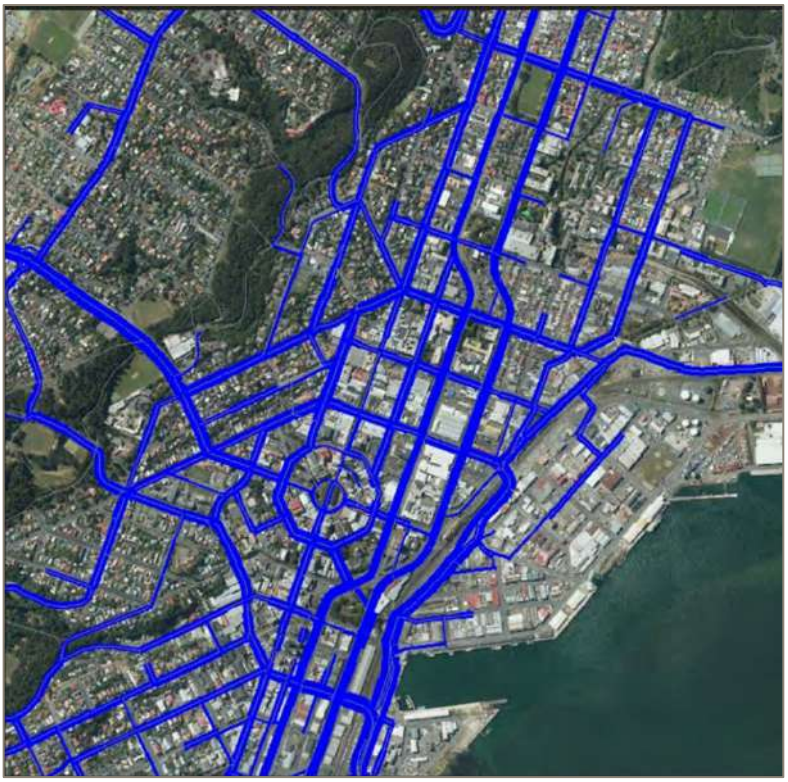


Figure 7-9: Average daily total traffic indicated by proportional line width (Dunedin Traffic Model, 2018)

Location	Count (vpd)
George Street	10,000
Cumberland Street	16,000
Castle Street	16,000
Anzac Avenue	13,000
Great King Street	9,000
Filleul Street	9,000
Leith Street	2,000
Frederick Street	10,000
St Andrew Street	8,000
Hanover Street	7,000
Jetty Street	14,000

Table 7-3: Traffic counts from Dunedin strategic transport model

Increasing car ownership along with population growth has, on many arterial routes, correlated to increasing traffic volumes. Figure 7-10 shows steadily increasing traffic volumes on Dunedin northern and southern motorway (SH1) and on SH88 over the last five years. The highest growth has been on the SH1 Southern Motorway and SH1 Northern Motorway, with growth averaging 4% per annum over the last five years. Growth on SH88 to Port Otago has averaged 2% per annum. However, trends are inconsistent on SH1 at Queens Gardens, with volumes decreasing in 2018 in both directions.

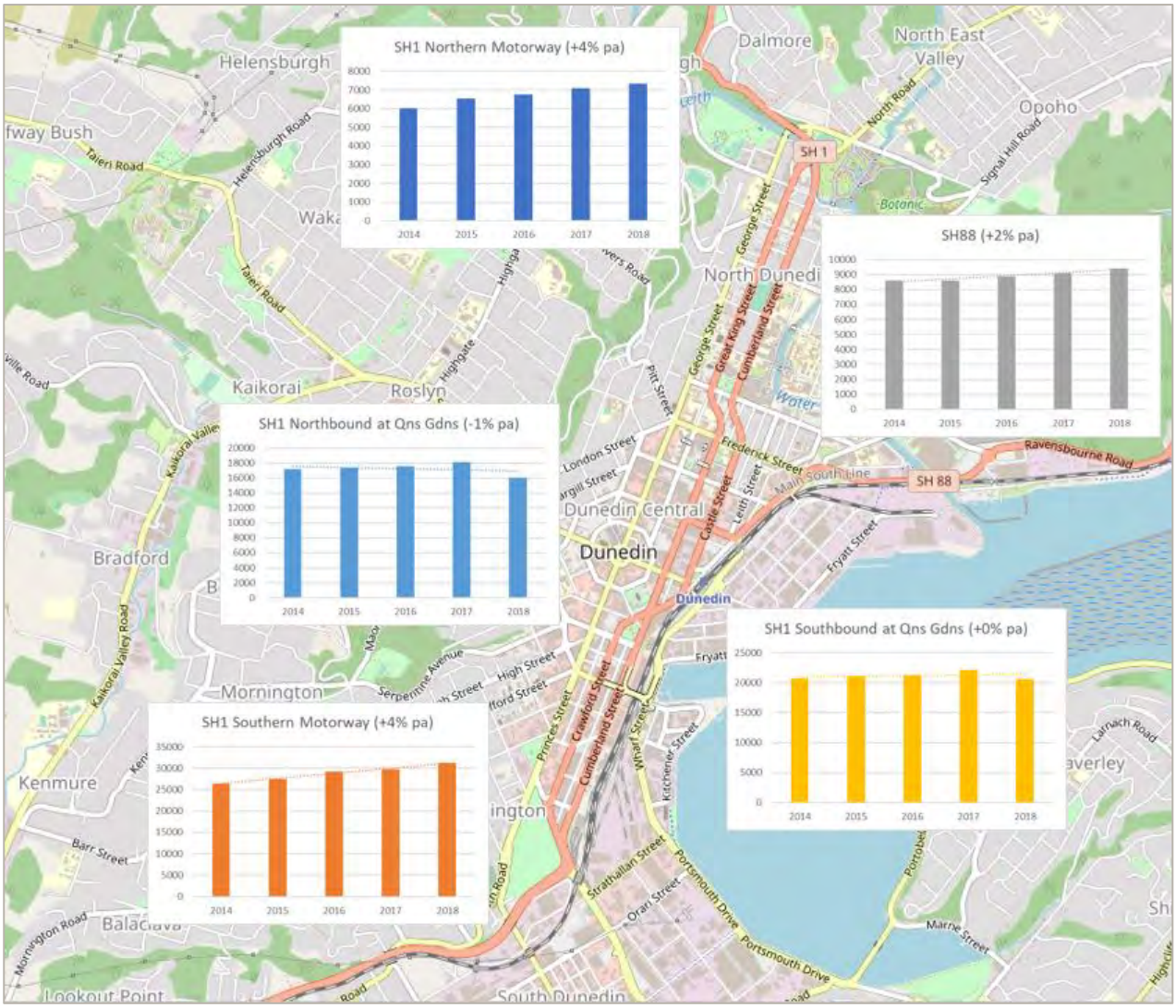


Figure 7-10: Average Annual Daily Traffic on Dunedin's State Highways (Waka Kotahi website)

Increasing car ownership and population growth has caused pressure on parking facilities. DCC does not regularly monitor parking occupancy rates, and satisfaction with parking availability in Dunedin is low. Only 28% of residents were satisfied with availability of parking in the central city in 2018.

The demand for travel is influenced by population growth, which is now proceeding at a rate of 1.4% per annum (refer Figure 3-1). Since 2019 Dunedin has been recognised by Stats NZ as a medium growth city. Population Projections produced by Stats NZ are for Dunedin's population to reach 130,700 by 2043. However, the city already reached this population in 2018, so the high growth projections are currently looking more realistic. The high growth projections are for an additional 22,400 residents from 2013 to 2043. It is expected that this will put additional load on the transport network and parking in the city centre, exacerbating the underlying causes of this problem statement and worsening the consequences.

7.2.3 Access to Central City

7.2.3.1 Mode Share

Transport in Dunedin is predominantly car based, with high and growing levels of car ownership demonstrated by the NZ Census data, and significant parking supply in and around the central city with much free parking within a walking distance of key destinations. Dunedin residents are highly dependent on car travel, with relatively low rates of public transport, walking or cycling, as illustrated by Figure 7-11, which shows the main means of travel to work or education. People driving their own, or company, vehicles make up 74.4% of the total.

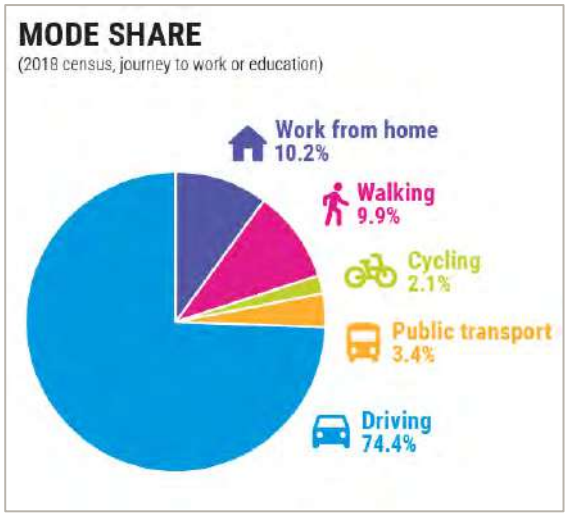


Figure 7-11: Main means of travel to work, Dunedin City (2018 Census)

Dunedin has an extensive bus network and a central bus hub which provides a legible system for visitors, new users, and those who need to change services. Patronage has been growing over the last three years but is still relatively low.

Dunedin's cycle network is growing but fragmented, with a separated cycleway on SH1 through the central city, and shared path routes around the harbour the primary infrastructure completed to date. The cycle network is perceived by many as dangerous, with only 28% of residents satisfied with the suitability of the road network for cyclists in 2018. Walking is a viable transport option for many residents due to the compact nature of the city, and medium density housing close to the central city. In 2013, over 10% of residents recorded their main means of travel to work as walk/jog, compared to 6.2% nationally. This is mainly attributable to the dense student population in North Dunedin.

7.2.3.1 Travel Times and Commuting Patterns

Each weekday, 32,727 people travel into the combined Dunedin Central, Harbourside and Campus South areas for work or education. An additional 3,174 also live in these areas and go to work or school there. Figure 7-12 shows where these people live, with the largest circles indicating the most trips from that part of the city. People arrive from 73 different parts of the city, but the majority of journeys are from surrounding suburbs and are relatively short, around 5-6km in length.



Figure 7-12: Commuter Waka (based data from Census 2018)

The Dunedin strategic transport model shows 11,800 vehicles per day entering the one-way system from the north and travelling south. Of these, 20% use SH1 as a through route to the south, 65% use it to access the CBD, University and waterfront areas with the remainder travelling to hill suburbs or South Dunedin.

Almost three times the number of vehicles enter the network from the south, with a total of 29,100 per day via SH1 (15,400) and Wharf Street (13,700). Only 10% use SH1 as a through route to the north. 80% of those on SH1 are accessing the CBD, University and harbourside. On the harbour arterial, 25% are going to the harbourside area, and 45% to the CBD and University.

Travel times in the morning peak for the last four years are shown in Figure 7-13. These are calculated using floating vehicle surveys on five key routes: Normanby, Waverley, St Clair, Mosgiel, and Brockville to the central city. The graph shows there is little variability in journey times. It also demonstrates that the journeys are relatively quick, taking between 8 and 10 minutes from the nearby suburbs (5-6km distance), and 17-18 minutes from Mosgiel (16 km distance). However, it does demonstrate that trips from Waverley and the south are taking longer.

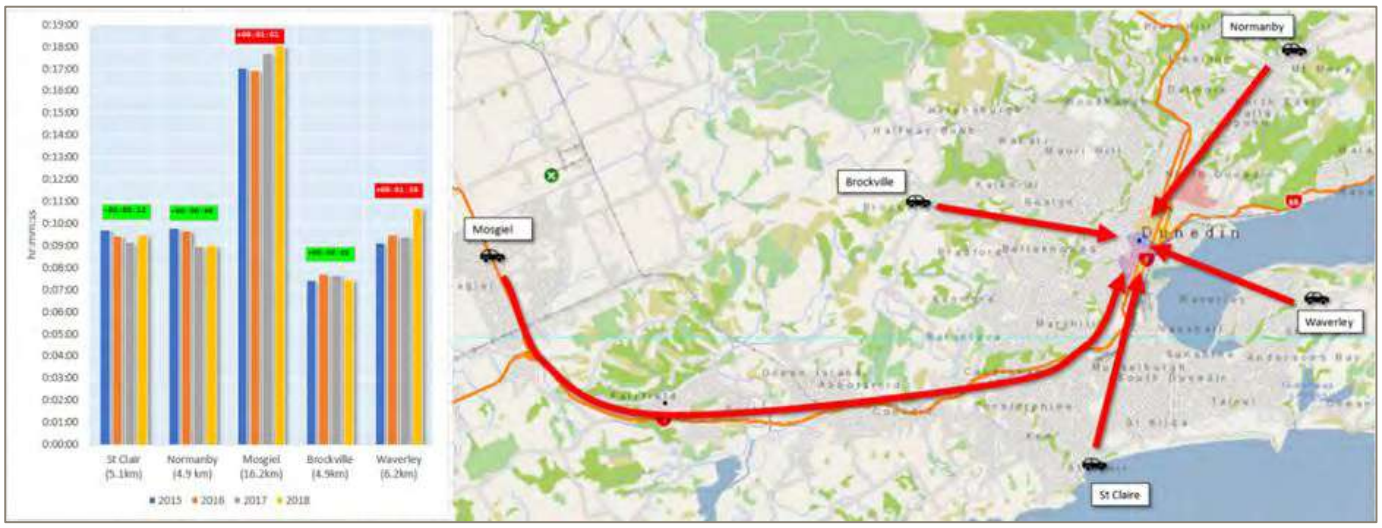


Figure 7-13: Travel times morning peak from five suburbs, 2015-18 (Source: DCC)

7.2.4 Freight and Port Access

Port Otago is located at Port Chalmers. It is the primary export and cruise ship port for the South Island. It handles 1.7 million tonnes per annum[12], and is the key destination for many exports generated from Otago and Southland such as logs, fuel, fertiliser and other agriculturally based products. It is accessed from the city centre via SH88. Port Otago have a plan to establish a Dunedin Bulk Port in the future, in the northeast part of the industrial area between the Leith, the Harbour, SH88 and Fryatt Street/Wickliffe Street. There are also plans to deepen the existing shipping channel to allow larger ships to access the Dunedin central wharves.

To an extent, freight movements distribute within the central city network. Figure 7-14 shows the indicative volume of freight on each route by proportional line thickness. A higher percentage of freight is present on Andersons Bay Road at 16-18% and northbound on the harbour arterial at Thomas Burns Street (15%), and actual truck volumes are greatest on these roads as shown in the table, with over 1000 truck movements per day in each direction. For east-west movements, the intention may be that Frederick, Hanover and St Andrew Streets serve different purposes. However, they all carry around the same volume (around 5%), indicating a lack of a clearly defined east-west route for freight. Volumes are lower than for the north-south movement, at 2-300 movements in each direction per day. The daily totals in the table show that generally eastbound flows are greater than westbound, and northbound are greater than southbound. In the study area, Andersons Bay Road and Thomas Burns Street on the harbour arterial experiences the largest number of truck movements per day, followed by SH1 outside the new Dunedin Hospital site.

Part of St Andrew Street is designated as SH88, providing the connection between SH1 and the route to the Port. As the NDH sites straddle SH88 for one block, its designation as a state highway may no longer be appropriate. This project will need to look at alternative locations for SH88 to provide a clear east-west route for freight.

[12] https://www.portotago.co.nz/assets/Uploads/Port-Otago-AR-2018-10-Sept.pdf



Site	Trucks per day/direction	
St Andrew Street	320 EB	290 WB
Hanover Street	210 EB	170 WB
Frederick Street	300 EB	190 WB
Anzac Avenue (north of Frederick Street)	590 EB	590 WB
Andersons Bay Road	1210 NB	1340 SB
Thomas Burns Street	1250 NB	1150 SB
Anzac Avenue (north of St Andrew Street)	530 NB	490 SB
Ward Street Bridge	390 EB	380 WB
SH1 outside NDH	750 NB	700 SB

Figure 7-14: Distribution of freight movements (Dunedin Traffic Model, 2018)

7.2.5 Liveability and Placemaking Aspirations

7.2.5.1 Tertiary Institutions

The University of Otago and Otago Polytechnic are significant property owners and investors in the city. The University has a significant planned capital spend over the next 10 years, including a new college, new Health Sciences Buildings, Food Sciences Development and various compliance upgrades. It has also developed a Health Precinct Masterplan, shown above in Figure 7-6.

7.2.5.2 Dunedin City Council's Central City Plan

The purpose of the Central City Plan is to guide development of the central city area for the next 10-15 years. It presents a vision of 'enhancing the heart of one of the world's great small cities', which supports the city's vision of Dunedin as 'one of the world's great small cities'.

The specific vision for the central city is: 'our central city is a place focussed on people. It will be vibrant, safe and attractive and a compelling destination to live, work, play, visit, learn and invest'[13]. The Plan identifies key projects with a strong focus on improving the street environment. It identifies four quarters, which reflect the different types of activities that occur in each precinct and to foster a distinctive character for each.

The document identifies that severance caused by the one-way system presents a challenge to achieving the vision for the city, and in particular enabling redevelopment of the waterfront area. Other challenges strongly linked to transport include a car-dominated environment causing congestion and high parking demand, at the expense of an attractive, high quality and safe environment for pedestrians. Insufficient quality public open space is an issue and the severance of Queens Gardens due to busy roads erodes the quality of the limited existing open space.

Dunedin's Waterfront: Currently the Council is progressing the Dunedin waterfront redevelopment project. The aim is to create a mixed-use development focussed on Steamer Basin and including a hotel and cultural centre. However, the opportunity for growth of this area is difficult due to severance caused by the SH1 one-way pair, railway line and harbour arterial. To help address this issue, the Council have committed $20 million for a new pedestrian/cycle bridge from Queens Gardens/Rattray Street to the Steamer Basin. However, pedestrians will still have to cross both legs of the one-way pair through Queens Gardens to reach this bridge.

[13] DCC Central City Plan 2015

Street and Open Space Design Guide: To guide amenity and transport improvements, the Council has developed this guide which categorises streets using a Place and Movement Framework. Typical cross sections are provided to guide placemaking activities.

Retail Precinct Upgrade: The Council are progressing with changes to enhance the place function on George Street, which may see George Street reduced to a one-way slow street with significant amenity improvements.

Stuart Street, Princes Street and Rattray Street Upgrades: Other street upgrades are planned to enhance the place function and create a unique sense of identity in Dunedin.

The effect of these changes will be to change traffic flows throughout the city and make it critical that the causes of the problem statement are addressed urgently.

7.2.6 Pedestrian Access – Existing and Future

The movement of traffic through the central city network comes into conflict with pedestrian movements, as people walk between key parts of the city. Figure 7-15 shows the underlying road classification along with the location of the main central city precincts, key landmarks, origin/destinations and the major new land uses of the NDH and the waterfront. The main desire lines between these areas are shown by blue arrows which indicate the flow of pedestrians. Investment by the University over the next 10 years will also lead to increasing pedestrian flows to and from the Tertiary Precinct, through the 'Wellness Corridor'.



Figure 7-15: People, place and movement diagram

For pedestrians walking around the central city, for the most part Dunedin is car dominated. Speed limits are 50km/h except for a stretch of 30km/h on the Princes Street – George Street corridor. Pedestrian

crossing is provided for at signalised intersections — a number of which are Barnes Dances crossings. In general, the pedestrian facilities are piecemeal and inconsistent.

7.2.7 Pedestrian Levels of Service

Levels of service for pedestrians have been assessed at the key locations where severance has been identified as an issue[14]. The results are shown in Table 7-4. Where traffic signals are provided the level of service for pedestrians is reasonable. However, at intersections without signals and mid-block the level of service for pedestrians is poor.

Table 7-4: Pedestrian levels of service at key intersections/mid-block desire lines

Site	Desire Line	Current Level of Service
Malcolm Street	Tertiary area to CBD, Health Sciences Precinct	LOS D midblock and LOS B Albany/SH1
Castle Street	CBD to Railway Station, Toitu	LOS B
Crawford Street	CBD to Queens Gardens and beyond	LOS B
Cumberland Street	CBD to Toitu, Chinese Garden, Proposed footbridge to waterfront	LOS B
Crawford Street	Warehouse Precinct (either side)	LOS E (Liverpool St)
Cumberland Street	NDH, bus hub, CBD	LOS B signals LOS E midblock
St Andrew Street	NDH	LOS E midblock

Although the pedestrian levels of service are rated B at signals, the delay for pedestrians is significant. For example, typically pedestrians crossing downstream of the Cumberland Street/Stuart Street and Cumberland Street/St Andrew Street intersections have 6 seconds protected crossing time, 12 seconds unprotected, and must then wait 1m 42 seconds for the next green crossing phase.

7.2.8 Placemaking: Pedestrian Environment Rating Scores

The Pedestrian Environment Review System tool that sits within the Valuing Urban Realm Toolkit[15] was used to complete assessments of central Dunedin city streets over nine blocks selected as they are near where the future hospital will be located. The tool provides 11 Link attributes and six Place attributes which are scored on a scale from -3 to +3.

The assessments were undertaken in October 2019 by technical specialists in urban design and transport planning and included client and consultant team members. The scores are shown in Table 7-5 and a heatmap is provided in Figure 7-16.

Table 7-5: Pedestrian Environment Review System Assessment Scores (possible score range: -51 to +51)

PERS Attributes	Link	Place	Aggregate
Hanover Street	-2	0	-2
Frederick Street	-8	-6	-14
St Andrew Street	-11	-10	-21
Stuart Street	+10	+10	+20
Cumberland Street (Stuart Street – St Andrew Street)	-10	-9	-19
Cumberland Street (St Andrew Street – Hanover Street)	-12	-13	-25
Cumberland Street (Hanover Street – Frederick Street)	-4	-8	-11

[14] Using the Australasian Pedestrian Crossing Facility Selection Tool v 2.0.3
[15] Developed by Transport for London

PERS Attributes	Link	Place	Aggregate
Queens South	-3	-2	-5
Queens North	-12	-9	-21

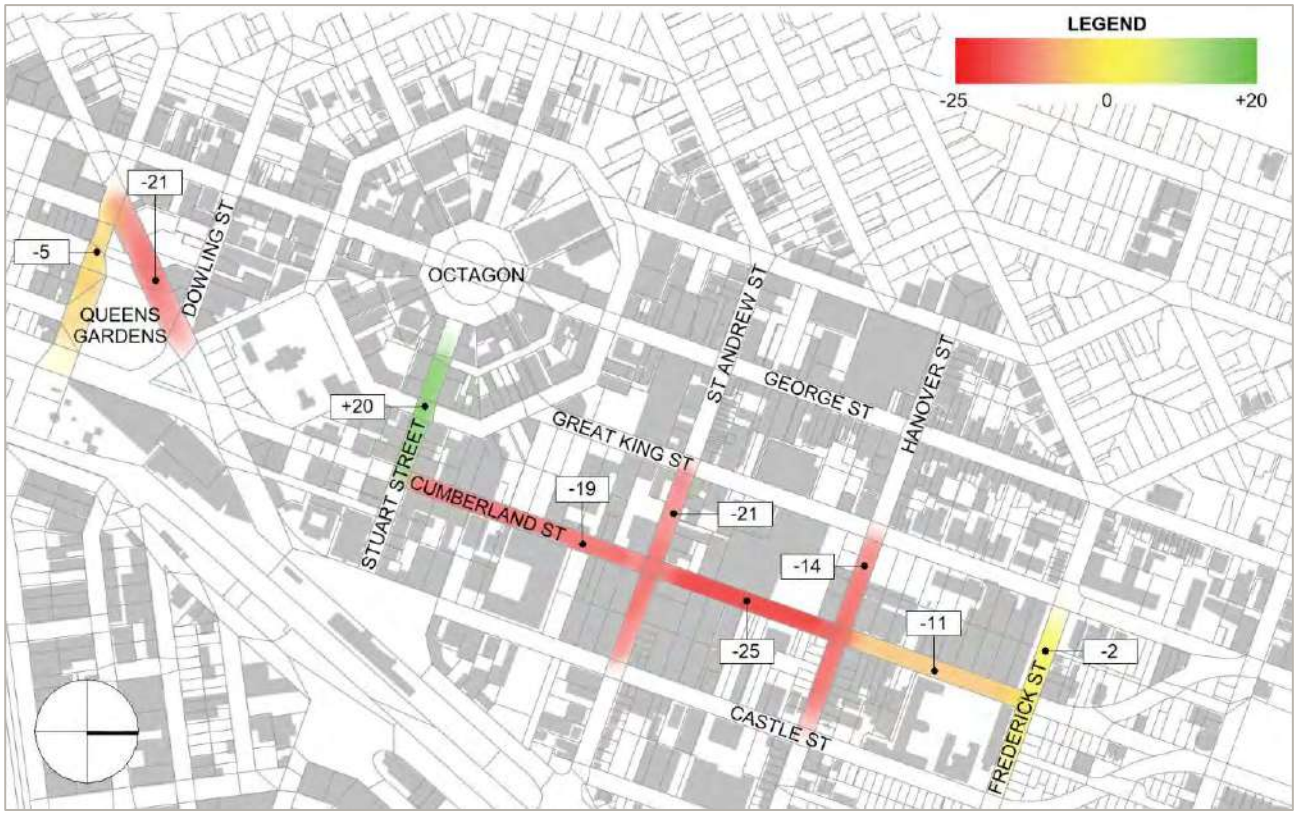


Figure 7-16: Pedestrian Environment Review System Assessment Heatmap

The results show that:

- Stuart Street scored significantly better than the other streets assessed and achieves a positive score.
- The poorest score was Cumberland Street between St Andrews Street and Frederick Street which was affected by obstructions, lack of crossings/permeability and poor quality of environment (noise), lack of comfort, poor sense of place and lack of opportunity for interaction with street given many blank walls with few windows/doors to street.
- Queens Gardens shows the difference between the two sides, with the Rattray Street side being better for pedestrians with less traffic meaning more permeability and less noise compared to the north side. Both scored well for place attributes.
- Noise and lack of crossings were significant negative factors for all Cumberland Street sites, as well as activity user conflicts where driveways (e.g. at supermarkets) crossed the footpath, and lack of legibility (wayfinding). Generally, effective footpath width, obstructions and lighting, were all at average levels. Negative scores were consistently given to factors such as quality of environment, personal security and permeability. This provides evidence of severance (low permeability scores) and amenity effects (low quality of environment scores) For other sites, surface quality and user conflict emerge as issues, particularly around Queens Gardens and on St Andrew Street.

7.2.9 Severance

The effect of the heavily trafficked roads combined with inconsistent provision for pedestrians on key desire lines between destinations causes substantial severance in key locations. In Dunedin, the evidence shows that severance is a widespread issue across the central city, as roads with high traffic volumes cross key pedestrian desire lines. This has been identified in key Council and University documents and is illustrated graphically in Figure 7-15.

- Dunedin's Central City Plan (Dunedin City Council, 2014) provides evidence of severance caused by the one-way system. This is listed as one of 12 challenges to achieving the vision:

  'The two parallel one-way streets that make up State Highway 1 bisect the central city, creating barriers for efficient, convenient and safe links for pedestrians and cyclists. They also reduce connectivity between different parts of the central city, particularly travelling west to east, isolate some of the city's best attractions and impact negatively on environmental conditions and the look and feel of adjacent areas. Reducing the severance caused by the state highway network is necessary to improve the central city as a people-friendly space.' (p11.)

  Poor connections to the waterfront are also identified as a challenge due to severance:

  'The city is disconnected from the Steamer Basin and the harbour by two busy state highways, a heavy freight route (Wharf Street) and the main trunk railway. Due to their width, design, and traffic volumes, these transport corridors present both a physical and a mental barrier between the harbour and the city centre. The two existing pedestrian links do not cross all of the physical barriers, are inaccessible to mobility impaired, and fail to deliver pedestrians or cyclists safely to the heart of the waterfront, where they want to go. Better connecting the central city to the waterfront has long been an aspiration of the city's residents.'(p13).

- The Tertiary Precinct Plan (2008, Dunedin City Council, University of Otago and Otago Polytechnic) identified the hostile road environment created by the one-way pair in Dunedin as an issue creating conflict between motor vehicles and pedestrians.
- The Otago University Masterplan (2010) identified weaknesses of the current campus including high speed traffic close to the campus, urban void around the S bends, and poor connectivity for pedestrians between the Health Sciences Precinct and core campus. The S bends were mentioned frequently in consultation, as being dangerous for pedestrians and a significant barrier to cross-campus connections.

Severance between the Octagon/George Street and Queens Gardens, Lan Yuan Dunedin Chinese Garden, Toitū Otago Settlers Museum and waterfront is illustrated by Figure 7-17. SH1 north and southbound does not provide an attractive or welcoming environment with wide roads, high traffic volumes, delays, and low amenity.



Figure 7-17: Dowling/Cumberland Street (Thursday 1/11/18 1pm)

7.2.10 Residents' Views of Central City Transport System

7.2.10.1 People's Panel Survey 2019

A People's Panel survey was conducted by the Council in November 2019 to understand how safe people feel and how satisfied they are using different modes of transport to get to, or within, the city centre, what would encourage them to change mode, and their experiences and views about the one-way system. 175 responses were received. This is not a representative sample however it gives an indication of people's views. The key findings were:

- Central City:
  - Majority felt walking and driving was safe but cycling or using scooters/skateboards was not.
  - Driving: congestion and driver behaviour were the most common issues raised.
  - Parking: price and supply were the most common issues, with suggestions to put more parking on the outskirts of the centre.
  - Bus network: most common area of dissatisfaction was cost, with poor frequency second. Other issues were hub location, large empty vehicles, poor network, takes too long, unreliable. Most common response when asked what would encourage people to change to bus was cheaper/free buses (39 people), followed by more frequent buses (18 people).
    - *"Free buses (for Dunedin residents) are the only thing that will change my car use. At the moment it is cheaper to drive than it is to bus."*[16]
  - Walking: crossing the road was the most common issue, followed by hills and access. There was strong support for Barnes Dance crossings, with over 30 positive comments and only 2 negative.
  - Cycling: hills were the most commonly cited issue, followed by paths not joining up and feeling unsafe. Better and safer cycling infrastructure and facilities was identified by 9 people as a way to encourage them to change to cycling.
- Views and experiences of the one-way system:
  - Overall: Comments were negative (65) rather than positive (10). Issues were congestion, too many traffic lights, noise, pollution, heavy vehicles and being 'industrial'. Neutral comments seemed to reflect acceptance that poor place quality is the necessary by-product of the arterial road network and talked about the one-way being functional and providing for better movement of vehicles. Quotes about the one-way system included:
    - *"The one-way is noisy, barren, and ugly. It also acts as a fence cutting through the city, separating the city centre from the rest of the harbour."*
    - *"We seem to have forgotten why the one-way system was installed - the efficient movement of vehicles through the city."*
    - *"Not sure that 'attractiveness' is a major requirement for a State Highway - more important is how it functions in terms of moving traffic from one end of the city to the other. Any beautification that hinder that function would be a major mistake."*
    - *"If you don't know the city well you just end up going in circles."*
  - Queens Gardens: seen as attractive, pleasant, historic, lovely, valuable and an oasis (77 positive comments) but there were 43 negative comments about how the Garden is isolated, difficult to access, noisy, surrounded by roads and difficult to navigate.
  - Driving: challenges included access, driver behaviour, excessive speeds, narrow lanes, signal phasing. Many felt the design of the one-way system was 'quirky' and difficult to understand for new users.
  - Walking: challenges included crossing the road, traffic noise and pollution.
  - Cycling: many felt cycling and cycleways should not be on the one-way system. Challenges for cyclists included inconsistent nature of the lanes, crossing difficulties, intersection design and driver behaviour

7.2.10.2 Residents Opinion Survey 2019

Satisfaction with the overall look and feel of the central city retail area was at 71% in 2019.

For the transport network, only 35% of residents were satisfied with the transport network overall. Only 28% of respondents were satisfied with the flow of traffic through the city at peak times, down 10% from 2018. Other areas of dissatisfaction include the availability of parking in the central city (22% satisfied).

7.2.11 Safety

The dispersal of general traffic across the network means that it is harder to manage the effects. One effect of having reasonably high traffic volumes across many routes, combined with high pedestrian activity, is that crashes are more likely to occur. Figure 7-18 shows the Collective Risk on roads within the

16 From 2019 People's Panel survey, prior to introduction of $2 fare in Dunedin.

study area, and Figure 7-19 shows Personal Risk. Parts of George Street and St Andrew Street have high personal and collective risk. In contrast, the Harbour arterial has relatively low risk.



Figure 7-18: Collective Risk[17]



Figure 7-19: Personal Risk[17]

Road safety is recognised as a major challenge for Dunedin. A snapshot of issues is provided by the Communities at Risk Register (2020) which compares the risk for each authority area. Dunedin City has the second highest risk out of all 67 authorities for crashes at intersections. It is ranked seventh highest risk for crashes at urban intersections. The highest Safer Journeys Areas of Concern for Dunedin are shown in Table 7-6.

Table 7-6: Communities at Risk Register 2020 - Areas where Dunedin is a high strategic priority

Safer Journeys Area of Concern	Dunedin's risk ranking out of the 67 authorities in NZ
All intersections	Ranked: 2nd highest risk
Urban Intersections	Ranked: 7th highest risk
All deaths and serious casualties	Ranked: 13th highest risk
For all other categories, risk in Dunedin was not high enough to be a strategic priority.	

SH1 One Way Pair

Crash totals and severity on the SH1 one way pair from just north of the intersection with Andersons Bay Road to just south of the intersection with Pine Hill Road are shown in Figure 7-20. Injury crash numbers fluctuate over the period. In total there were 159 injury crashes over the five years, with 29 resulting in serious injury or death. This is an average of around six per annum. Both corridors have high collective risk for some distance, which reflects the crash problem. In addition, of the crashes resulting in injury, the most common crash types were crossing/turning (40%), rear end/obstruction (28%) and pedestrian crashes (18%).

[17] From MegaMaps 2018

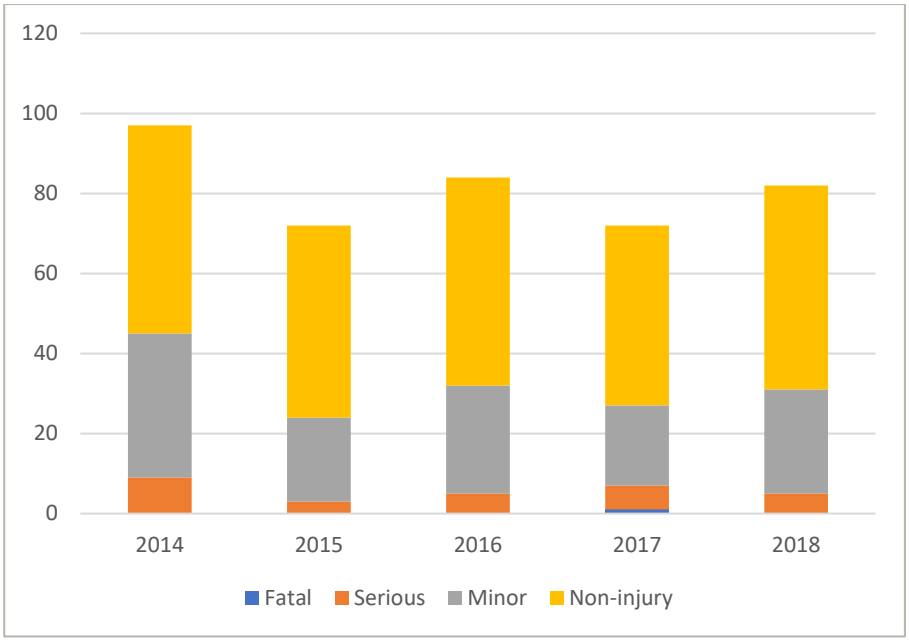


Figure 7-20: Injury crashes on the state highways within the study area (2014-18 CAS)

The data shows that vulnerable road users (cyclists, pedestrians and motorcyclists) are over-represented in more serious crashes, with 61% of serious injuries incurred by vulnerable users and 39% incurred by those in motor vehicles. Minor injuries are more likely to be experienced by those in vehicles (75% of total).

Table 7-7: Total number and severity of injury crashes by road user

Road User	Fatalities	Serious injuries	Minor injuries	TOTAL
Cyclists	0	4	13	17
Vehicle drivers	0	8	96	104
Motorcycle riders	0	5	9	14
Vehicle passengers	0	4	31	35
Pedestrians	1	10	20	31
TOTAL	1	31	169	201

The one-way pair currently present a high risk for vulnerable road users. With the NDH site on the one-way pair, more vulnerable users will be exposed to this risk.

Within the data above, a range of crash factors are present, but those most commonly recorded were poor observation (60%), failed to give way or stop (45%). The majority of crashes were at intersections (79%) rather than mid-block (21%).

Pine Hill Road/Great King Street Intersection

Included within the scope is consideration of the issues at Pine Hill Road/Great King Street intersection, to the north of the city. This intersection has been under investigation by Waka Kotahi for many years, due to safety concerns relating to the alignment. For example, a Scheme Assessment Report was completed in 2006, and a Strategic Case in 2017. A more detailed report on the intersection is provided in Appendix B.

The problem identified in the Scheme Assessment Report was that on SH1 between the Kilmog and Dunedin, drivers descend 630m with many heavy vehicles using their brakes instead of their engine brakes to save travel time. Some experience overheating of brakes as a result, resulting in brake fade or failure. Loss of control can then result, tending to happen after drivers cross the George Street overbridge on the low radius curve at the end of the last downhill section by the sports ground. In 2017 an out-of-control truck rolled, coming to rest across the intersection islands, in 2015 a truck lost its brakes crashing through signs and streetlights coming to rest against the Botanic Gardens and in 2001 a truck rollover crash ended in the middle of the sports field.

The layout of the intersection is shown in Figure 7-21. There are a number of issues with the design of the Great King Street southern approach which is a stop-controlled intersection. Sightlines are restricted to the north by overhanging vegetation and by northbound trucks using the slip lane (Figure 7-22). This compounds the risk of a DSI crash resulting from heavy vehicles losing control on the descent approaching the intersection.

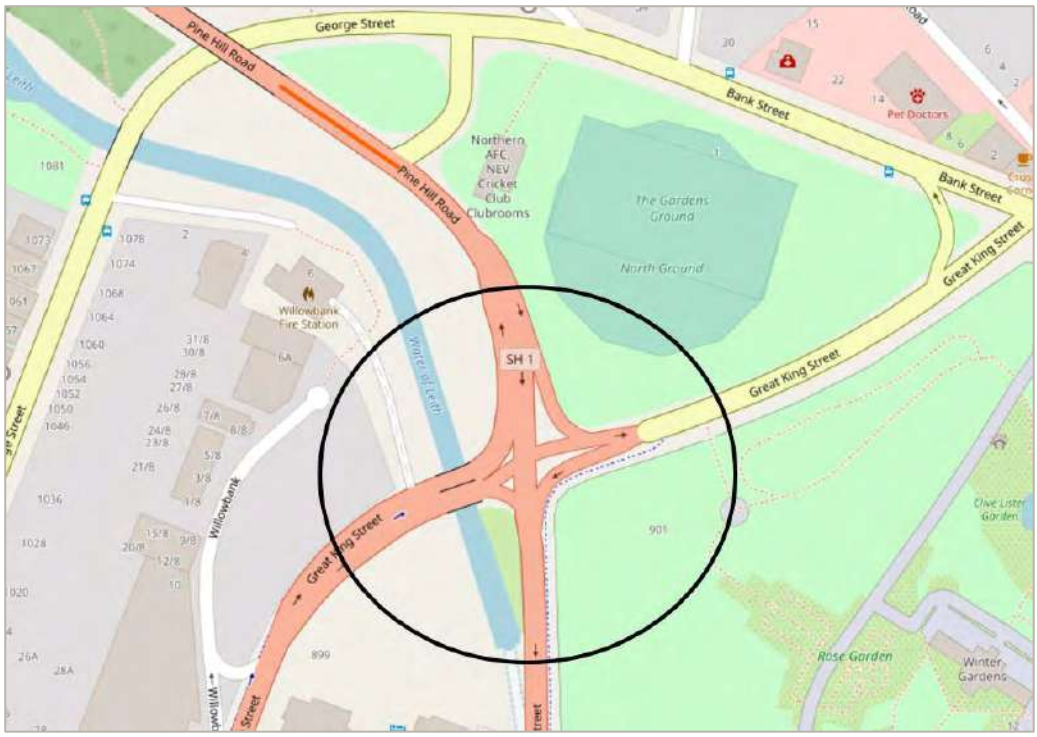


Figure 7-21: Pine Hill Road/Great King Street Intersection



Figure 7-22: Vehicle waiting to cross SH1 to reach North East Valley

The Strategic Case took a broader approach to the issue than the Scheme Assessment Report. Waka Kotahi worked with stakeholders during 2017 and identified three problems. The long-standing safety issues are articulated in problem 1.

Problem 1: The current intersection layout and road user behaviour create an increased risk that crashes will result in deaths and serious injuries. Evidence supporting this problem was the high collective risk rating with a DSI equivalent of 4.31 and non-compliance issues for traffic at the stop sign on Great King Street by through traffic to North East Valley.

Problem 2: The intersection does not have formal provisions for current and future pedestrians and cyclists which results in compromised connectivity an accessibility. Supporting evidence for this problem included location of schools, Botanic Gardens, Gardens shopping area and residential areas creating desire lines through the intersection. It is noted that provision has been improved through the SH1 Cycleway Project, as, with clear crossing facilities now providing a clear route with drop kerbs and tactile pavers (Figure 7-23).



Figure 7-23: New Pedestrian crossing facilities

Problem 3: The intersection control and volume of traffic sometimes using the intersection result in delays and rat running that impact the efficiency of a national highway. Evidence supporting this problem included observation of queues on Great King Street back to Duke Street signals during peak periods as vehicles wait to cross SH1 to reach North East Valley.

A high-level safety analysis completed to inform the evidence base of the 2017 Strategic Case for this intersection showed that in the last five years, there have been a total of 17 crashes. One was a serious injury crash, four were minor injury and 12 were non-injury crashes. The intersection has a medium-high personal risk and medium high collective risk. It is a high-risk intersection[18]. All injured parties were drivers or passengers, no crashes involving vulnerable users were reported. The most common cause was failing to give way or stop at the intersection (14 crashes), commonly due to poor observation, poor judgement or vehicle factors. This analysis from the Strategic Case has been updated as shown above.

[18] As defined in the High-Risk Intersection Guide

8. Opportunities

Five opportunities of investment have been identified. These are explained below.

1. Integrate hospital with city

This is one of the primary opportunities presented by this potential investment. The Ministry of Health and Southern District Health Board have identified the following opportunities and constraints:

- Two-way roads adjoining the site (rather than one-way) would improve accessibility and safety
- A shared-space concept to St Andrew Street would improve connectivity across hospital campus
- Pedestrian and public transport access need to be considered
- Separation of public/emergency/service traffic is desirable
- Availability and location of parking will be important for staff, patients and visitors
- Integration of hospital with city is a key design outcome
- Potential health precinct/connections to University and Polytechnic.

If the road network was modified so that traffic volumes and speeds were reduced on Cumberland Street outside the hospital frontage, there would be an opportunity to improve the connection between the hospital and the city. This opportunity is also about staff and visitors who have the hospital as their primary destination being easily and safely able to reach other destinations in the area, such as the central city shopping area, restaurants and cafes.

During the hospital build period there will be major works on most streets in the vicinity to provide services. There is an opportunity to reinstate the streets with improvements, rather than just replacing like with like.

2. Use risk free trials to enable easier travel behaviour change

Trials can help overcome people's concerns about change. A trial is temporary, and part of any trial can include feedback on potential improvements, resulting in a better solution if the change eventually becomes permanent. Trials that could be considered for this project include changes to the bus system, cycleways and parking. Clear communications are critical to the success of a trial and help avoid confusion.

3. Stimulate sustainable economic growth/regeneration

The Council have a focus on liveability, and ensuring Dunedin is 'one of the world's great small cities'. Liveable cities are walkable and have high quality, welcoming urban environments. This project offers the opportunity to improve city liveability through reducing severance created by multiple arterial routes. There is scope to create streets that are more focussed on 'place' and less on movement, and these types of city spaces are important to liveability as they provide locations where people can meet and gather, connected by walking links. In Dunedin, these spaces are dominated by the road environment.

Integrating the hospital with the city is one of the main ways in which economic growth could occur. The hospital will generate visitors and employ around 3000-4000 staff. Cafes and shops in the immediate vicinity will be supported by passing foot traffic. Reducing the journey time for pedestrians from the University to the hospital will result in economic benefits and may mean staff are more likely to walk than drive between sites, which in itself will lead to more passing trade for businesses between the sites.

Reducing severance created by the existing arterial network and railway line could result in economic regeneration of areas with poor pedestrian connection to the city, such as the Steamer Basin and Warehouse Precinct. When places are easier and quicker to walk to, visitors and residents are more likely to make the trip.

4. **Create Dunedin's future transport system**

There is an opportunity to consider how the transport system of Dunedin will function in the future in conjunction with placemaking activities to create a liveable city. The aim will be to provide a value for money, multi-modal network which offers transport choice to residents and visitors, as well as providing a high level of access to key parts of the city to support economic activity.

5. Utilise disruption due to construction to trigger travel behaviour change

There will be 5-6 years of significant disruption adjacent to the NDH sites, commencing in 2020. Demolition of existing buildings will be followed by a series of construction activities. It is estimated that temporary traffic management plans will be in place for the duration of construction, and there is expected to be 5-6

truck movements per hour to and from the site. Waka Kotahi and the MoH will aim to minimise disruption, but some level of additional delay is inevitable.

It is likely that the disruption will cause frustration for road users. There is an opportunity to change the story by being proactive in providing improvements that make it easier for the city to continue to function. For example, cheaper, more frequent public transport could be offered to offset the inconvenience on the road network, and bus priority measures provided where temporary traffic management is in place. Park and Ride services could be introduced. New parking areas could be identified that are located away from the building sites, on the edge of the city. Real time information signs could be used to direct traffic to the least congested route. For these measures to be successful, they would need to be promoted in a coherent way to the public, explaining that they have been put in place to prevent frustration and ensure continued easy access to the city.

There is overlap between this and the opportunity to undertake trials. Any of the measures mentioned above could be trialled and refined, and this would help the changes to be accepted. It would also ensure value for money.

9. Benefits/Project Outcomes

Six benefits/project outcomes have been identified. These are focussed on the future state and identify what any solution must deliver.

1. Improve safety

There are safety risks within the study area, and any solution should focus on improving safety in the city, particularly for vulnerable road users and at intersections. Addressing safety concerns at Pine Hill Road/Great King Street intersection is also an important part of the scope.

The one-way or two-way network options and in tandem development of a Network Operating Framework will mean routes that are primarily for movement will be identified, and those which are primarily 'places' will be protected. This will bring safety benefits. It will ensure reliable movement on the state highway network, and traffic will be directed to corridors where the interaction with land use and other users can be safely managed.

2. Improve multi-modal access to and within central city

The business case process will involve consideration of packages of improvements that will ensure better multi-modal access to and within the central city. All options will provide for a high degree of mode shift, in line with the Partner aspirations. This will ensure a better return on investment in cycleways, walking routes and bus services, and delay the need for additional parking provision or upgrades to the road network.

3. Improve place quality and walking environment within city

Amenity and the walking environment will be improved by reducing traffic speeds and volumes on certain routes, as well as by planting and urban design upgrades which are planned through the Central City Plan.

4. Improve attractiveness of city as place to invest, live, work and play

Reducing severance, effective management of clearly identified routes for traffic and protecting areas of high place value will ensure an attractive city for investment. It will also make for a more liveable city. Coupled with the Central City Plan improvements and the focus on placemaking, these benefits are likely significant and long term.

5. Enhance connectivity between key destinations for active modes

Reducing severance in key areas such as adjacent to the hospital, between the University and the city/hospital, the waterfront, and the Warehouse Precinct, should increase safety and connectivity particularly for those using active modes.

Good hospital access and a positive interface with the city is the primary benefit of investment. The Ministry of Health identified this as an objective for the hospital rebuild. It is also important to the University of Otago, as the hospital is a teaching hospital and there will continue to be a continual flow of students and staff between the different teaching sites. This benefit also reflects the desire for an outward looking hospital that embraces the city. A positive interface with the city will bring economic benefits of passing foot traffic to surrounding areas. Improved connections to the waterfront are particularly important given that investment is planned for preparing the Steamer Basin area for mixed use development.

6. Improve environmental outcomes, moving to zero carbon by 2030

Council and the University of Otago both have adopted a goal to become net carbon zero by 2030. Council furthermore declared a climate emergency in June 2019. The organisations have taken a lead from the government which recently passed the Zero Carbon Bill to create a Zero Carbon Act. The Act commits New Zealand to net zero carbon dioxide equivalents (CO_2e), excluding biogenic methane, by 2050 or sooner. It sets a legally binding pathway to this target, with the Government setting binding five-year 'carbon budgets', with plans to meet these budgets.

Transport is an area where it would be quite straightforward to reduce carbon emissions. There are well established low energy transport modes such as buses, cycles and walking which are already a key part of the transport network, as well as others which are being introduced, including electric vehicles, hybrids, electric bikes, scooters and ridesharing.

Through this process there is the opportunity to develop a solution which ensures continued access and economic activity in the city, but at the same time maximising the use of low carbon transport modes through improvements to bus services and cycle/walking facilities and other activities that can encourage and support behaviour change. Integrating transport and land use planning can also make a significant contribution to achieving this goal.

10. Project Outcomes

The project outcomes reflect both transport and placemaking. Figure 10-1 shows how the problem statements are directly linked to one or more project outcomes. The investment objectives provide SMART measurement of the project outcomes. They are presented in draft form and require refining in the next stage. The project outcomes were used to evaluate network scenario options (refer to Part B).

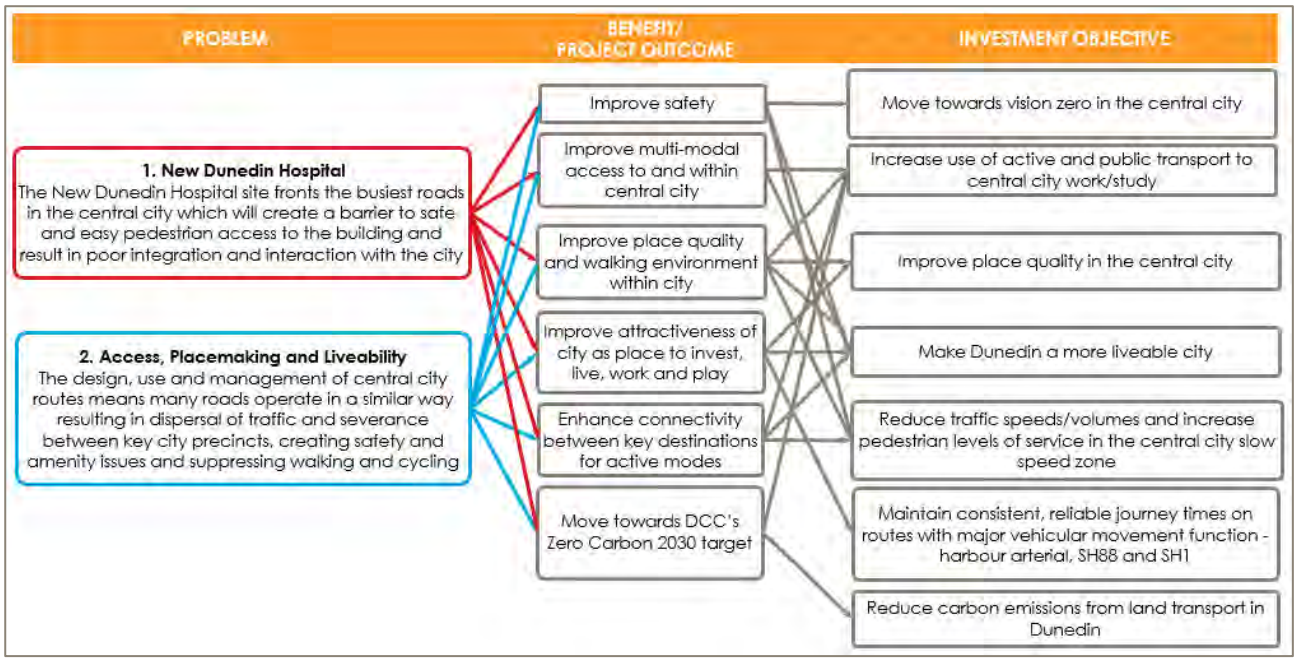


Figure 10-1: Project Outcomes

The benefits table shows key performance indicators and investment targets related to each investment benefit. The targets define the anticipated project outcomes. Gaps (TBC) will be filled in the next stage.

Table 10-1: Benefit Table

Project Outcome	KPI	Baseline	Target
Improve safety	Injury crashes at Pine Hill/Great King Street	5 (2014-18)	The target for each KPI will be confirmed in the next stage of work.
	DSIs on the one-way pair	32 (2014-18)	
Increase multi-modal access to the central city	% using active transport for work/study	14% in 2013	
	% using public transport for work/study	3% in 2013	
	Bus patronage (contracted services)	2,477,581 in 2018	
Improve place quality and walking environment in the central city	Traffic and freight volumes Cumberland Street NDH frontage	14,167 vpd and 525pd in 2018	
	PERS score Cumberland Street NDH frontage	-25 and -19 in 2019	
	Pedestrian level of service at SH1 intersections in core, midblock NDH frontage	LOS B signals LOS E midblock	
Improve attractiveness of city as place to live, work, play and invest	% change in Regional Investment Tool score	TBC	
	Journey times on key arterials peak period	TBC	

Project Outcome	KPI	Baseline	Target
Enhance connectivity between key destinations for active modes	Protected cycle network (study area)	5.5km in 2019	
	Network with 30km/h speed limit or slower (study area)	1km in 2019	
Move towards DCC's Zero Carbon 2030 target and Government's 2050 target	Estimate of carbon emissions from land transport in Dunedin, from Dunedin Community Carbon Footprint. Note draft Climate Change Commission targets – by 2030, increase walking by 25%, cycling by 95% and bus use by 120%, and overall reduction in vehicle kilometres travelled per person of 7%.	613,793 tonnes CO_2e for 2018/19	

11. Uncertainty Log

An uncertainty is an event or change in conditions that may result in a different future state from that originally anticipated or assumed. The main uncertainties associated with this project are as follows:

- Population growth assumptions used in traffic modelling – population may grow at a faster rate than anticipated which would affect the timing of interventions.
- Mode shift assumptions used in traffic modelling – an estimate of mode shift resulting from the mode shift programme has been used for modelling. However, in reality the programme may be more or less successful, and this will affect the outcomes.
- Transport modelling to date has been at a high level and needs further detailed analysis to confirm possible transport impacts.
- The scale and form of development – the university has a large investment programme and development at the waterfront is planned. However, the timing and impact of this is uncertain.
- Costs for amenity upgrades may be radically different depending on the exact form. Specifically, street upgrades involving relocating kerb lines (and the associated service relocations, pavement extensions and traffic management) could cost up to 10 times more than options retaining the current kerb lines.
- Continued economic uplift is uncertain. Dunedin may not have the population growth to support multiple new developments. The impact of this could be that existing areas decline, or new areas fail.
- The development of the NDH may be delayed due to unforeseen circumstances such as responding to budget constraints and consent delays.
- The COVID-19 pandemic will have ongoing impact of the economy, immigration and supply chains.

Part B – Developing a Recommended Programme

12. Programme Development Process

Part B outlines the process taken to develop the final partner preferred programme, which is described in Section 18. A traditional business case template is used, where the following sections (13 to 19) are in the order of how decisions were made. This PBC has taken two years to develop, so some of the information and policy described below that informed these decisions has changed.

Figure 12-1 below illustrates the overall process that was used to identify the Partner Preferred Programme.

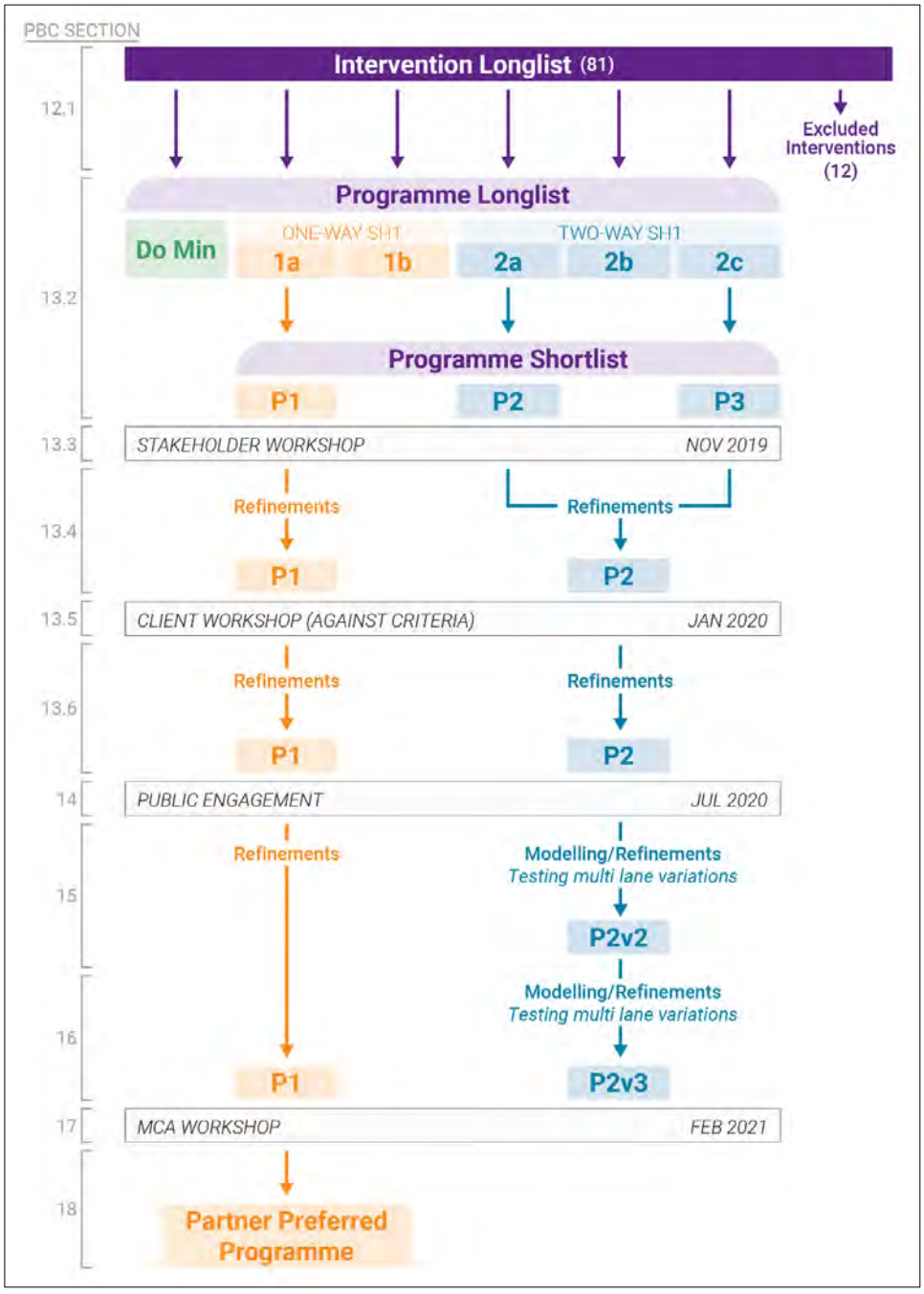


Figure 12-1 SFDT Programme Development

Within Part B of this document, Sections 13.4 to 13.6 explain the evolution of Programme 1 and 2 (the two short listed options), which were confirmed following the stakeholder workshop. These programmes went through an initial client team assessment prior to public engagement, which resulted in further refinements.

Following public engagement, there was a period of ongoing meetings and discussion with the client team, Connecting Dunedin Advisory and Steering Groups and with the Local Advisory Group for the New Dunedin Hospital. During this time Programme 2 was further refined with different multi-lane options tested through Paramics traffic modelling. This resulted in a refined Programme 1 and Programme 2v3.

A formal multi-criteria assessment (MCA) was completed for the refined Programme 1 and Programme 2v3. Further meetings and discussions with multi-party party discussions continued to enable the partners to reach agreement regarding a Partner Preferred Programme. The Partner Preferred Programme was very similar to the refined Programme 1, but with some differences primarily for the treatment of the state highway.

13. Alternatives and Options

13.1 Alternative and Option Generation

A standard long listing process was used to ensure a wide range of options were identified prior to grouping these into programmes. The DCC and Waka Kotahi both apply a 'Hierarchy of Interventions' to ensure value for money. Both hierarchies prioritise integrated land use and transport planning to reduce the need to travel by single occupant vehicle, followed by use of travel demand management to provide for non-car modes and manage traffic growth, prior to operational improvements and finally investment in new infrastructure.

Travel demand management (TDM) included: explaining the supply and availability of more sustainable alternatives, controlling demand for the use of less sustainable modes (e.g. through parking supply and pricing) and encouraging sustainable travel habits through behaviour change initiatives. Imposing full cost pricing on vehicle use was not included as it is beyond the scope of the project and would require national intervention and legislation to enact.

The long list was developed by the project team with input and review provided by a client workshop. The following alternatives were identified: SH1 configuration; TDM – Public transport, walking and cycling, parking, behaviour change; public realm; harbour arterial. Land use planning interventions were included as relevant within each of the alternatives.

The long list is provided in Appendix A.

13.2 Excluded Options

The long list was examined to understand if there were any options that should be excluded. It was desirable to only have options that were expected to make a material difference to the way people travelled to and within the central city to keep the programmes manageable and meaningful. Long listed options that would only have a minor influence were excluded.

Options for Pine Hill Road/Great King Street intersection were developed as part of a separate process, for both one way and two-way SH1 configurations. These options were presented, discussed and evaluated at a stakeholder workshop, in August 2020. Refer to Appendix B for the Pine Hill Issues and Options Report. The recommendation from this assessment was for grade-separation to be further investigated, as this would maintain access to North East Valley whilst at the same time removing the safety issue at the existing intersection. It was recommended that a lower cost intersection upgrade with traffic signals was also progressed to the SSBC stage.

Options for the S Bends, Malcolm Street and Gowland Street, were also considered separately and discussed at a stakeholder workshop in August 2020. Both one way and two-way SH1 configurations were considered. Refer to Appendix C for the S Bends Issues and Options Report.

Other options that were excluded are shown in Table 13-1, along with an explanation.

Table 13-1: Options Excluded from the Long List

Alternative	Option	Rationale of exclusion
SH1 Network Configuration	Hybrid a: South section two-way; North/Central sections one way	With the hospital as the main driver this would not give the desired outcome on Cumberland Street. Most of the place/movement conflicts are in the central section. Could be a staging option.
	Hybrid b: South and North sections two-way; Central section one way	Does not address issues at Hospital for access; legibility difficult; does not provide much additional capacity as the north and south sections are constrained.
	Hybrid c: South and Central sections two-way; North section one way	Although 2-waying South and Central sections offers significant benefits for hospital access and reduces severance around Waterfront/Warehouse, it does not provide any outcomes for reducing severance to the Tertiary Precinct and enhancing the University's wellness corridor. It could be a staging option.
	All other hybrid combinations	From early work it appears most benefits and least negative efficiency effects would be experienced in the south section. Therefore, the process built up hybrids starting from south

Alternative	Option	Rationale of exclusion
		section only and ensuring south was always included. Thus, other hybrids were excluded.
Public Realm Improvements	Close Queens Gardens between Rattray and Dowling Street and improve place	Under the two-way option Queens Gardens would be part of the two-way local road and it would not work to close this route. Not feasible for 1 way option.
Public Transport	All new buses electric	Incorporated in brand, perception and quality of bus services option.
	Water bus services e.g. for harbour communities	Ferry is around 10 times the cost of bus. There is a lot of scope to improve buses first and increase patronage on them.
	Port Chalmers commuter rail service	Not enough residents in Port Chalmers to make this viable. Train for Cruise Ships passengers will not affect commuter peak.
Parking	First half hour free for paid parking	Contradicts mode shift objective. Already have 70+ parking and disabled parking schemes to provide for those in need.
Cycling and Walking	Develop Park and Cycle sites with bike hire	Leave to commercial operator - one is looking at bike hire scheme for Dunedin which could include Park and Cycle.
	E-bike purchase	Covered under potential future Travel Management Association arrangements.
Behaviour Change	Congestion charging	Not supported politically in New Zealand at the moment. Requires national direction and legislation.

14. Programme Development and Assessment

14.1 Travel Demand Management

There were a large number of Travel Demand Management options in the long list. In order to manage this, so that programmes could be developed efficiently, each option was allocated to one of three TDM sub-programmes (refer to Appendix A). The TDM sub-programmes are described further in Appendix D, and summarised as:

Sub prog X: Do minimum – activities that were already planned and budgeted. Expected to have a minimal impact on mode shift. Included more frequent and direct bus service to Mosgiel, real-time passenger information (RTPI) via an app, new pedestrian/cycle bridge to Waterfront, slower speed on George Street, travel planning with major employers.

Sub prog a: Some improvement to existing levels of service. Expected to have some impact on mode shift. Includes do minimum activities plus better parking management with some price increases funding a modest expansion of the bus fleet, more Barnes Dances, better protected cycleway links between SH1 cycleway and harbour circuit.

Sub prog b: Significant improvement to existing levels of service. Expected to have a substantial impact on mode shift. Includes significant expansion of bus fleet, $2 flat fare, RTPI, commuter Park and Ride, bus priority, expansion of cycle network, demand-based parking pricing, migration of parking to edges of CBD, travel planning with major employers, schools and communities.

For TDM sub-programmes a and b, the public transport and parking packages complement one another so that the viability of the public transport service is not undermined, for example by cheap/free parking and for potential revenue hypothecation.

The TDM sub-programmes were applied as follows:

- Sub-programme a: added to programmes where levels of service on the road network were expected to be similar or better than current levels of service, for example by retaining the one-way system and upgrading the harbour arterial, which will accommodate some of the expected growth in travel demand resulting from population growth and increased residential development.
- Sub-programme b: added to programmes where operation of SH1 is expected to be constrained, for example if there is little or no investment in the harbour arterial, and/or if operation of SH1 changes to two-way and this results in declining levels of service. In these circumstances it is expected that more mode shift will be required to achieve the same levels of service and journey time reliability.

14.2 Programme Development

Five programmes and a Do Minimum were developed by the project team from the long list of options (Appendix E) as summarised below.

Do Min One-way system retained, do minimum TDM sub-programme, slower speeds on SH1 and targeted public realm improvements around hospital only. SH88 relocated to Frederick Street and St Andrew becomes a Slow Street.

1a As for Do minimum but with more investment in public realm improvements with targeted upgrades at the S bends, University, Queens Gardens and Crawford Street. Signage and minor improvements to the harbour arterial.

1b As for Programme 1a but with more focus on TDM to deliver sub-programme a.

2a Two-way system reintroduced, otherwise similar to Programme 1a, but with TDM sub-programme b to provide substantial mode shift, and high-quality corridor enhancements including kerb realignment as required for full length of the current SH1 northbound to provide a high-quality place and active mode spine through the city.

2b As for Programme 2a but with some intersection upgrades to improve the attractiveness of the harbour arterial. Targeted public realm improvements only.

2c Two-way system reintroduced and harbour arterial upgraded and prioritised for through traffic. TDM sub-programme a to support some mode shift. Corridor enhancements for full length of current SH1 northbound but assume kerb line remains as current. Maximum investment in harbour arterial to state highway standard.

The project and client team considered the five programmes and identified three for presentation and discussion at the stakeholder workshop. The three that were chosen were deliberately quite different from one another, to stimulate discussion and feedback. These were 1a, 2a and 2c. They were renamed Scenario 1, 2 and 3 respectively, but are effectively Programmes. They are illustrated and key features highlighted in Table 14-1.

The three scenarios refer back to scenarios that were presented to stakeholders at a workshop in November 2018, for the Draft Central Dunedin Transport Network Planning PBC.

Table 14-1: Scenarios Presented at Stakeholder Workshop

SCENARIO ONE

RETAINS ONE WAY SYSTEM - CURRENT THROUGH ROUTES REMAIN

Scenario 1



- Builds on Option B from 2018 Workshop
- Slow speeds to 40km/h for most of SH1
- Frederick Street connects SH88 and SH1
- Pedestrian focus on St Andrews Street at Hospital
- Targeted crossings at Cumberland Street opposite the hospital, at Queens Garden and S bends
- Good signage for harbour arterial
- No change to parking, cycle route stays on SH1
- More express buses from Mosgiel
- Travel Management Association (TMA)

SCENARIO TWO

TWO WAY SYSTEM WITH CASTLE STREET AS MAIN THROUGH ROUTE

Scenario 2



- Builds on Option C from 2018 Workshop
- Significant public transport improvements e.g. more frequent buses, $2 fares, real time information, Park & Ride, supported by increased parking charges for commuters
- Pedestrian/cycle spine on Cumberland Street (Oval to Gardens) with streetscape improvements and crossings around Queens Garden, hospital and University
- Pedestrian/cycle link on St Andrews Street to connect city to harbour routes and protected cycleways to southern suburbs, NEV, and tunnels route to Green Island/ Mosgiel
- Frederick Street connects SH88 and SH1
- Some improvements to harbour arterial e.g. signage, intersections

SCENARIO THREE

TWO WAY SYSTEM WITH HARBOUR ARTERIAL AS MAIN THROUGH ROUTE

Scenario 3



- Builds on Option E from 2018 Workshop
- Targeted investment in harbour arterial e.g. signage, realign at Ward Street and intersection upgrades
- Frederick Street connects SH88 and SH1
- Streetscape improvements around hospital on Cumberland and Castle Streets, plus at Rattray Street/Queens Garden and University.
- Pedestrian/cycle link on St Andrews Street to connect city to harbour routes, extend protected cycle way to south
- Limited public transport improvements e.g. lower commuter fares supported by slight increase in parking charges
- Many opportunities for future amenity improvements

14.3 Programme Assessment

A stakeholder workshop was held in November 2019 and was attended by around 40 people, representing key Dunedin stakeholders ranging from landowners, public and private transport industry representatives, social agencies, emergency services, new hospital design team members, key community groups and representative councillors and staff of DCC and ORC.



Figure 14-1: Stakeholder Workshop November 2019

As with the previous stakeholder workshop in November 2018, there were presentations from the major organisations, which laid out each organisations' general plans and projects that have transport-related aspects. The speakers included DCC's Principal Urban Designer, Port Otago Commercial Manager, New Dunedin Hospital Project Director and the University of Otago's Strategic Resource Planner.

Attendees were split into six groups and presented with the scenarios to compare and assess against the project outcomes. A traffic light scoring system was used and scores presented back to the wider group, before being combined into a single score (Table 14-2.) Programme 3 scored highest, followed by 2 and then 1.

Table 14-2: Traffic light scoring for each scenario, against the project outcomes/criteria

Project Outcomes	Improve safety	Improve multi-modal access to and within central city	Improve place quality and walking environment within city	Improve attractiveness of city as place to invest, live, work and play	Enhance connectivity between key destinations for active modes	Improve environmental outcomes, moving towards zero carbon by 2030
Programme 1 (one-way SH1)						
Programme 2 (two-way SH1, Castle Street primary)						
Programme 3 (two-way SH1, Harbour Arterial primary)						

The main comments from the table notes and broader feedback session were:

- Significant public transport investment and mode change should be included in all options.
- People saw value in an improved harbour arterial and thought this should be included in all scenarios but raised concerns with how this would impact on Frederick Street. There was also concern this did not target carbon zero reductions and seemed to support vehicle travel.
- Consensus that improving access to and from the hospital site was important, particularly with regards to pedestrian connectivity across the current State Highway.

- Debate about a one-way versus a two-way system. Some thought the one-way was safer and more efficient whilst others argued a two-way system would be safer and would be efficient with mode shift.
- Concerns that a two-way option would lead to more traffic in front of the museum/railway station.
- The one-way option scored lowest overall, but the discussion was that this should be tested further to understand the opportunity to improve amenity, reduce speeds and increase connectivity to the new hospital.
- Consensus that slower speeds within the city are appropriate, even on the state highway.
- Cycle spine welcomed by some – particularly by using routes which had lower traffic volumes (if the network becomes two way and/or with a harbour arterial).
- Some concerns with harbour arterial and proximity to waterfront development – needs careful design.
- East-West connections needed to be improved on all scenarios.
- General support for improving the urban environment and the opportunity associated with this. Some discussion on how this could include reduced speeds, pedestrian priority and high amenity places.

This feedback, and particularly the stakeholder consensus that Harbour Arterial improvements should feature in all scenarios, led subsequent project and client team discussions to conclude that the primary difference between scenarios came down to the configuration of the SH1 one-way pair, and whether this remain a one-way pair, or return to two, two-way streets; being an arterial route and a local road. This was the fundamental question that needed to be explored, with other variables, such as the level of investment in alternative modes and the harbour arterial, remaining constant.

14.3.1 Harbour Arterial (low-moderate cost)

For completeness, a separate long list was developed for the Harbour Arterial (Appendix F). Excluded options are shown in Table 14-3.

Table 14-3: Excluded Options - Harbour Arterial

Excluded	Rationale
Provide four lanes for full route by removing parking and land purchase	Cost beyond scope of Low-Moderate Investment. Some known issues and pinch points created by Heritage buildings and railway shunting yards.
Make St Andrew Street/Anzac the through route by redesigning St Andrew/Anzac intersection to give priority to through route (Thomas Burns - Anzac). Remove or reduce movements to St Andrews Street and Railway station, these could be pedestrian/cycle only. Could make a T intersection and remove signals.	This route is not considered a long-term solution due to the at-grade crossing of the railway which causes delays when trains pass through, affecting the efficiency and attractiveness of the route. Frequency of closures for rail expected to increase in the future as more rail moved by freight causing more unexpected delays to arterial route. Safety also already an issue with some vehicles queuing at the signals over the railway lines.
Construct new raised roundabout over railway line between Ward/Frederick/Anzac Avenue	Cost beyond scope of Low-Moderate Investment. Some known issues associated with significant trees on Anzac Avenue and new development (Emerson's Brewery) at intersection, which would make this hard to achieve.
Extend Strathallan Street across Portsmouth Drive and around to Kitchener Street to provide local road access and ban right turns in and out of Kitchener Street.	DCC advised there had been discussions with the businesses in the area over a number of years, and that the preferred option was for signals at Kitchener/Portsmouth Drive. The extension of Strathallan Street would require land purchase which may delay and add cost to this option.
Construct a new section of Thomas Burns Street through land adjacent to railway currently used for parking, rather than using Ward Street to reach the Ward Street bridge.	This land belongs to KiwiRail and is currently leased by DCC for car parking with a six-month notice period.

Excluded	Rationale
Realign Thomas Burns through 41 Wharf Street to allow more space for Waterfront development.	This would require land purchase and the benefits for the roading network would be minimal. The driver for this needs to be the waterfront development. The master planning may indicate this option should be explored further, but not currently a priority for this project.
Relocate KiwiRail shunting yards elsewhere, and realign Thomas Burns west to railway land	There is no obvious location in the city to relocate the shunting yards to. Previous studies considered reclaiming land in Blanket Bay for this purpose. This would require lengthy consent and land purchase processes which may be worth it to deliver a four-lane highway, but not for a low-moderate cost harbour arterial. At this stage the driver for this is more likely to be the waterfront development. The master planning may indicate this option should be explored further, but not currently a priority for this project.
Andersons Bay/Strathallan - upgrade intersection to a signalised roundabout	The location and street geometry appear too constrained and the right turn for southbound trucks too tight to provide a roundabout in this location. Land purchase would be required which would add delay and cost. The left slip for northbound trucks on to Strathallan Street also works well currently.
Add a single large signalised roundabout/gyratory system at Andersons Bay/SH1/Strathallan intersection.	This was considered in previous studies and needs undergrounding of the railway line to provide the space required. Not considered part of a low-moderate cost harbour arterial.

The proposed harbour arterial is shown in Figure 14-2.

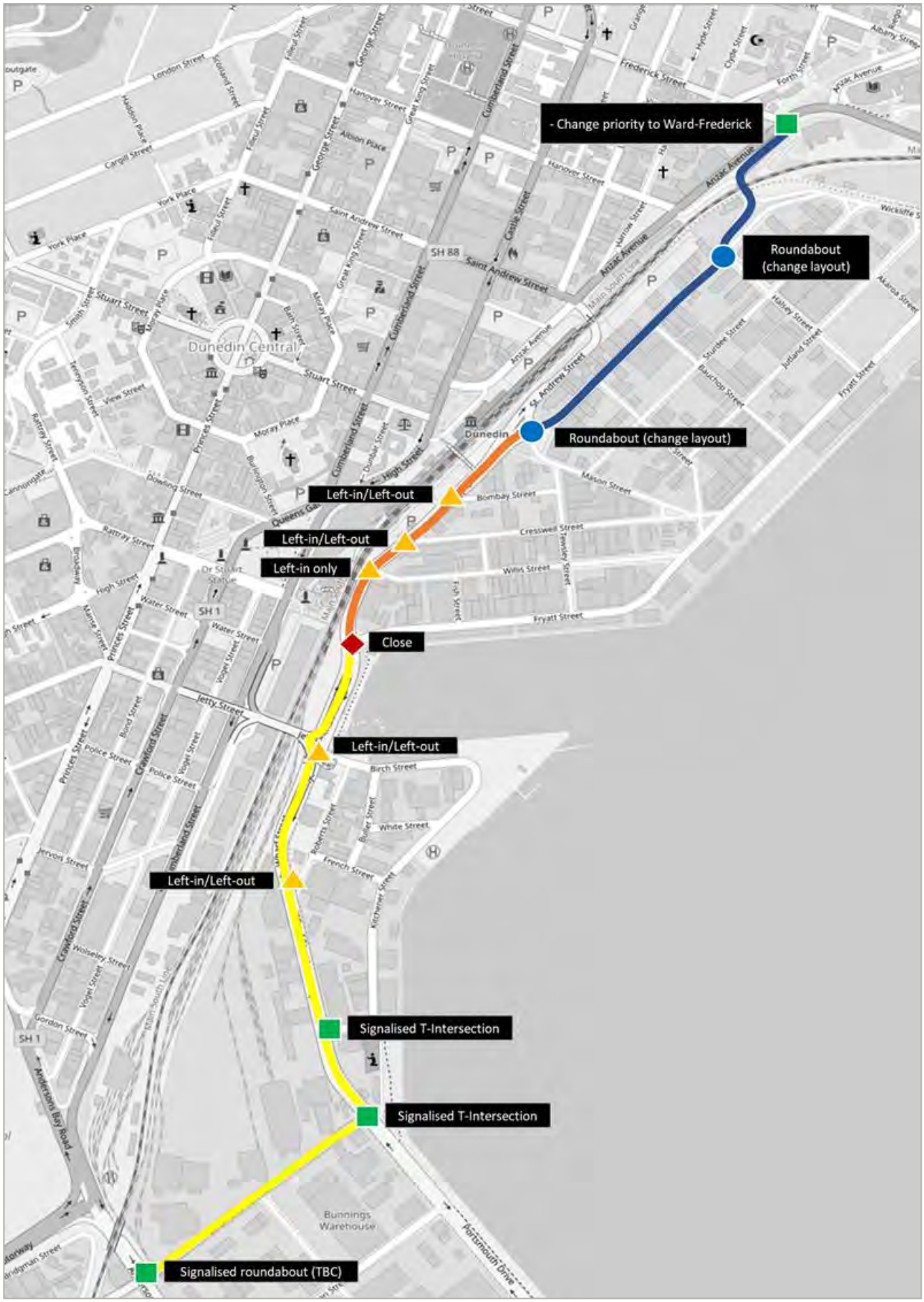


Figure 14-2: Harbour Arterial Improvements

14.4 Programme Short List for Initial Assessment

During January – March 2020, a series of workshops were held with Waka Kotahi staff, DCC staff and ORC staff to refine the two short-listed programmes and understand the improvements needed to achieve a more attractive, low-moderate cost harbour arterial route, the details of the TDM package, and how the new arterial and local road would operate with the two-way option. Discussions were also held regarding the appropriate street type for each part of the network, as per the DCC's draft Place and Movement Framework.

The two short listed programmes that emerged are shown in Figure 14-3. The DCC's Place and Movement Framework typologies are described in Table 14-4. Table 14-5 provides an overview summary of each programme element, as evaluated at the time. This information was used to develop the community engagement material. Community engagement questions and feedback focussed upon these two options described below (noting imagery and key messages were further developed).

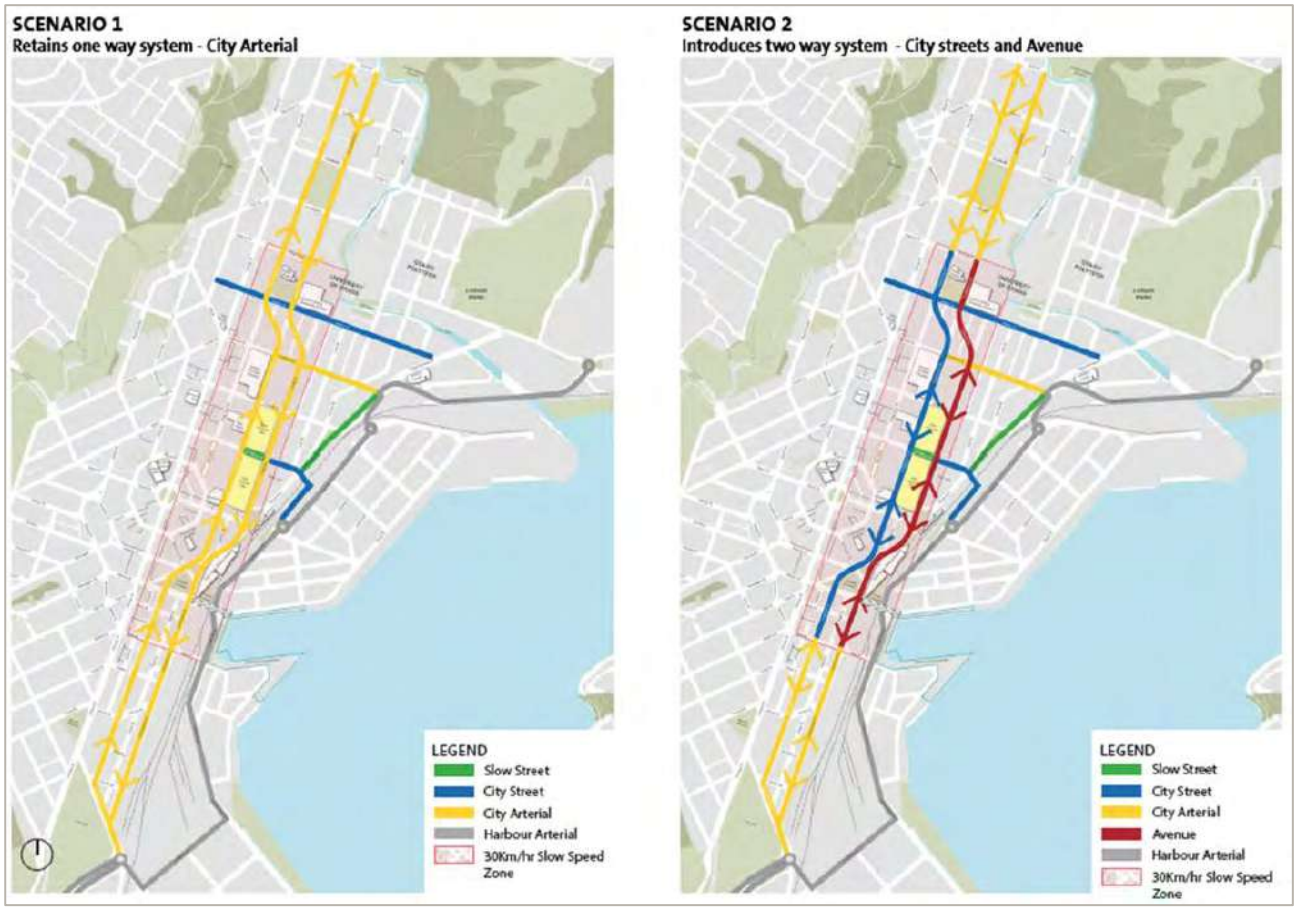


Figure 14-3: Initial short listed programmes following stakeholder workshop

Table 14-4: DCC's Place and Movement Typology Descriptions

Type	Function	Guide to features
Highway	m3p1	Priority route for private vehicles and freight. Moves large volumes of traffic on reliable bypass routes through outer central areas. Facilitate movement of light-heavy goods vehicles and promote reliable journey times for all modes of travel. Painted median providing safety benefits and space for right turn bays as required. Pedestrian crossing intermittent and grade separated or controlled. Pedestrians and cyclists provided for on shared path/separated facilities. Limited planting. Significant attractions are often nearby.
Arterial	m3p2	Reliable routes through the city with bus priority if required. Facilitate movement of light-heavy goods vehicles and provide reliable journey times for all modes of travel. Planting zones are incorporated which act as buffer zones and add amenity. Two traffic lanes are provided, which can be one-way or two-way. Protected cycle lanes are provided. Pedestrians cross via controlled crossings. Car parking provided, may be on one side only. Street trees and planting improve pedestrian experience, amenity and safety.

Type	Function	Guide to features
Avenue	m3p3	High levels of vehicle movement including pedestrian activity. Vibrant focal points providing high quality walking and social/cultural spaces. Traffic lane are two way with wide planted medians, which reduces the effect of high traffic volumes and creates a more secure and legible street. Car parking kept to a minimum. Crossing is via controlled pedestrian crossings. Street furniture and trees on both sides provide the opportunity for pedestrians to linger.
City Street	m2p2	High quality and visually stimulating public realm. Vibrant street use with lively entertainment, generous footpaths and high levels of pedestrian activity. High density of mixed use with access to shops/services provided by buses and cycleways. Car parking provided. Street trees and plantings to improve amenity and pedestrian experience.
Slow Street	m2p3	Organic movement with priority for pedestrians (all ages). Traffic calming such as street trees, footpath planters and furnishings create pedestrian scale. Vehicles, cyclists and pedestrians share the space on single surface paving (kerbs are removed). Car parking provided.

Table 14-5: Overview summary of programmes that emerged, by element

Theme	Scenario 1	Scenario 2
Overview	One-way pair as existing with through traffic able to use SH1 and harbour arterial. Slow speed zone in core. Investment in travel demand management and harbour arterial.	Two-way system with a main arterial through route (current southbound route) and a local road (current northbound route). Slow speed zone and increased place value in core. Investment in travel demand management and harbour arterial.
Main differences		
SH1	One-way pair as existing with through traffic able to use SH1 and harbour arterial. Partial green wave can be operated.	Two-way system with through traffic encouraged to use current southbound route and/or harbour arterial. Arterial route (current southbound SH1): main through route with one through lane in each direction and three approach lanes at intersections. Green wave. Local road (current northbound SH1): one through lane in each direction, two approach lanes at intersections (through and right turn lane). Rapid signal phasing giving equal priority all directions and to active modes.
Amenity / Place	Targeted plantings and build outs on hospital frontage (Cumberland Street), Queens Gardens and wellness corridor.	Arterial route: Avenue with trees on each side and planted median separation (trees) in core zone. Outer zone street type is arterial with a solid median and targeted planting. No on-street parking. Local road: City Street in core zone with planted central median and trees on both sides.
Parking	No change to on-street parking supply.	Arterial route: Parking removed except for priority spaces. Local road: Additional parking added at north and south ends, through angle parking.
Active Travel	New mid-block pedestrian signals outside hospital frontage on Cumberland Street. Protected cycleways stay on SH1 but may need to change side.	Arterial route: No cycle facilities. Pedestrian facilities as currently provided. Local road: New pedestrian signals outside hospital (both blocks), route to waterfront, and along wellness corridor. Barnes Dance crossings at all other signals. Two-way protected cycle spine from Oval to the Gardens.

Theme	Scenario 1	Scenario 2
Public Transport	Buses to/from south via Princes Street. Buses to/from north as present, via George Street.	Buses to/from south via Princes Street. Buses to/from north via local road (current northbound SH1).
Common elements		
Central network	Slow speed zone in core (30km/h).	
Freight	SH88 relocated to Frederick Street.	
Harbour Arterial	Low to moderate cost route upgrade using existing infrastructure to provide higher quality route. Intersection upgrades and side road turn bans to improve efficiency. Route to use Ward Street and Ward Street bridge with modifications, to avoid at-grade rail crossing at St Andrew Street. Comprehensive signs and with real time information to promote when SH1 congested.	
Amenity and active modes	St Andrew Street pedestrian focused between hospital sites. Pedestrian priority at signals on hospital frontage, shorter wait time for pedestrians and side street traffic, longer protected crossing time. Build outs. Improve cycle connections to SH1 Harbour Circuit by providing protected cycle facilities on Albany and St Andrew Streets. Central city bike hub, dedicated bus and scooter parking,	
Public Transport	Significant investment to provide bus priority from south to bus hub, more frequent and direct service from Mosgiel, Park and Ride at Mosgiel and Burnside, bus stop upgrades, real time information key stops, $2 flat fare, schools clusters shuttles from bus hub, free bus zone from Gardens to Oval. Note primary bus route remains on Princes Street. Express buses to use main arterial routes but no bus stops on those routes.	
Parking	Prioritise parking based on need. Price parking for 85% occupancy. New parking building on Harbour Arterial (700 space) for city centre and new hospital, and on SH1 (Police Street/Jervois Street) provide commuter parking at south end of one-way system (150 spaces). Divest some existing parking (e.g. Filleul Street and Frederick Street carparks). Parking guidance system. New revenue source to support buses.	
Education/ promotion	Travel plans with major employers to encourage mode shift. Additional support for work with schools. Travel Planning for targeted suburbs e.g. North East Valley.	
Land use planning	Continue to enact 2GP policies to support more people living in the city centre and focus new residential growth near public transport. Expand heritage grants scheme. Review minimum parking requirements	

14.5 Short-list - Initial Assessment

A workshop was held with the project and client team in January 2020. The purpose of the workshop was to gain a better understanding of the differences between the programmes and to help clarify key messages for consultation. The programmes were discussed in the context of 11 assessment criteria which were based on the Strategic Case, previous PBC and Waka Kotahi's Draft Design Assessment Tools MCA Template. Table 14-6 shows how each criteria links to the project outcomes and investment objectives.

Table 14-6: MCA - Criteria, Project Outcomes and Investment Objectives

Criteria	Project Outcome	Investment Objective
Enduring outcomes: Expected high level impacts		
1. Safety	Improve safety	Moving towards vision zero in the central city
2. Inclusive access to city	Improve multi-modal access to and within central city	Increase use of active and public transport to central city
3. Inclusive access in city	Enhance connectivity between key central city destinations for active modes	Reduce traffic speed and volumes and increase pedestrian level of service on City Streets.

Criteria	Project Outcome	Investment Objective
4. Sense of Place	Improve place quality and walking environment in central city	Improve PERS score at key locations.
5. Liveability	Improve attractiveness of city as place to invest, live, work and play	Make Dunedin a more liveable city, increasing the RIT score.
6. Reliable journey times	Improve attractiveness of city as place to invest, live, work and play	Maintain consistent reliable journey times on key arterials.
7. Zero Carbon	Improve environmental outcomes moving to zero carbon by 2030	Reduce carbon emissions from transport in the study area.
Other considerations: Additional impacts in light of RMA		
8. Noise/vibration and air quality	n/a	n/a
Project critical success factors: Practical considerations that influence successful implementation		
9. Potential affordability	n/a	n/a
10. Urgency and timing	n/a	n/a
11. Network resilience	n/a	n/a

Programmes 1 and 2 were presented and discussed at the workshop. Table 14-7 provides a high-level summary of comments.

Table 14-7: MCA comments for P1 (Programme 1) and P2 (Programme 2) (recorded at MCA workshop and confirmed by attendees).

Criteria	Comments
Inclusive access to the city	Agreed that both programmes improve from the Do Minimum, but Programme 2 is better providing mode shift occurs. It disincentivises driving and parking. Need to better understand impact of network delays on access from model.
Inclusive access within city	Programme 2 achieved this to a greater extent, but Waka Kotahi staff felt Programme 1 could be improved to provide better connectivity. It was agreed that more mid-block and Barnes Dance crossings could be provided on the state highway provided these are evidenced and the outcome is balanced with traffic disruption. Modelling should look at vehicle and pedestrian delays.
Sense of place	Concerns that there could be double counting with noise criteria. Harbour arterial will reduce traffic along SH1for both options which will be positive. Speed reductions and new landscaping will also be positive. Waka Kotahi staff indicated potential to reduce SH1 to a single lane past the hospital provided traffic volumes can be managed.
Liveability	P2 includes all the opportunities for improving liveability and increasing economic uplift, plus stimulating land use change, however some of these things are out of our control and may not eventuate.
Reliable journey times	Both harbour arterial and TDM programme will contribute to improved journey times but expect P2 will result in more variable journey times.
Safety	Parked/no consensus until experts can access. Some thought P1 better as fewer conflicting movements. Others thought P2 better as freight and cyclists/pedestrians separated on different routes.
Zero carbon	No stimulus to behaviour change for P1, still significant support for vehicle use. More radical change with P2 that could make people reconsider travel options.
Noise, vibration and air quality	Concern this is double counting the Sense of place criteria. Slower speeds may not equal less noise as there may be more starting and stopping. Depends on where most pedestrians and cyclists are e.g. around the University and in front of new hospital. P2

Criteria	Comments
	may lead to less exposure on the local road but more exposure on the arterials, noting there are fewer people here.
Potential affordability	P1 expected to cost less as no need to reconfigure network and less spend on amenity. However, P2 may be more attractive for co-investment by other partners, and there may be more economic uplift resulting in increased rate revenue.
Urgency and timing	All agree project is urgent. Criterion may not be relevant for this project. P1 requires less upfront work and planning than P2, but both are equally stageable.
Network resilience	TDM programme and harbour arterial add to resilient network. If there is a crash on the one-way pair this is very disruptive and minimal alternative routes. Two way presents more route options.

The main feedback from the workshop was that Programme 1 and 2 should be made more similar in terms of amenity and improvements for pedestrians, particularly around the hospital. This was because the quality around the NDH site was a key driver. It was agreed that it was important to compare two very similar programmes with the main differentiator being whether SH1 was two, one-way roads (both arterial routes), or two, two-way roads (an arterial route and a local road).

14.6 Final Short List for Engagement

The team used the feedback from the workshop to further refine the programmes. Ultimately the team moved away from using the DCC's Place and Movement Framework as it provided a higher level of detail and complexity than required for a Programme Business Case. Instead, arterial through routes were identified, along with routes for cyclists, pedestrians and public transport. The two short listed programmes that emerged from this process are illustrated in Figure 14-4.



Figure 14-4: Short Listed Programmes

Key features of the short-listed programmes are described in Table 14-8.

Further work was completed to develop the pedestrian packages on SH1 for each programme as detailed in Appendix G. This involved:

- Identifying and mapping the existing and future origins and destinations for pedestrians within the study area, pedestrian desire lines and the ONRC network to understand locations where severance is an issue.
- For those locations and for each short-listed scenario, identifying the existing provision and a package of pedestrian improvements that respond to the project drivers. Available pedestrian data was used to understand demands at key locations.

Table 14-8: Features of the short-listed Programmes (public engagement)

	Programme 1	Programme 2
Overview	Investment in alternative modes and harbour arterial. Retains one-way system with	Investment in alternative modes and harbour arterial. Slow speed zone and increased place value in core. Introduces two-way system, with existing southbound

	Programme 1	Programme 2
	slow speed zone and increased place value in core.	route becoming the main arterial through route, and existing northbound route becoming a local road.
Common to both programmes		
Harbour Arterial	Low to moderate cost route upgrade using existing infrastructure to provide higher quality route. Intersection upgrades and side road turn bans to improve efficiency. Route to use Ward Street and Ward Street bridge with modifications, to avoid at-grade rail crossing at St Andrew Street. Comprehensive signs and with real time information to promote best through route at busy times.	
Public Transport	Significant investment to provide: bus priority on main route from south to bus hub, more frequent and direct services from Mosgiel, Park and Ride at Mosgiel and/or Burnside, bus stop upgrades, real time information at key stops, $2 flat fare, schools clusters shuttles from bus hub, free bus zone from Gardens to Oval. Note primary bus route remains on Princes Street. Express buses to use main arterial routes but no bus stops on those routes.	
Parking	Prioritise parking based on need. Price parking for 85% occupancy. New parking building on Harbour Arterial (700 space) for city centre and new hospital, and on SH1 (Police/Jervois Street area) provide commuter parking at south end of one-way system (150 spaces). Divest some existing parking (e.g. Filleul Street and Dowling Street carparks). Parking guidance system. Central city parking for shoppers, further out for commuters/long stay. Extend paid parking area. New revenue source to support buses.	
Cycling	Improve links from SH1 to harbour circuit through separated cycle facility on Albany Street and slow speeds on St Andrew Street. Central city bus hub(s) plus bike and scooter parking.	
Pedestrians	SH88 relocated from St Andrew Street to Frederick Street. More Barnes Dances and pedestrian priority. Universal access and design as baseline. Pedestrian priority at signals on hospital frontage, shorter wait time for pedestrians and side street traffic, longer protected crossing time. Build outs. St Andrew Street pedestrian focussed between hospital sites.	
Amenity	Streetscape improvements and enhancements for pedestrians on sections of St Andrew Street and Anzac Avenue.	
Education and awareness	Travel Planning with major employers to support mode shift e.g. through free bus pass, marketing/promotion activities and initiatives. School travel planning and safe routes to school for walk/cycle, cycle skills training and cycle parking. Travel planning for targeted communities e.g. NEV	
Land use planning	Continue to enact 2GP policies to support more people living in the city centre. Focus new residential growth near good public transport. Expand heritage grants scheme. Review minimum parking requirements for central city zones.	
Differences between the two programmes		
Arterial through routes	SH1 one-way pair as existing with through traffic able to use SH1 and harbour arterial. Green wave.	SH1 becomes a two-way system with through traffic encouraged to use arterial (current southbound route) and/or harbour arterial. Arterial route (current southbound SH1): main through route with one through lane in each direction and three approach lanes at intersections. Green wave. Local road (current northbound SH1): one through lane in each direction, two approach lanes at intersections (through and right turn lane). Short signal phases giving equal priority to all directions and to active modes.
Slow speed zone	Encompasses both SH1 one-way routes between St David	Arterial route: 50km/h throughout. Local road: 30km/h between St David Street and Police Street.

	Programme 1	Programme 2
	Street and Police Street. Speed limit 30-40km/h.	
Amenity	Targeted plantings and build outs on hospital frontage (Cumberland Street), Queens Gardens and wellness corridor. Threshold treatments to signal speed changes.	Arterial route: Planted central median and buffer zone in core (St David Street to Police Street). Remainder of route has solid median and targeted plantings. Local road: Threshold treatments, build outs, indented parking and plantings in core zone.
Parking	Minimal change to on-street parking supply.	Arterial route: Parking removed except for priority spaces. Local road: Additional parking added at north and south ends, through angle parking.
Cycling	Protected cycleways stay on SH1 and are extended to the Oval.	Arterial route: No cycle facilities. Local road: Two-way protected cycle spine from Oval to the Botanic Garden.
Walking	New mid-block pedestrian signals outside hospital frontage on Cumberland Street.	Arterial route: Pedestrian facilities as currently provided. Local road: New pedestrian signals outside hospital (both blocks), route to waterfront, and along wellness corridor. Barnes Dance crossings at all other signals.
Public Transport	Buses to/from the south via Princes Street. Buses to/from the north as present, via George Street.	Buses to/from the south via Princes Street. Buses to/from the north via local road (current northbound SH1).

14.6.1 Configuration of SH1 in Short-list Programme

The configuration of SH1 in Programme 1, and the new arterial and local road in Programme 2 was investigated and the following agreed, based on input from stakeholders, DCC and Waka Kotahi staff with detailed knowledge of the network and issues, and an understanding of the outcomes sought for each programme. The information was also used to model the programmes to understand the impacts.

SH1 in Programme 1

SH1 will be 30-40km/h in the slow speed zone (St David Street - Police Street), and 50km/h for the rest of the route. The green wave will be retained except for the hospital section. There will be targeted amenity improvements for the full length, and a new off-street parking area at Crawford Street between Police and Jervois Streets (150 spaces). In front of the hospital there will pedestrian priority at signals, a shorter wait time for pedestrians and turning traffic and a longer protected crossing time. There will be build outs and new mid-block signals to the main hospital entrance. There will be no change to intersection layouts, on-street parking or to the cycle facility, although the location of the cycle facility may need to be reviewed in light of concerns around safety and legibility of the route during demolition/construction of the New Dunedin Hospital. A typical cross section for the northbound SH1 route is shown in Figure 14-5, and for the southbound SH1 route in Figure 14-6.



Figure 14-5: Typical cross section for SH1 Northbound - Central (Cumberland Street outside new hospital)



Figure 14-6: Typical cross section for SH1 Southbound - Central (Castle Street behind new hospital)

Arterial Route in Programme 2

There will be one through lane in each direction. At intersections there will be three approach lanes and one departure lane. All movements will be allowed at intersections although there is the option to restrict movements if modelling suggests this is required. The arterial will be 50km/h with a physical median and a green wave. There will be targeted amenity improvements at key locations, a planted median in the core zone, and signals at Gordon Street to provide the connection between the arterial and the local road. Most on-street parking will be removed and there will be no cycle or bus facilities, although express buses may use the route. A typical cross section for the arterial route is shown in Figure 14-7.



Figure 14-7: Typical cross section for arterial route on Castle Street (behind new hospital)

Local Road in Programme 2

There will be one through lane in each direction, with one or two approach lanes at intersections (to allow for right turns). The outer sections of the route will be as per the arterial route, but with additional parking provided at north and south ends of the route. In the core (St David to Police Street) the route will be 30km/h with no green wave. There will be rapid signal phasing giving equal priority to all directions and to pedestrians. There will be Barnes Dances at all signals and midblock pedestrian crossings outside the hospital on both blocks, and at the S bends. There will be a two-way protected cycle facility for the full length of the route, and some bus routes may use this route especially to the north. A high level of amenity will be provided. A typical cross section for the local road is shown in Figure 14-8.



Figure 14-8: Typical cross section for local road on Cumberland Street (outside new hospital)

14.7 Timing

The timing of the overall programme (either P1 or P2) is critically important to a successful outcome. A high-level staging skeleton programme was developed in April] 2020, for engagement purposes, as shown in Figure 14-9. The factors which drove the timing of different elements were:

- The indicative timeframes for opening of the hospital outpatients and inpatient buildings.
- Disruption caused by hospital works provides an opportunity to promote public transport, so public transport comes early in the programme.

- To encourage a shift to public transport, public transport improvements come before network changes, as this way they will have most impact.
- Relocating SH88 needs to be completed early to maintain access and reduce delays associated with hospital construction.
- Disruption caused by hospital works will cause delays in the centre, so the Harbour Arterial needs to be operating early to help maintain access.
- Hospital works provide the opportunity to change the local state highway network, so having the Harbour Arterial operating prior to these changes is key to maintaining access, particularly for through traffic and freight.
- Amenity and pedestrian works on Cumberland Street outside the new hospital should be complete by the time the new building opens (2024).
- To achieve behaviour change that is lasting and includes travel to the new hospital, viable alternatives (public transport, cycle routes and hubs) need to be in place before the hospital opens.
- Before parking restrictions are extended alternatives need to be in place, so this comes later in the programme.
- Providing new car parking areas and divesting some of the existing parking areas will take some time and some new car parking needs to be available at the time the first hospital block opens in 2024, to ensure access and functioning of the hospital. The MoH only have budget for parking spaces required under the 2GP (184 spaces within 250m of the new hospital, including 6 mobility spaces – spaces are likely to be primarily for staff and fleet vehicles, with a few for disabled and priority patient parking).

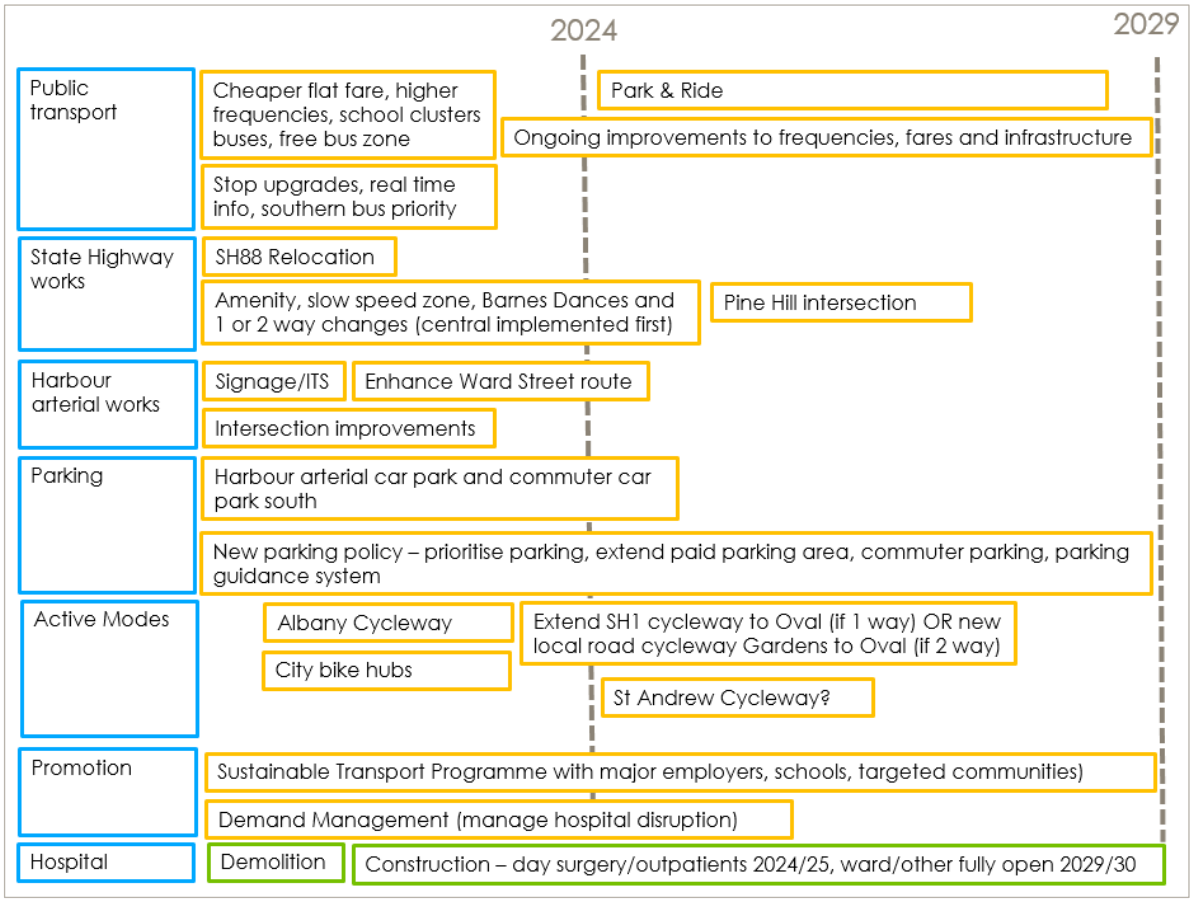


Figure 14-9: Staging Skeleton for P1 and P2

15. Engagement

15.1 Public Engagement

The Connecting Dunedin partnership completed public engagement on Programme 1 and 2 from mid-June to mid-July 2020. Engagement was online due to the COVID-19 pandemic, with social pinpoint used as a platform to host a series of detailed maps and project information. During the period there were over 22,000 visits to the website from 5,000 separate users. A survey was completed by 756 users, and 459 comments were posted on to the social pinpoint pages. A summary of the feedback is provided in Appendix H.

In general, there was strong support for investment in public transport, walking, the Harbour Arterial, and a new parking building near the hospital as well as on the CBD edges.

The majority (66%) of survey respondents supported retaining the existing one-way system due to concerns that a two-way system would increase congestion and delay. Respondents wanted to see evidence that a two lane, two-way arterial could provide for future traffic.

Another theme that emerged was a lack of comfort with the SH1 cycleway. Moving this to a local road was seen as a benefit of the two-way option, along with better walking access to key destinations such as the new hospital and the University, and placemaking opportunities.

The following key stakeholders submitted:

- University of Otago – prefer P2 because it reduces severance between the University Campus and the Health Sciences Precinct
- Public Health South – prefer P2 because the hospital will be less isolated and will have a safer frontage due to far few heavy vehicles and lower traffic volumes
- Automobile Association – prefer P1 in the absence of evidence that a two-way, two lane arterial can cope with future traffic.

A full engagement report is supplied in Appendix H.

16. Further Programme Development and Assessment

16.1 P2 - Multi-lane Variations

During and after consultation, Programme 2 continued to be developed through a number of iterations. Modelling and fatal flaws analysis were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width. The most significant difference between each programme was the configuration of SH1 through central Dunedin.

The programmes used for consultation, and the multi-lane iterations developed for Programme 2, were as follows:

Table 16-1: Multi-lane Variations for Programme 2

Programme	One way	Two way	Description
P1	√		Two, one-way arterials with two through lanes (used for consultation)
P2		√	Two lane local road and arterial with two through lanes (used for consultation)
P2v2		√	Two lane local road and arterial with four through lanes
P2v3		√	Two lane local road and arterial with following configuration: • Two through lanes north of Albany Street • Three through lanes (two southbound and one northbound) between Albany Street and Queens Gardens (in line with Burlington Street) • Four through lanes south of Queens Gardens

16.2 Fatal Flaws Analysis

Ongoing development of the two-way option identified that the corridor in the central section would not be sufficiently wide enough to allow for four traffic lanes (mid-block), a median, and a narrow shoulder that could be used for cycling if a confident cyclist were to use the arterial (P2v2).

There were also concerns that additional capacity north of Albany Street may not be required given that two thirds of the traffic is generated from the south of the city and returns south at the end of the day. Four laning of this northern section may not therefore be required, and would worsen severance effects for the University, which has its frontage on the proposed two-way arterial.

Exploration of these issues, and detailed consideration of the modelling outputs and network constraints, led to the development of the 3-lane layout through the central area of the network (P2v3). In broad terms, the key aspects of this on-going work identified:

- Southern part of the central city network from Queens Gardens south: 4-lanes can be readily provided through this area and there is significant traffic demand to/from the south of the city.
- Central area, from north of Queens Gardens to north of Albany Street: 3-lanes are possible through the mid-block sections of this area. Traffic flows, volumes, and time-of-day considerations demonstrate that the most appropriate arrangement is 2-lanes southbound and 1-lane northbound. Figure 16-1 demonstrates the lane configuration which was used in the modelling to test that there was sufficient space kerb to kerb to accommodate 3 through lanes.
- Northern part of the central city network from north of Albany Street: Desire for 2-lanes in mid-block road sections through this area of the network.

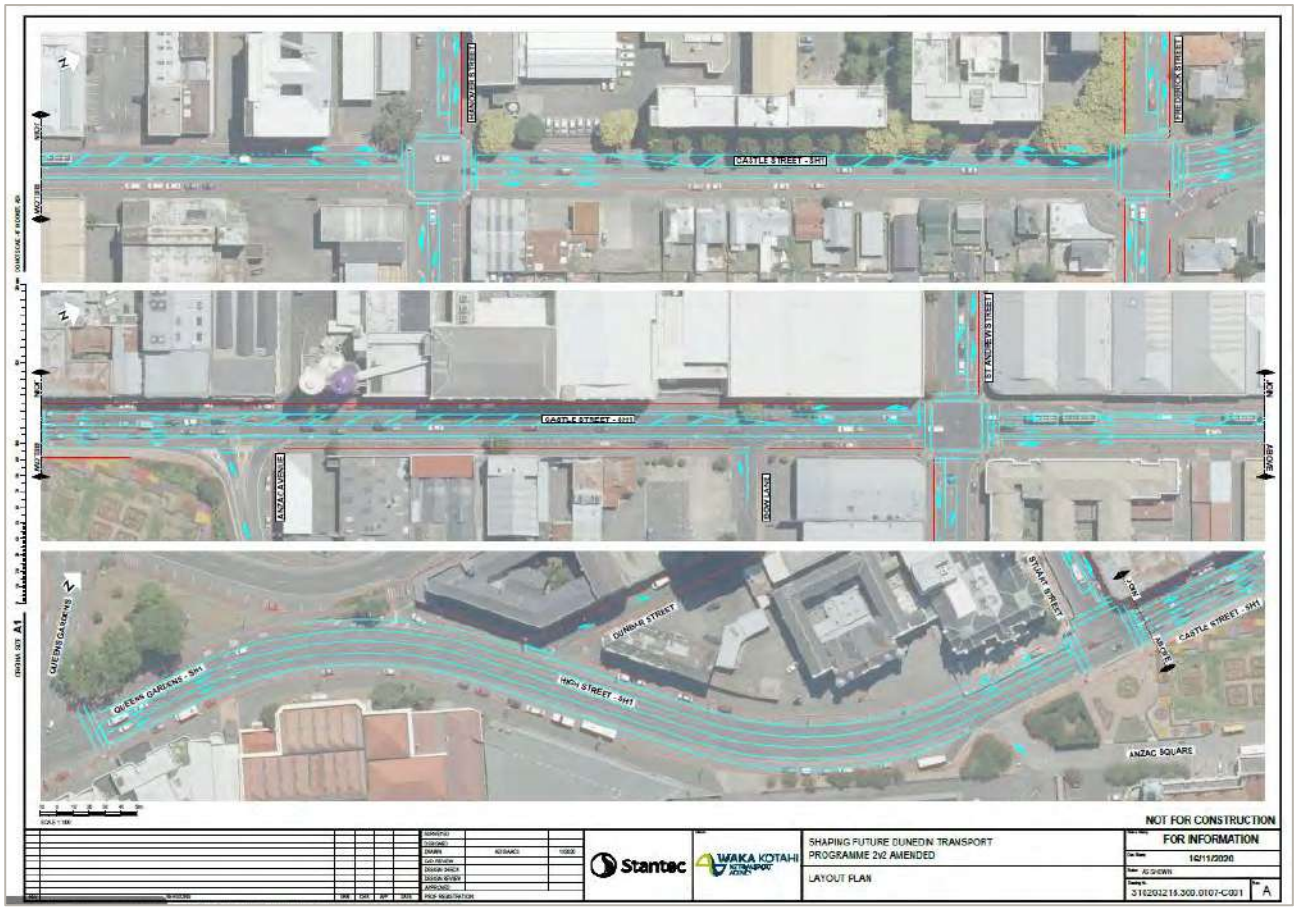


Figure 16-1: Programme 2v3 Central Section

16.3 Traffic Modelling

16.3.1 Overview

Dunedin has a two-tier transport model system. The regional citywide CUBE model estimates travel demands from land-use by mode and trip purpose. This links to the operational city centre microsimulation model which has a 2038 forecast year. The microsimulation model was developed in 2018 and was used to assess the programmes in this phase of the business case.

A series of straightforward option layout and operation refinement tests were completed on the one way and two-way scenarios. The Modelling Report is provided in Appendix I, which provides details of all tests which were completed.

The modelling was used as a guide to understand:

- Traffic volume and heavy vehicle volume changes in the key regions of the network
- Network wide travel times and distances in the central city study area
- Route travel times for sections of key routes through the network
- Intersection movement delays and overall intersection delay/Level of Service

16.3.2 Applying Travel Demand Management

The Do Minimum and SFDT options all include a Travel Demand Management (TDM) strategy aimed at reducing the level of single occupancy light vehicle trips in the area. This TDM component has been applied to the 2038 demand estimates, reducing the growth to around 2-4% in terms of total city centre trips compared to the 2017 base year demands.

16.3.3 Testing Refinements

Initially, the microsimulation model was used to test the two originally short-listed programmes. This allowed locations where there were deficiencies to be identified. A workshop was held to identify further refinements that could be tested in response to deficiencies. See Appendix I for full results of the modelling.

Programme 1 Tests

Option testing of Programme 1 (one-way) was straightforward and limited benefits were identified from alternatives. No refinements were made to that Programme.

Programme 2 Tests

The original Programme 2 provided a single through lane on the two-way arterial route (currently southbound one-way carriageway) and this demonstrated higher levels of delay and congestion. A number of layouts, operation and refinement tests were carried out to develop alternative two-way scenario options.

The following test was found to perform significantly better on the two-way arterial route:

- 4-lanes south of Queens Gardens in the southern part of the central city network to accommodate significant traffic demand to/from the south of the city.
- 3-lanes in the Central area, from north of Queens Gardens to north of Albany Street, configured as 2-lanes southbound and 1-lane northbound.
- 2-lanes mid-block in the northern part of the central city network (north of Albany Street)

These changes led to Programme 2v3 being added to the short list for testing through the MCA process.

Harbour Arterial Tests

Several tests were also carried out on potential refinements to Harbour Arterial network elements, including

- Kensington Avenue (Warehouse and PaknSave carpark access) left-in only and signalising the carpark access on Hillside Road.
- Removing the Jetty Street northern ramp to/from Wharf Street.

These tests found that left-in only at Kensington Avenue had some benefits to the traffic network operation, particularly the Anderson Bay corridor route. However, signals at the carpark access on Hillside Road were a component of the left-in only at Kensington Avenue (i.e. the two changes were modelled together).

Removing the Jetty Street ramps resulted in increased traffic flow and pressure within the key Central Business District (CBD) area. This was most notable on intersections along the State Highway corridors to the southeast and northeast of the Octagon. The ramps are retained in the SFDT option assessment.

16.3.4 Modelled Programme Descriptions

The programmes assessed in the models are described below:

Do Minimum

- Barnes Dance and Cycle-Way Signal Phasing Changes: Key intersections along the current State Highway one-way pair, George Street and Moray Place.
- Intersection Upgrades: St Andrews Street/Anzac Avenue, Cumberland Street/Howe Street signals, Stuart Street/Castle Street, Toitu Museum pedestrian crossing, Ward Street/Halsey Street roundabout.
- Public Transport: Bus Hub changes, bus route changes, schedule/service alternations, and associated intersection re-configurations around the area of the hub.
- George Street Scheme: 10kph speed limit for four blocks (Albany Street to Moray Place)
- Tertiary Precinct: 30kph speed limit on Union Street, Harbour Terrace, Clyde Street and Forth Street

Programme 1

This retains the existing State highway northbound and southbound one-way routes through the city centre, has a 40kph speed limit through central city area, and provides additional pedestrian crossings and Barnes Dance pedestrian phases at Frederick Street, Queens Gardens and Stuart Street.

Programme 2v3

Following the initial testing, the updated Programme 2v3 includes:

- Two-way local route (replacing existing northbound one-way): Local road with 30kph speed limit in central area, 2-lane approaches, simple signal phasing, short signal cycle times, and all-pedestrian Barnes Dance signal phases.
- Two-way arterial route (replacing existing southbound one-way): 50kph along whole route. 4-lanes are provided south of Queens Gardens, 3-lanes (1-lane northbound and 2-lanes southbound) are provided from north of Queens Gardens to north of Albany Street, and 2-lanes are provided north of Albany Street. The right turns are retained as there is space to provide right turn bays at these intersections and available green-time due to the revised signal phasing (removal of split-phasing).

Both programme 1 and P2v3 include the TDM strategy.

16.3.5 Changes in Traffic Distribution

For the city overall, when compared against the Do Minimum, the modelling showed traffic reductions through the centre of the city on Castle and Cumberland Streets (green shows where traffic flows are lower, red where it is higher), and increased traffic volumes around the CBD, on roads to the west and east (Table 16-2).

Table 16-2: Traffic impacts for each Programme (PM peak shown)

Programme 1 (one-way) vs Do Min	Programme 2v3 (two-way) vs Do Min
Red: more traffic than Do Min Green: less traffic than Do Min	
	
The Harbour Arterial changes result in more traffic using Strathallan Street, Thomas Burns Street, and Ward Street. The speed reductions on the one-way corridor results in reductions on these routes along with the overall trip volume reductions associated with the TDM strategy	As in Programme 1, flow differences from the Harbour Arterial changes are evident. The conversion of the northbound one-way (Crawford Street, Queens Garden North, Cumberland Street, Malcolm Street, Great King Street) to a local road reduces the flows on this route markedly. Correspondingly, traffic volumes increase on the two-way arterial route and sections of George Street, Dundas Street and Clyde Street.

16.3.6 Severance and Placemaking

Regarding severance and placemaking in specific locations, the key focus areas and streets creating severance in these areas are shown in Table 16-3. The table shows the indicative traffic volumes, which have been used as a proxy for severance, on these streets for each scenario. The morning and inter-peak volumes are similar but consistently lower than the evening peak.

Table 16-3: PM peak hour Traffic Volumes for main north-south routes (green shading indicates lowest volume)

Focus Area	Street	Do Min	P1	P2v3
University to CBD and new hospital	University frontage (Gowland Street nearest)	1,710	1,260	1,500
	Malcolm Street	1,550	1,250	600
Hospital to CBD and harbour	Cumberland Street (north of St Andrew Street)	1,670	1,470	650
	Cumberland Street (south of St Andrew Street)	1,540	1,370	600
	Castle Street (south of St Andrew Street)	1,980	1,630	1,640
Queens Gardens and Warehouse Precinct to CBD	Queens Gardens North (Queens Gardens to Dowling Street)	1,660	1,470	520
	Queens Gardens South (Dowling Street to Queens Gardens)	2,500	2,130	2,360
Waterfront to CBD (Harbour Arterial)	Thomas Burns Street	2,010	2,190	2,450

The model suggests that:

- University: Programme 1 reduces PM peak traffic on the university frontage more than Programme 2v3, but Programme 2v3 is the most effective at reducing severance on Malcolm Street (S bend by Health Sciences). Both are better than the Do Minimum in this location.
- Hospital: Programme 2v3 reduces volumes most on Cumberland Street. Both Programme 1 and P2v3 are better than the Do Minimum for reducing volumes on Castle Street.
- Queens Gardens/Warehouse Precinct: Programme 2v3 is more effective for reducing severance of Queens Gardens and the Warehouse Precinct.
- Waterfront: There is a small difference between the programmes regarding severance of the Waterfront. Traffic volumes are 10% lower for Programme 1 compared to Programme 2v3.

The improvement in severance at central locations may be offset by more traffic on local roads which may be undesirable.

16.3.7 Travel Times and Distances

A summary of modelled 2038 travel times and distances for the Do Minimum, P1 and P2v3 is provided in Table 16-4. The results show that:

- In the morning peak period Programme 2v3 has higher overall network travel times than the Programme 1 and Do Minimum scenarios.
- In the inter-peak, Programme 1 has the highest network travel times. Travel times in Programme 2v3 are around 3% higher than the Do Minimum. The average trip length is longer for Programme 2v3, compared to the Do Minimum and Programme 1.
- In the evening peak Programme 2v3 has average travel times up to 1 minute higher than the Do Minimum and Programme 1. Some trips in the network will experience a larger increase in travel time than the average and people would require a period of time to adjust to these higher travel times if Programme 2v3 was implemented in this form. Programme 1 has the shortest average trip length in the PM peak.

Table 16-4: Summary statistics from the microsimulation models

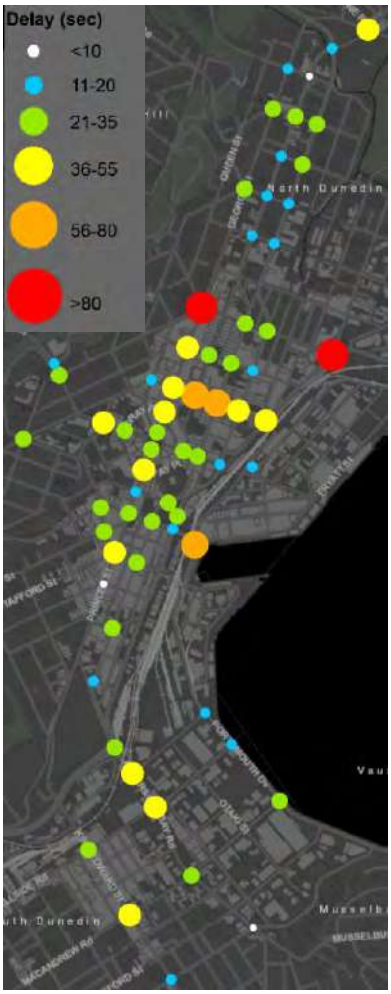
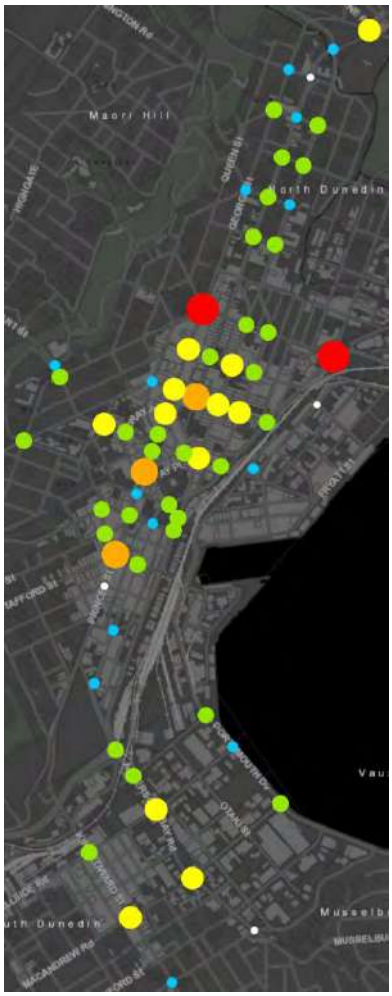
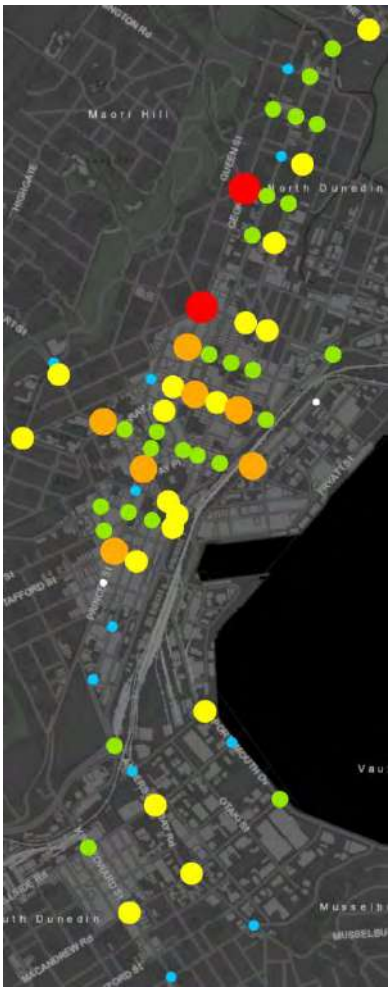
Metric	Scenario	Period		
		AM	IP	PM
Average trip length (km)	Do min	2.49	2.24	2.34
	P1 (one-way)	2.49	2.25	2.23

Metric	Scenario	Period		
		AM	IP	PM
	P2v3 (two-way)	2.47	2.33	2.33
Average trip time (mins:ss)	Do min	5:08	4:23	5:29
	P1 (one-way)	5:11	4:34	5:25
	P2v3 (two-way)	5:19	4:38	6:16

16.3.8 Congestion

Delays at intersections throughout the study area were mapped Table 16-5 for the PM peak hour.

Table 16-5: PM peak hour delays at controlled intersections

Do minimum	P1 (one-way)	P2v3 (two-way)
		
	Programme 1 has similar intersection delays to the Do Minimum.	In the PM peak period Programme 2v3 shows degraded levels of service and increased delays at several intersections, particularly on George Street, St Andrew Street and the Harbour Arterial
Total number of intersections in the study area with level of service D or worse (PM Peak)		

Do minimum		P1 (one-way)		P2v3 (two-way)	
All intersections:	20	All intersections:	18	All intersections:	28

The table shows that delays and therefore levels of service in the PM peak are comparable in the Do Minimum and Programme 1. Programme 2v3 has several intersections which degrade from LOS B/C in the Do Minimum to LOS D in this programme. The number of intersections at LOS E and F, experiencing higher delays, is similar across all programmes.

In the AM and interpeak, both Programme 1 and Programme 2v3 have similar intersection delay outcomes to the Do Minimum.

16.3.9 Journey times on key routes

The model was used to understand journey times on select north-south and east-west routes for each network scenario. The results for each peak are shown in Table 16-6, together with the difference against the Do Minimum for comparison.

Table 16-6: Travel times on sample north-south and east-west routes

Route	Time of day	Do Min (mins:ss)	P1 one-way (mins:ss)		P2v3 two-way (mins:ss)	
Northbound on SH1	Morning peak	8:45	9:56	1:11	10:02	1:17
	Interpeak	7:50	9:19	1:28	8:57	1:07
	Evening peak	9:24	10:13	0:49	11:51	2:27
Southbound on SH1	Morning peak	7:37	8:16	0:38	9:29	1:52
	Interpeak	7:18	8:16	0:58	8:59	1:41
	Evening peak	7:55	8:38	0:43	11:52	3:56
Northbound on Harbour Arterial	Morning peak	6:34	5:16	-1:18	4:10	-2:24
	Interpeak	4:06	3:40	-0:26	3:35	-0:31
	Evening peak	5:10	5:23	0:13	4:44	-0:26
Southbound on Harbour Arterial	Morning peak	4:16	4:19	0:03	4:14	-0:02
	Interpeak	3:54	3:57	0:03	3:50	-0:04
	Evening peak	4:52	4:27	-0:25	5:01	0:10
Westbound on Frederick Street	Morning peak	7:04	5:53	-1:11	8:51	1:47
	Interpeak	5:13	5:21	0:08	5:04	-0:09
	Evening peak	10:16	6:04	-4:12	7:19	-2:57
Eastbound on Frederick Street	Morning peak	7:41	8:20	0:39	6:56	-0:45
	Interpeak	6:20	7:31	1:11	5:08	-1:12
	Evening peak	9:09	9:58	0:49	7:42	-1:27
Westbound on St Andrew Street	Morning peak	6:12	5:31	-0:41	6:05	-0:07
	Interpeak	5:08	5:05	-0:02	5:10	0:02
	Evening peak	7:53	7:08	-0:45	8:47	0:55
Eastbound on St Andrew Street	Morning peak	6:32	6:16	-0:16	6:05	-0:27
	Interpeak	5:54	5:45	-0:09	5:23	-0:31
	Evening peak	12:28	8:11	-4:17	8:00	-4:28

The results suggest:

- Each programme shows a similarly low level of travel time increase along SH1 northbound and southbound (1-to-2 minutes) compared to the Do Minimum. An exception is the evening peak where Programme 2v3 shows 2-to-4min increases on SH1 northbound and southbound.
- All options also show improved travel times northbound along the harbour route of 1-to-3mins compared to the Do Minimum, except for Programme 1 in the evening peak which is slightly slower.
- There are negligible differences in travel time southbound along the harbour route in the morning and interpeak. In the evening peak, Programme 1 is slightly faster and Programme 2v3 slower than the Do Minimum.
- Westbound on Frederick Street is slightly faster with Programme 1 while Programme 2ve is a minute slower in the evening peak.
- Eastbound on Frederick Street is up to 1.5min faster with Programme 2v3 and approximately 1min slower with Programme 1.
- Westbound on St Andrew Street, Programme 1 is around a minute faster than the Do Minimum. Programme 2v3 is around a minute slower than the Do Minimum in the evening peak and equivalent in other periods.
- Eastbound on St Andrew Street is faster for both Programme 1 and Programme 2v3 and significantly faster in the evening peak than the Do Minimum.

16.4 Summary

Based on 2038 demand estimates with TDM applied, retaining a Do Minimum will lead to traffic moving through the area of the city to the northeast of the Octagon being constrained and experiencing delays, particularly in the evening peak. Eastbound and westbound traffic going in and out of the city centre is affected and delayed by the requirement to cross one of the one-way routes in order to access the other. Intersections located in the central city to the north of the Octagon are strained due to the Barnes Dance pedestrian phases added on both State Highway routes along with the cycle-way signal phasing.

Congestion is most prevalent in the weekday afternoon / evening peak. This time period is perhaps the most critical in terms of delay and congestion outcomes. Programme 1 operates similarly to the Do Minimum. Programme 2v3 shows a 14% increase in network-wide travel times and a 2-to-4min increase in travel times on key routes.

Level of service (delays) at intersections is comparable for the Do Minimum and Programme 1 but deteriorates for Programme 2v3.

Programme 1 has similar issues to existing/Do Minimum network. The addition of Barnes Dance signal phases and slower speeds limits increases delays to vehicle traffic and general network congestion. Shortening signal cycles was unsuccessful in reducing vehicle delays. Harbour arterial improvements increase traffic along Frederick Street, adding to pressure along this corridor. All programmes show that the George Street/London Street/Frederick Street intersection is a notable constraint in the network, with increased delays due to the number of approaches and movements at the intersection.

In Programme 2v3, intersections on the arterial route through the central area experience increased delays as the overall intersection volume at these locations is increased. In the evening peak, the two-way arterial is operating at capacity, resulting in traffic re-assigning onto other routes. Frederick Street/Castle Street and Hanover Street/Castle Street are key points in the network and have notable delays. Similar to Programme 1, the harbour arterial improvements result in increased traffic volumes and delays along Frederick Street.

17. Short-Listed Programmes

Through traffic modelling and fatal flaws analysis, P2v3 was identified as the preferred layout for a two-way option.

A full description of the final two programmes short listed for technical analysis, Programme 1 and Programme 2v3, is presented below. Both Programmes consist of 7 items. Only item 1, the treatment of SH1, is different; items 2-7 are common to both programmes.

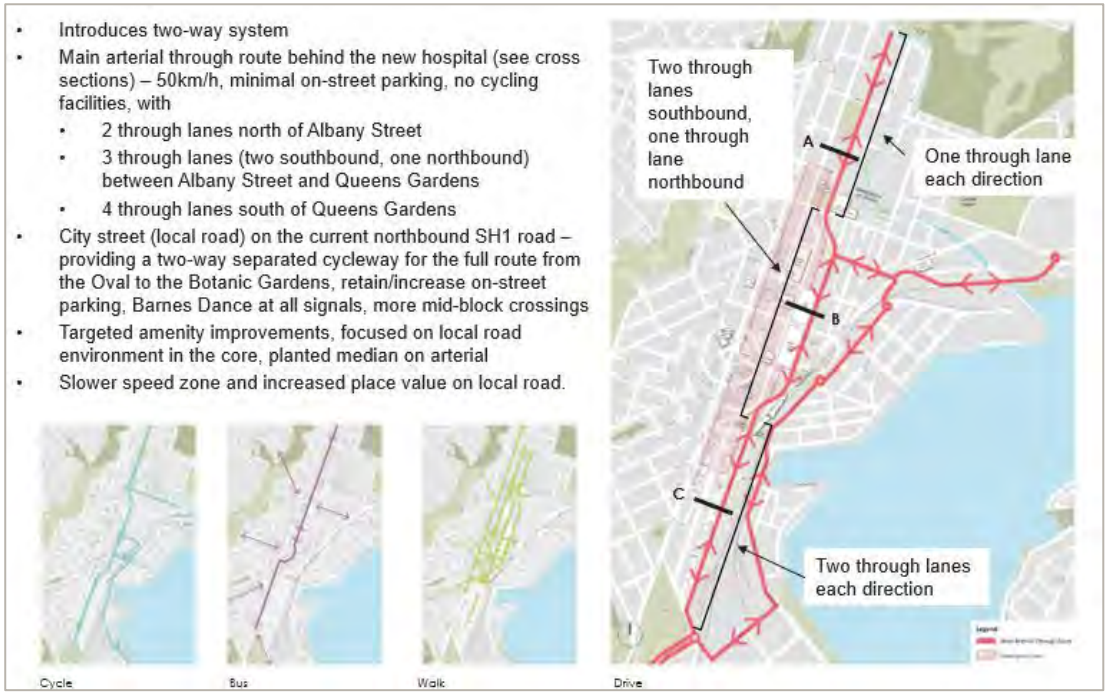
17.1 Programme 1

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: retain one way system as follows:



17.2 Programme 2v3

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: introduce two-way system as follows:



17.3 Common to Programme 1 and 2v3:

2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:

- Direction signage and real time information promoting the route
- Major and minor intersection upgrades to address known safety and efficiency issues
- Corridor improvements to reduce side friction
- Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:

- Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
- Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
- Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:

- Demand responsive pricing to which will reduce congestion caused by circulating traffic.
- Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
- Parking Wayfinding System to direct drivers to selected off street parking locations.
- Replace parking meters with more efficient parking technologies for payment and enforcement.
- Install sensors for data collection and easy analysis of information.
- Longer term – consolidate existing off-street carparking and explore potential new parking areas.

5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:

- Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
- Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:

- Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
- Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
- Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
- St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St

Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.

- Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

17.4 Cost Estimates

Cost estimates were developed for each programme[19]. An overview for each programme by workstream is provided in Table 17-1. A contingency of 30% was applied to the base estimate for local road improvements and 50% for state highway estimates, to give the expected estimate. Funding risk contingency was not included.

Table 17-1: Programme by workstream

Stream	Activities	Programme 1	Programme 2v3
Public Transport	Bus Hub Upgrade	$2.0m	
	Superstop Upgrades (5)	$5.0m	
	Fare and Frequency Review SSBC and Implementation (increased bus fleet and operating costs). Focused on attractive fares and frequency increases.	$17.0m	
	Princes Street Bus Priority and Corridor Safety Plan SSBC and Implementation	$6.6m	
State Highway 88 Revocation	SH88 SSBC	$0.5m	
	Frederick Street Upgrade	$2.5m	
	St Andrew Street Upgrade	$3.0m	
State Highway 1	SH1 SSBC	$1.1m	
	Programme 1: State Highway Upgrades	$13.2m	n/a
	Programme 2v3: New Two-Way Arterial	n/a	$15.5m
	Programme 1: Extend SH1 cycleway to Oval	$4.5m	n/a
	Programme 2v3: New Two-Way Local Road (including cycleway)	n/a	$26.0m
	Pine Hill Intersection	$3m	
Arterial Routes	Harbour Arterial Efficiency Improvements SSBC and Implementation	$15.8m	
Parking	Central City Parking Management	$9.5m	
	Mosgiel and Burnside Park and Ride SSBC and Implementation	$10.25m	
Walking and Cycling	Central City Cycle and Pedestrian Improvements SSBC and Implementation – Slow speed zone, pedestrian crossing points, Albany Street	$4.2m	
	Central City Bike Hubs	$2.5m	

[19] The SMO14 spreadsheets were not used to calculate the cost estimates as there was not enough detail known about the projects. These spreadsheets will be used in later stages, when more detail is known.

Stream	Activities	Programme 1	Programme 2v3
	Behaviour Change Programme	$1.2m	
	Project Delivery Resources	$1.6m	
Total	Rough Order Cost Estimate (rounded)	$103m	$127m

17.5 Relative Risks

The two programmes have quite different risk profiles. Programme 2v3 will be more difficult to implement and fund but will deliver transformational change in how people use the transport network. Programme 1 will be easier to implement but may not represent value for money as the opportunities for placemaking and liveability improvements are more limited. A comparison is provided in Table 17-2, which focuses on the differences in risks between the programmes, and therefore does not consider risks for the packages which are common to both programmes.

Table 17-2: Relative Risks (SH1 only)

Theme	Programme 1	Programme 2v3
Stakeholder and public views	Key stakeholders may be disappointed as there is an expectation by some key stakeholders that there will be a significant network change to a two-way system. These stakeholders recognise that opportunities for significant change to an established transport network are rare.	The wider public/community may not like the proposed changes, and this may provoke negative reactions. The one-way system has been in place for 50 years and changing to a two-way system is very significant. Many people see the one-way system as key to preserving current travel times by car in Dunedin. The changes are likely to influence how people choose to travel and may cause additional congestion. This will be controversial and cause public debate.
Practical implementation	It may be difficult to achieve reduced speed on SH1 without some of the following: signal phasing to slow traffic and prevent green wave, raised platforms, speed cameras. These methods would increase travel times and may be unpopular with some customers.	It will be challenging to implement a two-way system. It may be difficult to stage the changes, and there will need to be a significant public communication programme to ensure the change is managed safely and effectively. It may be difficult to align the network changes with key land use changes that are planned e.g. the NDH.
Delivery on project outcomes	Starts to prepare the city for mode shift by improving levels of service for alternative modes but does not have significant push factors.	People will rethink their journeys as the change reconfigures the heart of the city. Delays in the evening peak will make driving less attractive.
Delivery on project outcomes	The SH1 improvements are a significant investment that may not deliver a return against all the project outcomes (liveability, placemaking, connectivity), particularly if speeds cannot be reduced in line with expectations. Less opportunity to achieve the full benefits for mode shift, carbon zero, liveability, placemaking and safety with less significant network changes.	Two-waying requires an appetite for transformational change. It is likely to result in land use change (planned and unplanned) which may not be popular with some. There may be erosion of network performance and potential loss of future proofing for growing numbers of motor vehicles.
Staging	Hospital construction will disrupt the network and lead to delays. Introducing a two-way system now could facilitate hospital construction and reduce delays if the new two-	Significant risk around implementing the changes as it will be difficult to construct in stages, there will be more disruption and need for careful change management. Safety risk may increase for a short period as

Theme	Programme 1	Programme 2v3
	way arterial were fast tracked. There is not likely to be another such opportunity in the short-medium term	people using the road get used to the new arrangement.
Dispersal of traffic	Traffic modelling suggests there will be dispersal of traffic to other routes, for both programmes. In some cases, this may require additional traffic management works to ensure traffic moves to the intended routes. This is expected to be more significant for Programme 2v3 as the network change is greater.	

18. Programme Assessments

Because the scope of this PBC was to investigate the future transport system for central Dunedin to allow the city to achieve its liveability goals, with an emphasis on placemaking with transport as an enabler, non-traditional transport business case technical assessments were applied.

Technical assessments relating to Liveability, Place Quality and Health Impact are non-traditional. Safety, access, connectivity and mode shift assessments, and use of modelling to indicate travel time impacts and safety assessments are traditional business case assessments.

18.1 Liveability

The NZ Institute of Economic Research (NZIER) assessed the wider economic benefits of the programmes. The full report is in Appendix J. NZIER used its Regional Investment Tool (RIT) to account for the hard to quantify wider economic benefits.

Wellbeing was assessed by using the NZ Treasury 12 domains of wellbeing and working with Waka Kotahi to understand which measures were most relevant.

Liveability was assessed through application of the RIT, which defines the value of improvements in factors of the living space based on the priority that the population puts on them, ascertained from previous research studies. It captures lived experience and is realised through improvements in socioeconomic diversity, good neighbourhood design, accessibility, public transport, safety (less crime) and sense of cohesiveness.

Benefits were quantified using a multi-staged and dynamic approach involving five steps:

- Estimate the impact of each programme on local industry composition.
- Model the behavioural response to altered industry composition e.g. inward and outward migration by Dunedin residents.
- Agree the economic geography and travel pattern that is most likely to emerge as a result.
- Quantify the changes in social, cultural, economic and environmental outcomes under this future state, measuring changes in life satisfaction through a liveability metric.
- Monetise economic and liveability impacts to provide an estimate of benefits in dollar terms, adjusting for overlapping effects.

The results of the research analysis and modelling are shown in Table 18-1.

The Common Programme (section 17.3) makes a significant contribution to both wellbeing and liveability. The one-way package for the SH1 one-way pair makes a minor positive contribution to wellbeing and liveability. The two-way package makes the greatest contribution to wellbeing and liveability, exceeding that of both the Common Programme and the one-way package added together.

Table 18-1: Liveability and Wellbeing Assessment Results

	Improvement in Wellbeing of Residents	Annual benefits from improved wellbeing	Value added to liveability
Common Programme	+0.60%	$92.0m	$56.2m
SH1 – one way package	+0.13%	$19.9m	$12.0m
SH1 – two-way package	+0.90%	$138.0m	$84.5m
TOTAL Programme 1	+0.73%	$111.9m	$68.2m
TOTAL Programme 2v3	+1.50%	$230.0m	$140.7m

The most significant wider effects from the programmes will be improved accessibility and higher residential satisfaction for residents. The Common Programme leads to improvements in cultural identity, sense of belonging, households' subjective wellbeing from having a cleaner environment, improvements to physical health, improved amenities, improved residential satisfaction, improved walkability and better public transport. In comparison to the one-way package, the two-way package leads to significant improvements in households' social wellbeing from having a cleaner environment, and most other outcomes.

A peer review of the research/modelling was completed by Ernst & Young. The peer review concluded that the analysis is robust and defensible, and that WEB analysis suggests that Programme 2v3 represents the more attractive option, with wider benefits expected to be twice as large as those of Programme 1.

18.2 Place Quality

Boffa Miskell's report on Place Quality is provided in Appendix K. The assessment approach was based on the Valuing Urban Realm Toolkit (VURT) methodology. Preliminary VURT assessments were undertaken for each programme at key locations along the road network. The VURT assessments were used to establish a monetary value to the benefits to pedestrians of changes to the street environment under Programme 1 and Programme 2v3, using the Pedestrian Environment Review System (PERS). The following PERS attributes were assigned a score from +3 to -3:

- LINK ATTRIBUTES: Effective width, dropped kerbs, obstructions, permeability, legibility, lighting, personal security, user conflict, quality of environment, maintenance.
- SPACE ATTRIBUTES: Moving in the space, interpreting the space, personal safety, feeling comfortable, sense of place, opportunity of activity.

The assessment concluded that improved street attributes on the SH1 one way pair are estimated to provide benefits to pedestrians over the next 30 years of $17m for Programme 1 and $22m for Programme 2v3, both in present value terms.

The Place Report also explores opportunities for improving sense of place within three focus areas – North, Central and South. For the North and South Areas, 'ideal scenarios' have been identified, as shown in Table 18-2. Both ideal scenarios identified require the one-way SH1 network to be reconfigured to provide two, two-way routes, an arterial and a local road, as this consolidation of arterial traffic on a single route provides many development opportunities for the new local road. The 'North Area' scenario also sees the removal of the S Bends.

Table 18-2: 'Ideal Scenarios' for Developing Stronger Sense of Place

North Area – University
Ideal Scenario | Opportunity Diagram  • The Museum Reserve and its surrounds are at the heart of the Tertiary Precinct and the University of Otago campus. • Removing the 'S' bends enhances pedestrian permeability across Cumberland and Great King Street to the campus and reconnects the campus to the city (both visually and physically) • Extending green space across Albany Street (a slower street) and weaving green through neighbouring streets provides a green framework to the northern gateway of Dunedin's central city. • Development opportunities exists to the south of the reserve and library by reinstating street layout original form. • Improves pedestrian connectivity to the Leith Walk and Leith River and into the wider tertiary precinct. Green space opportunities Potential development opportunities Key vehicle movement routes One way SH network Two way SH network Slow vehicle areas Pedestrian connectivity desire lines *Figure 20. North - Ideal Scenario Diagram*
South Area – Warehouse Precinct/Queens Gardens
Ideal Scenario | Long Term Outcomes  • Queen's Garden and Exchange Square are special places with strong cultural value and pre-1840 history. • Opportunity to create a 'front lawn/plaza' experience for Toitu Museum and reconnect Queens Garden to the city (both visually and physically). • Opportunity to reinforce the grid and diagonal street pattern of Kettle's street plan. • Opportunity to close Crawford Street at Rattray Street which bisects the Queens Garden, which can reconnect open, green space close to the centre of the city. • Several iconic Dunedin landmarks are in close proximity to the Queens Garden - connecting these with safe, controlled pedestrian crossings, especially across Rattray and Cumberland Streets is an opportunity. • Burlington Street could be developed into a pedestrian only area or a shared space to allow vehicles to gain access. • Development opportunities exist to the north, south and west of the gardens notably the DCC carpark land and along Crawford Street which would be enhanced by addressing the street hierarchy differently. • Connectivity to the Warehouse Precinct and the harbour area could be made easier and more accessible by spreading the vehicle movements across the transport network and enhancing linkages back into the city. *Figure 27. South - Ideal Scenario Diagram*

18.3 Health Impact Assessment

In early 2021, a Health Impact Assessment (HIA) was completed for the Do Minimum, Programme 1 and Programme 2v3. The full report is provided in Appendix L. The purpose of the assessment was to judge the potential health effects of the two proposed programmes against the Do Minimum scenario.

The HIA set out to answer the question – whether there may be any health effects:

1. Arising from the two roading scenarios versus the Do Minimum
2. On access to health services, safety, pollution, activity (via mode shift), connectivity within the CBD, and sense of place
3. Arising from being an older person (Dunedin and/or outer centre such as Oamaru); a hospital staff member; a university student, or person with disabilities?

In depth literature reviews and engagement with stakeholder agencies formed part of the assessment, along with telephone interviews and focus groups. The focus groups were used to reach the following groups: older people (25% of population), people with disabilities (20% of population), tertiary students (22% of population) and hospital staff (4% of population if considered representative of all visitors to hospital).

The HIA applied -3 to +3 scoring system to four determinants of health, and then averaged these scores to give a score for the Do Minimum, Programme 1 and Programme 2v3, as shown in Table 18-3.

Table 18-3: Results of Health Impact Assessment

Determinant	Do Minimum	Programme 1	Programme 2v3
Access to health services	-1	0	+2
Safety	-2	+1	+2
Modes of access to/from city and connectivity within CBD	-1	+1	+2
Sense of place	-1	+1	+3
Average score	-1.25	+0.75	+2.25
No. preferring this scenario (from the 66 participants of focus groups)	0	3	63

The assessment concluded that the Do Minimum option has the potential to negatively affect health and wellbeing outcomes, whereas both Programme 1 and Programme 2v3 have the potential to improve health and wellbeing outcomes, with Programme 2v3 substantially more so than Programme 1.

18.4 Multi-Criteria Assessment

18.4.1 Criteria

Nine assessment criteria were used to assess the short-listed programmes. The criteria are shown in Table 18-4. The criteria draw on the investment objectives identified in the Part A, the latest Waka Kotahi guidance for MCAs and input from technical workshops.

Table 18-4: Assessment Criteria

Criteria	Project Outcome	Investment Objective	Assesses how well the programme
Enduring outcomes: Expected high level impacts			
1. Transport Choice	Improve multi-modal access to and within central city	Increase use of active and public transport to central city	Provides transport choice for trips to the city. Consider impact of parking changes and congestion on relative attractiveness of different modes.
2. Central City Connectivity	Enhance connectivity between key central city destinations for active modes	Reduce traffic speed and volumes and increase pedestrian level of service in and	Improves and/or provides better quality (increased choice, safer, more convenient) walking routes between key city precincts: a) Hospital, bus hub and retail precinct

Criteria	Project Outcome	Investment Objective	Assesses how well the programme
		between key city precincts	b) Retail precinct, Queens Garden, waterfront c) Wellness Corridor d) Octagon and Railway Station/Toitu.
3. Reliable journey times	Improve attractiveness of city as place to invest, live, work and play	Maintain consistent reliable journey times on key arterials.	Contributes to maintaining movement of people/goods and provides reliable journey times on key arterials – harbour arterial, SH1 and SH88.
4. Place Quality	Improve place quality and walking environment in central city	Improve PERS score at key locations.	Contributes to a sense of place and provides a quality experience for people on foot. Consider scope for creating areas where pedestrians want to linger. Key locations with severance: University, hospital frontage, Queens Gardens.
5. Safety	Improve safety	Moving towards vision zero in the central city	Has a positive impact on road safety in the study area, reduces the number of injury crashes, improves safety for vulnerable users.
6. Liveability	Improve attractiveness of city as place to invest, live, work and play	Make Dunedin a more liveable city, increasing the RIT score.	Helps to make Dunedin a more liveable city. Consider overall sense of identity, opportunities for economic uplift and maximising benefits of future investment, support for inner-city living, cultural identity, sense of belonging, wellbeing, satisfaction with living environment.
7. Zero Carbon	Improve environmental outcomes moving to zero carbon by 2030	Reduce carbon emissions from transport in the study area.	Contributes to local goal of zero carbon from transport network by 2030, and government goal by 2050. Consider low carbon transport modes – walking, cycling, e-bikes and scooters, and lower carbon modes - mopeds, motorcycles, buses.
Project critical success factors: Practical considerations that influence successful implementation			
8. Potential affordability	n/a	n/a	Provides value for money. Consider scale of capital and operating expenditure required.
9. Technical Challenge	n/a	n/a	How difficult the programme is to complete from a technical perspective – overall achievability and staging.

18.4.2 Scoring

A seven-point scoring system was used for the assessments. This is shown in Table 18-5.

Table 18-5: Seven-point scoring system

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1

Neutral	No discernible or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

18.4.3 Do Minimum

The scoring for the two short-listed programmes, Programme 1 and Programme 2v3, reflects how well each programme performs against the criteria, compared to the Do Minimum. The Do Minimum consists of the transport network as it currently exists with the addition of the following committed interventions:

- Permanent Barnes Dance at both Albany Street/SH1 intersections (a trial at the time of writing)
- George Street – 10 km/h for four blocks - Albany to Moray Place
- Tertiary – 30km/h speeds on Union Street, Harbour Terrace, Clyde Street and Forth Street.

18.4.4 Assessment Results

Technical Reports are provided for each of the assessment criteria. The assessments were completed by specialists, most of whom were independent from the project team.

Each report provides a technical assessment of the performance of Programme 1 and Programme 2v3 in relation to the criterion. The Multi Criteria Assessment Reports are provided in Appendix M and summarised below.

Table 18-6: Technical Reports Summary

Criteria	Do Minimum	P1	P2v3	Summary Explanation for Scores
Liveability	0	2	3	P1 is expected to generate $112m annual benefits to the economy through improved liveability. P2v3 is expected to generate $230m annual benefits to the economy through improved liveability. The additional benefits are a result of reinstating a two-way system, and the types of land use change that will result from that significant change.
Place	0	1	2	P1 is expected to provide benefits to people walking valued at $16m. Place improvements accrue from diversion of some traffic from SH1 to the improved Harbour Arterial, and slower speeds on SH1. Additional streetscape improvements will provide a more legible street network and some amenity improvement. However, retention of the one-way system will continue to have a negative impact on pedestrian permeability and feelings of comfort and safety, and in turn place quality. P2v3 is expected to provide benefits to people walking valued at $19.9m. Significantly larger volumes of traffic are diverted to the east side of the new hospital and the Harbour Arterial, which enables a city street quality environment on the new local road – with slower traffic, reduced volumes and new mid-block crossings adding to pedestrian permeability, and feelings of comfort and safety. The quieter street environments will encourage people to spend time in the place which assists with activation. Legibility of the street network will be significantly improved. Whilst the proposed three through lanes on the new arterial between Albany Street and Queens Garden present a reduction in pedestrian benefits and place quality when compared to Programme 1, this is outweighed by the benefit of introducing a two-way local road, which will provide a more positive impact on place quality than Programme 1.
Mode Shift	-2	2	3	P1 is expected to decrease the use of private motor vehicle for journey to work from 84% (2018 census) to 60% (2030), and as such it provides a moderate improvement over the Do Minimum, largely due to pull factors from the mode shift programme leading to more attractive walking, cycling and public transport options, combined with more effective parking management. P2v3 is expected to decrease the use of private motor vehicles by a further 10%, to 50%, and as such provides significant improvement over the Do Minimum, due to pull factors from the mode shift programme combined with increased opportunities offered by the new local road for walking, cycling and residential intensification, as well as push factors from travel time delays in the evening peak as a result of a more constrained network.
Connectivity	-2	1	2	P1 provides a slight improvement over the Do Minimum, due to slightly reduced traffic volumes on both SH1 routes and aspects common to both programmes e.g. Albany Street cycleway, Princes Street improvements, and slow speeds in central city. P2v3 provides a significant increase in active mode connectivity through the new local road with its low traffic volume, low speed, separated cycle lanes, increased number of crossing points and increased accessibility of crossing points. These factors combine to produce a road that allows strong north-south active mode connectivity and reduces east-west severance. This is seen when considering key routes e.g. University Campus to Health Sciences Precinct, Bus Hub to New Hospital and connections in the Warehouse Precinct.
Reliable Journey Times	1	1	-1	P1 achieves similar outcomes to the Do Minimum and limits the potential for larger increases in travel times, delays and congestion. P2v3 is expected to lead to a minor level of increased travel time and delay. This is likely to be most noticeable in the weekday evening peak period, when there is an overall increase in travel time of around 1 minute

Criteria	Do Minimum	P1	P2v3	Summary Explanation for Scores
				(approximately 15%) on average for all trips on the network. The key route affected would be SH1, where travel times increase by 2-4 minutes. Over time, people would adjust and adapt to this delay, and the effect would be reduced.
Safety	0	1	1	Both programmes see an improvement in safety. For P1, this is a result of slower speeds, relocation of some heavy vehicles to the Harbour Arterial, Barnes Dance operations at some intersections, and the retention of separated cycle lanes. However, the majority of traffic remains over the length of both SH1 routes, and accesses to existing destinations remain on both routes, increasing the potential for conflict. For P2, there are significant safety gains on the new local road as a result of slow speeds, reduced traffic including heavy vehicles and high-quality pedestrian and cycle facilities. On the arterial there are minor safety gains from a mid-block solid median and removal of on street parking. However, no cycle facility is provided and cyclists would need to be banned to remove risk completely. For both two-way routes there are additional conflict points at intersections, noting some are addressed through split signal phasing.
Zero Carbon	-3	2	3	In terms of achieving the DCC's Zero Carbon 2030 target, the Do Minimum would have a significantly adverse impact. P1 is expected to have a moderately positive impact, as a result of the common programme elements. Although driving may become slightly less attractive due to congestion during hospital construction, and changes to parking management overall there is no significant change to the key arterial routes in the city, and driving is still prioritised. In contrast P2v3 is expected to have a significant positive impact as it has all the benefits of the common programme elements, in combination with a restructure of the heart of the city, with the consolidation of arterial traffic on one, two-way road, allowing a new local road to be created with a walking and cycling focus. The new local road offers opportunities for successful residential densification supporting low carbon lifestyles.
Potential Affordability	0	-2	-2	The rough order cost estimates are P1: $103m and P2v3: $127m. In terms of affordability, these are of a similar order, with both being greater than any existing allocated budgets.
Technical challenge	2	1	-1	The programmes are similar in terms of technical challenge, with the main difference being the treatment of the SH1 routes. P1 can be easily staged, and the impact of temporary works on the SH1 routes is likely to be slightly adverse, however there is sufficient space to complete works whilst maintaining traffic flows. The vast majority of works are within the road reserve with little or no impact on adjacent properties, with the exception of the Harbour Arterial where minor consenting may be required for Ward Street bridge works. Stormwater, utilities, and ongoing maintenance and operations are not expected to be affected. P2v3 presents some minor technical challenges overall, particularly with regard to the transition from one-way to two-way network, whilst maintaining capacity. There will be an impact on property access which will introduce engagement/approvals risk. The two-way operation of the new arterial route will require traffic movements to utilise existing parking lanes. The integrity of these lanes to accommodate this traffic is uncertain and pavement rehabilitation is likely to be required. Using the parking lanes may also result in conflict with existing utilities. These risks are common practice within the industry and easily managed within normal design and construction processes. The change to two way will result in a change in ownership, with the local road being transferred to DCC.
TOTAL	-4	9	10	Overall, P2v3 scores marginally higher than P1 because it makes a greater contribution to Liveability, Place, Mode Shift, Connectivity and Zero Carbon than P1, whilst scoring the same as P1 for affordability and safety. It does not score as

Criteria	Do Minimum	P1	P2v3	Summary Explanation for Scores
				well as P1 for technical challenge and reliable journey times, as reinstating the two-way system has some risk and challenge and is expected to create increased delays across the network, particularly during the evening peak. The technical assessment demonstrates that the Do Minimum is not desirable. It would have negative outcomes for Mode Shift, Connectivity and Zero Carbon, and neutral outcomes for Liveability, Place and Safety.
Rank	3	2	1	

18.4.5 Sensitivity Testing

Ten weighting systems were developed by the project team, as shown in Table 18-7. The weighting systems were developed to provide a number of different lenses through which the outcomes could be viewed.

The different weightings systems have been given titles to capture the essence of each system. For example, 'Traditional Transport' puts higher weightings on aspects that have been long considered important for the transport system, but less weighting on wider city benefits.

Table 18-7: Weighting Systems

	Liveability	Place	Mode Shift	Connectivity	Reliable Journey Times	Safety	Zero Carbon	Potential Affordability	Technical challenge
Equal weighting	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Project Outcomes Equal	12.9	12.9	12.9	12.9	12.9	12.9	12.9	0.0	0.0
Traditional Transport	0.0	0.0	10.0	10.0	20.0	20.0	0.0	15.0	15.0
Traditional Mixed	5.0	5.0	10.0	10.0	20.0	20.0	10.0	5.0	5.0
Waka Kotahi Benefits Framework	18.7	11.3	5.6	5.6	11.3	15.0	22.5	0.0	0.0
Wider Central City Benefits	20.0	20.0	5.0	20.0	5.0	5.0	5.0	5.0	5.0
Zero Carbon	20.0	10.0	20.0	10.0	5.0	0.0	25.0	0.0	0.0
People Driving	0.0	0.0	10.0	0.0	40.0	40.0	0.0	0.0	0.0
People Taking Bus	5.0	15.0	20.0	15.0	20.0	15.0	0.0	0.0	0.0
People Walking or Cycling	10.0	20.0	20.0	20.0	0.0	20.0	0.0	0.0	0.0

The weighting system that reflects the Waka Kotahi Benefits Framework was developed by:

1. Identifying the overarching benefits that were relevant to the project. Four of the five were relevant, and 25% was assigned to each. For example, 25% was assigned to 'Healthy and Safe People'.
2. Considering the 3 or 4 KPIs under each benefit and identifying those that were relevant to the project and assigning an equal split of the 25% to those sub-benefits. For example, all 3 KPIs for Healthy and Safe People were relevant, so 8.3% was assigned to each.
3. Identifying which Shaping Future Dunedin Transport criteria capture those benefits and assigning the percentage available to the relevant criteria. For example, User Safety and Perceptions of Safety are captured under the 'Safety' criteria, whereas 'Health' is captured under the Liveability criteria.
4. Scaling the results to match the other weighting systems.

A matrix that illustrates the assignment of weightings using this method is shown in Table 18-8.

Table 18-8: Matrix illustrating how Waka Kotahi Benefits Framework benefits are captured within the MCA criteria

Waka Kotahi - Benefits Framework Relevant benefits only, with weightings split equally across each subset of benefits.	Available Weighting	Liveability	Place	Mode Shift	Connectivity	Journey times	Safety	Carbon	Total
Healthy and Safe People (25%)									
User Safety	8.3%						8.3		
Perceptions of Safety	8.3%						8.3		
Human Health	8.3%	8.3							

Waka Kotahi - Benefits Framework Relevant benefits only, with weightings split equally across each subset of benefits.	Available Weighting	Liveability	Place	Mode Shift	Connectivity	Journey times	Safety	Carbon	Total
Economic Prosperity (25%)									
Transport Costs (reliability, productivity)	12.5%					12.5			
Wider Economic impact (productivity, regional economic development)	12.5%	12.5							
Environmental Sustainability (25%)									
Greenhouse Gas Emissions	25%							25.0	
Access (25%)									
Mode Choice/Cohesion	12.5%			6.3	6.3				
Liveability/Townscape	12.5%		12.5						
WEIGHTING (sum of %s)		20.8	12.5	6.3	6.3	12.5	16.7	25.0	100.0
Proportional Weighting for Sensitivity Tests		18.7	11.3	5.6	5.6	11.3	15.0	22.5	90.0

The results of the sensitivity tests are shown in Table 18-9.

Table 18-9: Sensitivity Testing

Weighting System	Programme 1	Programme 2v3	Preferred
Equal	90	100	P2v3
Project Outcomes Equal	129	167	P2v3
Traditional Transport	55	5	P1
Traditional Mixed	100	90	P1
Waka Kotahi Benefits Framework	137	178	P2v3
Wider Central City Benefits	105	155	P2v3
Zero Carbon	105	155	P2v3
Outcomes Only - People Driving	55	5	P1
Outcomes Only - People Taking Bus	105	155	P2v3
Outcomes Only - People Walking or Cycling	129	167	P2v3

The sensitivity testing demonstrates that:

- P1 provides a more traditional transport improvement where facilities for people walking, cycling and taking the bus, in addition to amenity uplift, are balanced against a priority for safety and journey travel times.
- P2v3 provides wider benefits than would normally be included in a traditional transport project, with an uplift in liveability, placemaking, connectivity, faster progress towards carbon zero and an improved outcome for people walking, cycling and taking the bus. There is some detriment to traffic due to increased delays and travel times across the network.

18.5 Assessment Summary

The assessments demonstrate that both P1 and P2v3 are better than the Do Minimum. This shows the importance of investment in the projects common to both programmes (the Common Programme).

P2v3 scored best against the project outcomes. Overall, it is expected to make a significantly greater contribution to the Investment Objectives. It leads to transformational change, by reconfiguring the heart of the city by consolidating arterial traffic on one, two-way route, which can be designed taking a corridor approach to maximise safety benefits. This frees up what is currently the northbound SH1 route, allowing it to become a local road with high place value, low traffic volumes and speeds, a walking and cycling focus, and opportunities for higher density mixed use and residential development. This unlocks the central city from the current limitations imposed by the SH1 road network, creating a more connected, liveable city with higher place quality, which would be more likely to stimulate travel behaviour and land use change, resulting in user carbon reductions. However, journey times are slower in the evening peak as the network is more constrained, and there is more technical challenge and more risk.

P1 provides improved travel times and reduced delays across the network. It also maximises the use of the current network configuration and therefore presents less technical challenge than 2v3 and is therefore lower risk. It offers strong benefits across mode shift and liveability and moderate contributions to the other Investment Objectives, with some improvements likely in connectivity, place quality and user carbon reductions. It is a more moderate investment approach which is easier to achieve, due to its reduced technical complexity and cost, whilst still delivering many of the outcomes desired of the project.

The relative 'closeness' in scoring of the options when not weighted (9 vs 10) demonstrates the similarities in the programmes. When weightings are applied the scoring of each option relative to the other is shown to fluctuate depending on how the weightings are applied (sensitivity testing). This is to be expected given how similar each of the programmes scores when not weighted and aligns with the differing views heard from stakeholders and the public.

18.6 Economic Evaluation

18.6.1 Introduction

The economic evaluation is focused on the monetised element of the analysis as defined in Waka Kotahi's *Monetised Benefits and Costs Manual* (MBCM) requirements.

The analysis is a full procedures economic evaluation performed in accordance with Waka Kotahi's MBCM (February 2021), using 4% discount rate and a 40-year analysis period.

The analysis adopts benefits from travel time costs, vehicle operating costs, vehicle emissions, pedestrian and cyclist benefits and crash savings for the two programmes under consideration. The analysis considers the proposed programmes as a package for both the northbound and southbound one-way corridors plus the Harbour Arterial corridor including all intersection and mid-block improvements, although several elements could be considered (from an economic viewpoint) as stand-alone projects.

18.6.2 Travel Time and Vehicle Operating Benefits

Travel time is the key benefit contributor derived from the results of a Paramics network model. The City Centre microsimulation mode has been applied to testing the SFDT programmes. The vehicle operating cost (VOC) benefits applied are based on the travel distance outputs from the Paramics model and reported together with the travel time savings for each of the programmes.

Full details of this testing and operations results are provided in the Stantec Report '*Microsimulation Modelling Option Testing Results, Prepared for Shaping Future Dunedin Transport, 09/06/2020'* together with subsequent reports. Further updates were made with the testing of Programme 2v3, with these results incorporated into the latest version of the economic evaluation.

18.6.3 Reported Crash History

The crash history for the SH1 study area is detailed above in section 7.1.5. An additional assessment was completed for the Harbour Arterial which found that this route had six serious injury, 14 minor injury and 39 non-injury crashes in the five- year period between 2015 and 2019. There were a variety of crash movements with 39 crashes occurring at intersections and 11 rear end movement crashes along the route. There were 2 crashes involving a pedestrian and 6 involving a cyclist. Note that this crash data excludes the SH1/Andersons Bay Road intersection.

The DSi (death and serious injuries) equivalents were calculated for the Do Minimum and both programmes. These are summarised in the following table.

Table 18-10: DSI Equivalent Summary

Programme	DSi Equivalents
Do Minimum	12.18
Programme 1	3.76
Programme 2v3	4.95

Programme 1 provides the highest reduction in DSi equivalent when compared to the Do Minimum.

18.6.4 Wider Economic Benefits

The Wider Economic Benefits (WEBs) have been assessed with the following evaluations undertaken:

- VURT Benefits provided by Boffa Miskell Ltd based on the Valuing Urban Realm Toolkit (VURT) methodology. Refer to their report dated 27 May 2020 for further detail. These benefits were updated for the MCA3 in early 2021 and these latest values used in this updated evaluation.
- Liveability benefits were calculated by NZIER, with the improved Wellbeing benefits used for each Programme. Refer to the NZIER report dated 15 June 2020 for further detail.

Table 18-11: Summary of the WEBs Benefits

Programme	Shaping Future Dunedin Transport Application	Programme 1	Programme 2v3
Benefit		Undiscounted Value	Undiscounted Value
VURT	Whole Corridor	$16,000,000	$19,900,000
Improved Wellbeing Benefits (Total)	Whole Corridor	$111,900,000	$230,000,000
Total WEBS	All	$127,900,000	$249,900,000

The assumptions for these WEBs are as follows:

- Liveability is a component of wellbeing and taken into account in the Wellbeing approach. If these were added together then this would lead to double counting.
- The annual benefit is not additive as per the notes from the NZIER report therefore the WEBs have been discounted at the year in which the benefits are first realised.

18.6.5 Cost Estimates

Cost estimates have been provided as Expected Estimates including contingencies. These costs were tested in the evaluation as a sensitivity test together with testing the BCRs with and without the Wider Economic Benefits.

The cost estimates are as follows:

Programme 1 $103,238,000

Programme 2v3 $127,038,000

Note no costs have been included as part of the Do Minimum together with any annual and periodic maintenance costs.

The assumptions used in the economic evaluation are given in Table 18-12.

Table 18-12: Economic Evaluation Assumptions Summary

Economic Evaluation Assumptions	
Earliest implementation start date	2023
Expected duration of implementation	3 years
Date of first year of benefits realised	2026
Time zero	1 July 2021

Economic Evaluation Assumptions	
Base date for costs and benefits	1 July 2020

Table 18-13 summarises the Benefit Cost Ratio (BCR) ranges for each programme with and without the WEBs. The full evaluation worksheets are provided in Appendix N.

Table 18-13: Benefit Cost Ratios for 40 Year Analysis Period and 4% Discount Rate

Programme	Including WEBS	Excluding WEBs
Programme 1	3.2	2.0
Programme 2v3	2.7	0.7

The best performing programme economically is Programme 1 with a BCR range of 2.0 to 3.2 for the 40-year analysis. WEBs provide the most significant benefits for all programmes followed by crash costs, then travel time and vehicle operating costs.

Programme 2v3 has travel time and vehicle operating cost disbenefits, while the potential for safety benefits is reduced due to the proposed function of the arterial road. Essentially the positive benefits gained from the improvements to the city street corridor with slower speeds and better amenity for vulnerable road users are negated by the proposed cross section for the arterial road. The WEBs are a significant proportion of the benefits for Programme 2v3 and when these are removed, the overall BCR reduces.

A summary of the Present Value (i.e. discounted) benefits and costs are provided in Table 18-14 for reference together with a graphical representation of the benefits in Figure 18-1.

Table 18-14: Present Value Benefits and Costs for 40 Year Analysis Period and 4% Discount Rate

Programme	Travel Time and VOC	Vehicle Emissions	WEBs	Crash Costs	Walking and Cycling Benefits	Total Benefits	Discounted Cost ($m)
Programme 1	$38,009,645	$3,099,805	$109,329,456	$95,022,391	$36,089,142	$281,550,438	88,207,796
Programme 2v3	-$46,353,874	$3,074,909	$213,615,567	$79,061,427	$38,673,139	$288,071,169	108,542,805

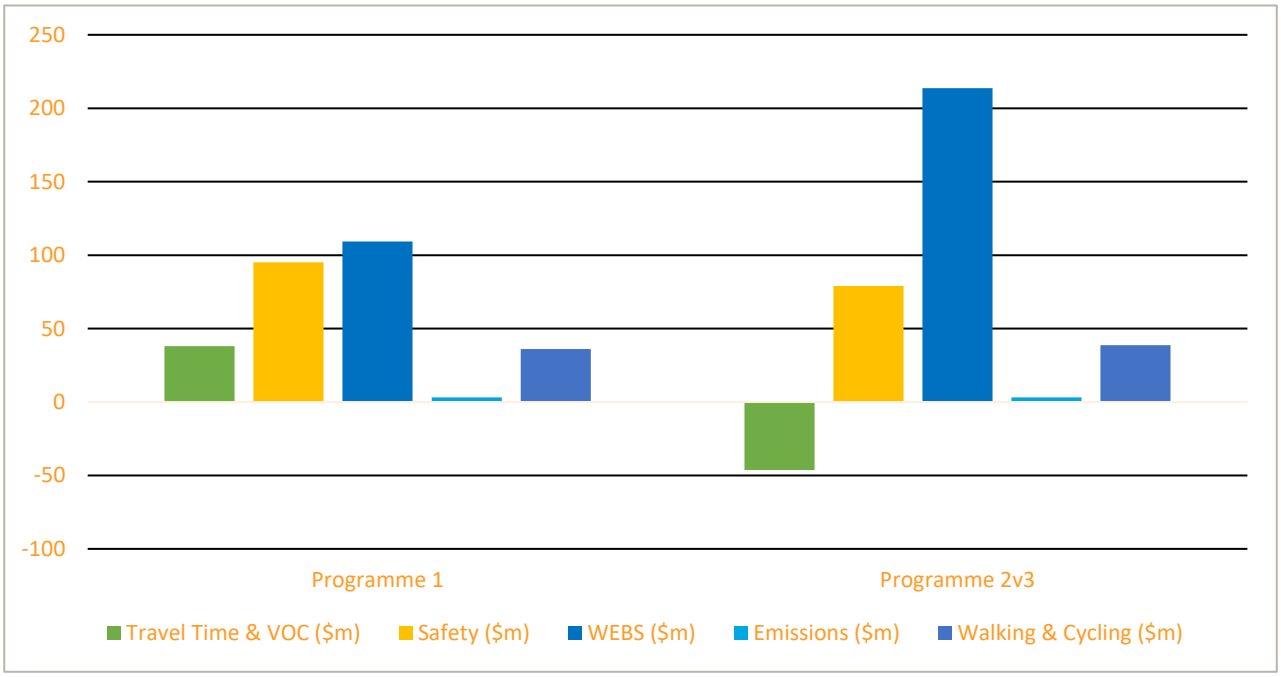


Figure 18-1: Summary of Programme Economic Benefits for 40-year Analysis Period and 4% Discount Rate

19. Partner Preferred Programme

The assessment of P1 and P2v3 demonstrates how closely each of the programmes score against the agreed assessment criteria. When weightings are applied to these criteria the gap between the options increases. However, during sensitivity assessments this resulted in the highest score alternating between each of the programmes depending on what criteria was valued most. From this it is possible to conclude two things:

3. Both programmes deliver significant benefits and achieve many of the outcomes sought
4. The relatively close scoring of the programmes in comparison to one another has made it difficult for stakeholders to accept that either one of the programmes is preferable to the other.

With respect to point 2 above, this also resonates with the feedback heard from the general public. Whilst there was strong support for amenity enhancements, walking and cycling upgrades and public transport improvements from some of the submitters, there were many who favoured improvements to travel time and network operation.

Although P2v3 was scored higher by the technical team when weighted to the project outcomes sought, this is shown to come with additional risk, complexity and cost. Ultimately, the close scoring of the options combined with the public and stakeholder sentiment means it is not appropriate to progress this option at this time.

However, the work completed to date clearly demonstrates that the common elements of both P1 and P2v 3 deliver significant benefits and will go a considerable way to achieving the outcomes sought of this project. As a result, the project team has reconsidered the feedback received and reassessed the programme options to determine a preferred programme and way forward.

Having the benefits of the stakeholder and public feedback alongside the technical assessments, the project team remoulded the programmes to achieve as many of the benefits sought whilst balancing the investment against traffic impacts, risk and cost. This resulted in an amended P1 programme being developed which retained the Common Programme, representing significant investment in improving access and providing travel choices, alongside focussed interventions on SH1 to reduce heavy vehicle movements in the central core, implement safe and appropriate speed and provide safer crossings for pedestrians and cyclists. The Partner Preferred Programme also includes a specific focus on managing disruption during the hospital build.

Changes to the one-way system in the short-medium term will be provided by the Waka Kotahi Road to Zero Programme, and a business case will be completed in 2024-27 to determine any further improvements to hospital access for all modes, and amenity improvements in the blocks around the NDH. This could include further evolution of the transport system through the central city area.

As the short-medium term programme is implemented, the Connecting Dunedin partners will take an active approach to ongoing transport system improvements. In the longer term, further changes to the one-way system are possible. Potential trigger points for further investigations are:

- Outcome focussed reviews. For example, if mode shift targets are not met through the Partner Preferred Programme, alternative solutions could be explored. These may be further up the intervention hierarchy.
- Changes in Government direction such as a new Government Policy Statement on Land Transport or legislation changes.
- Discussions or actions aligned with the DCC strategic refresh including the Spatial Plan or 2GP, which trigger land use change.
- Safety trends.
- Effectiveness and satisfaction with pedestrian levels of service, particularly east-west movements.

Future investigations can also explore transport system options which have not been considered to date.

19.1 Amended Work Package: Short-Medium Term Changes to SH1

The amended P1 programme replaces the SH1 improvements to pedestrian connectivity, safety and amenity with an amended work package 'Short-Medium Term Changes to SH1'. This work package focuses on improving safety on the entire SH1 one way system and improving pedestrian connectivity and amenity on the NDH blocks only, and access to the new hospital. Whilst the committed programme of works focusses amenity upgrades on the NDH blocks only, this does not preclude further amenity

improvements as part of any future targeted interventions from the subsequent business case work proposed.

It is anticipated that the work that will be completed for SH1 in the period 2021-24 will include:

- Waka Kotahi, NDH team, DCC and ORC work together to develop a traffic management strategy for the construction of the new hospital.
- Engage with the community on speed management for SH1 through central Dunedin, with a view to lowering the speed limit to 40km/h
- Advance safety interventions through the Road to Zero Programme. Potential sites include the SH1 southbound and northbound intersections with Hanover Street and St Andrew Street, to provide safe pedestrian access to the new hospital, and safety improvements at the Pine Hill Intersection.
- A Single Stage Business Case (lite) may be required to develop any cycle connection on the highway(s) between Queens Gardens and the Oval, if required.

Following completion of this work, the following projects are anticipated for SH1:

- 2024-27 period: Develop a business case to determine any further improvements to hospital access for all modes, and amenity improvements in the blocks around the NDH. This could include further evolution of the transport system through the central city area.
- 2027-30 period: Project considering further safety interventions as part of the Road to Zero programme for the Dunedin urban (Central and Ravensbourne) area of SH1 and SH88.

Close liaison will be required with DCC regarding parking and the MoH NDH team regarding the required layout outside the new hospital.

19.2 Programme Overview

An overview of the Partner Preferred Programme is provided in Figure 19-1. The high-level cost estimate for Programme 1 is $103m, and the BCR is 3.2, including wider economic benefits. The Partner Preferred Programme is very similar to Programme 1, but with a different approach taken to SH1. The cost estimates and BCR have not been recalculated to account for this change, as the change is not expected to be significant.

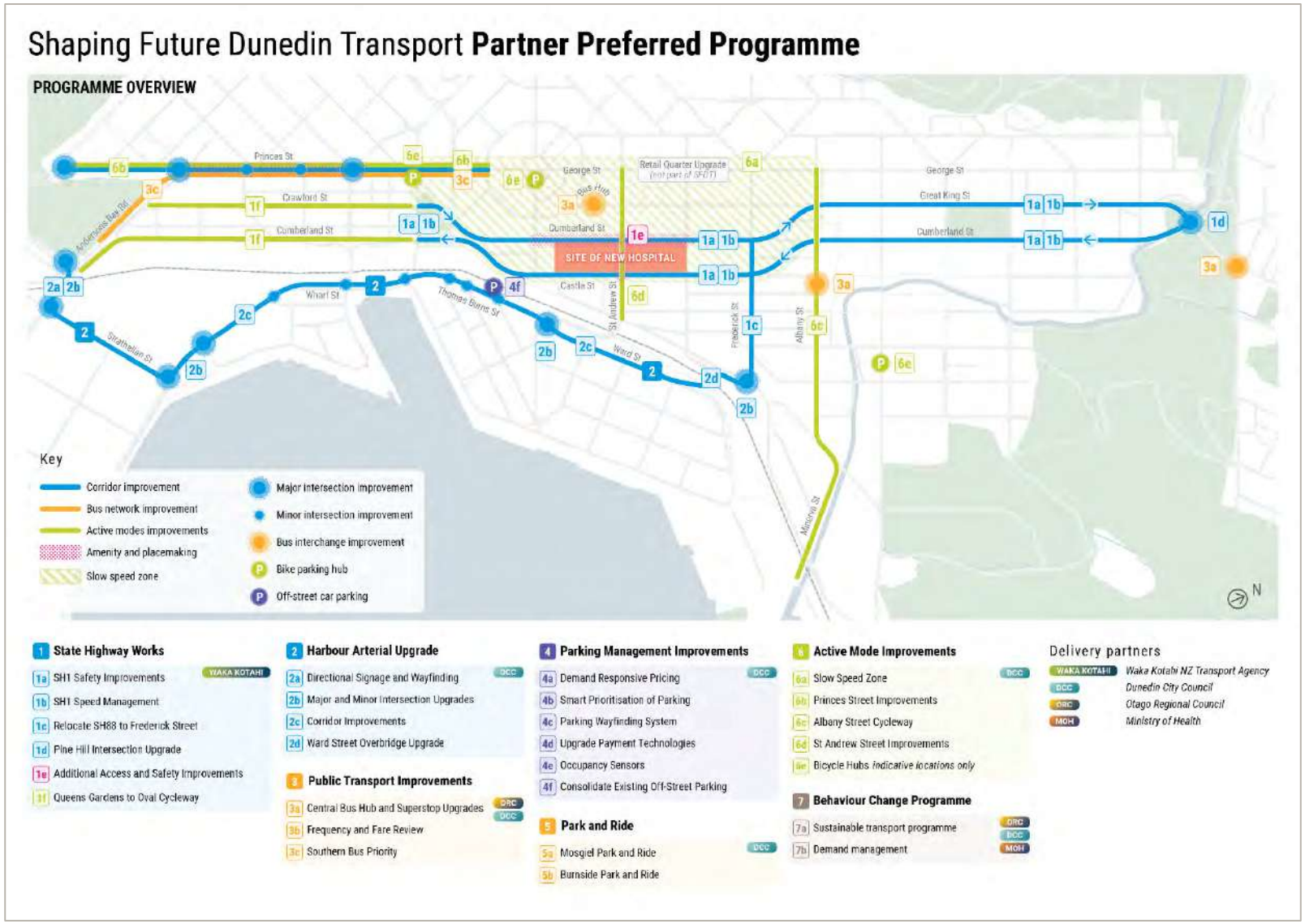


Figure 19-1 Partner Preferred Programme

19.3 Programme Implementation Strategy

The original high-level programme that was developed (14.7) was reviewed and updated to incorporate the confirmed way forward. The following factors were critical in determining relative timing:

- The indicative timeframes for opening of the hospital outpatients and inpatient buildings.
- Disruption caused by hospital works provides an opportunity to promote public transport, so public transport comes early in the programme.
- To encourage a shift to public transport, public transport improvements come before other transport network changes, as this way they will have most impact.
- Relocating SH88 needs to be completed early to maintain access and reduce delays associated with hospital construction.
- Disruption caused by hospital works will cause delays in the centre, so the Harbour Arterial needs to be operating early to help maintain access.
- Hospital works provide the opportunity to make changes to the local state highway network, so having the Harbour Arterial operating prior to these changes is key to maintaining access, particularly for through traffic and freight.
- SH1 optimisation work to improve amenity, slower speeds, cycleway changes, parking layouts and pedestrian connectivity improvements on Cumberland Street outside the new hospital should be complete by the time the new building opens (2024).
- To achieve behaviour change that is lasting and includes travel to the new hospital, viable alternatives (public transport, cycle routes and hubs) need to be in place before the hospital opens.
- Before parking restrictions are extended alternatives need to be in place, so this comes later in the programme.
- Providing new car parking areas and divesting some of the existing parking areas will take some time and some new car parking needs to be available at the time the first hospital block opens in 2024, to ensure access and functioning of the hospital. The MoH only have budget for parking spaces required under the 2GP (184 spaces within 250m of the new hospital, including 6 mobility spaces – spaces are likely to be primarily for staff and fleet vehicles, with a few for disabled and priority patient parking).
- Following the completion of the DCC walking and cycling PBC, it is anticipated that a SSBC 'lite' will be progressed to consider options to extend the existing cycleway to the Oval.
- In order to maximise the benefits from the programme it is important that delivery timing recognises the interplay between the different work packages. Figure 19-2 provides the optimal timing for delivery of each work package.

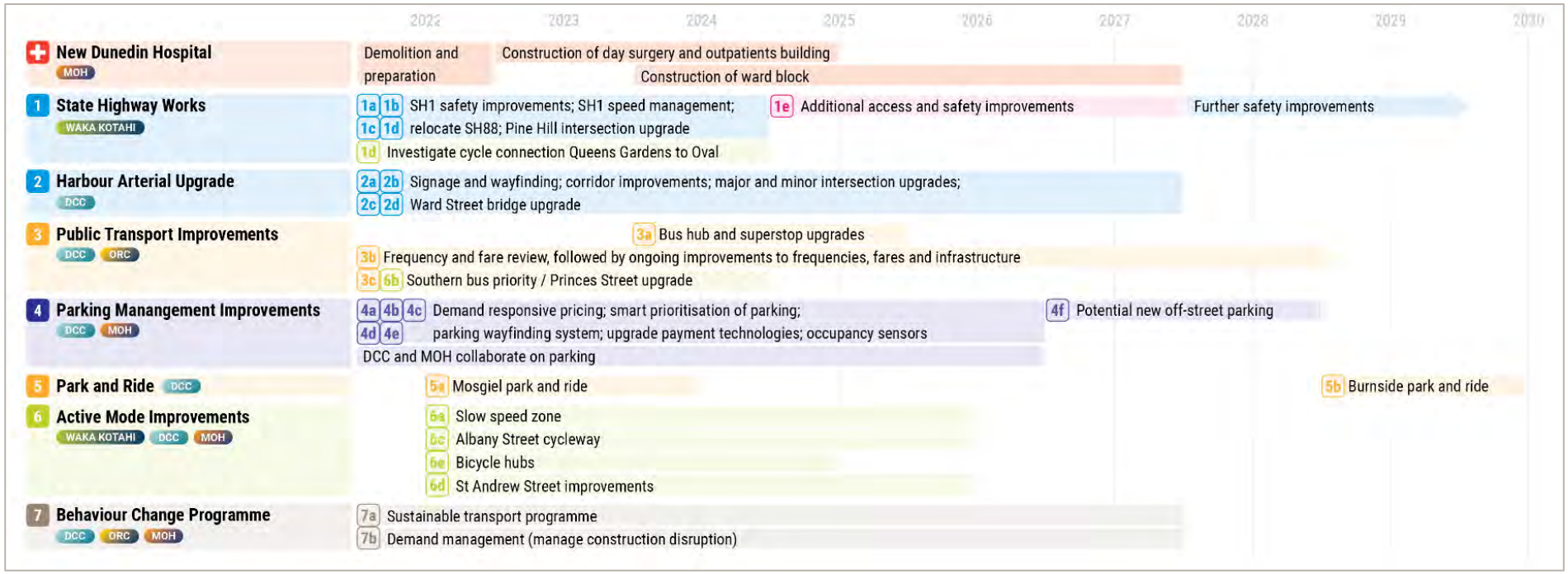


Figure 19-2 Staging for Partner Preferred Programme

19.4 Programme Risks

The risks associated with the Partner Preferred Programme have been considered and are summarised below. Additional risks are likely as the project progresses and these should be captured in a risk register during the next stage of work.

Technical

- Difficulty in achieving a lower speed limit on SH1. Lower speed limit signs would be posted but the road would remain straight, with wide lanes to provide for freight, and achieving may be difficult without some or all the following: signal phasing to slow traffic and prevent green wave, raised platforms, or speed cameras to enforce speed limit. These interventions could reduce the level of service and may be unpopular with some customers.
- The speed management solutions adopted will need to consider the potential traffic migration implications should lower speeds be implemented on the SH network.
- Location, condition and extent of services and utilities within and adjacent to the road corridors included in the Partner Preferred Programme.
- Challenging to develop and implement a co-ordinated and effective travel demand management programme to minimize disruption during hospital construction, as this will require close and ongoing liaison to be prioritised between DCC, Waka Kotahi, MoH NDH team and ORC.
- Potential lack of resources in Dunedin to allow the Partner Preferred Programme to be prioritised and implemented
- Although 30% contingency has been included, there is a risk that of unforeseen challenges/costs relating to the Ward Street overbridge improvements.

Operational

- Multi-partner programmes can be challenging to co-ordinate and deliver.
- May be difficult to resource delivery of the programme.
- May be challenging to align and collaborate with the MoH NDH team, as there are different interests and drivers.
- Maintaining safe and effective travel for all modes during construction phases, and during NDH construction.
- Increased maintenance requirements following changes (e.g. additional amenity features).
- It may be difficult to recruit additional bus drivers in Dunedin, to support the increased bus frequencies

Financial

- Difficult to accurately account for benefits, many of which are intangible or difficult to attribute, resulting in a lower BCR, which may make the project less attractive for investment.
- Cost of Partner Preferred Programme in a constrained funding environment.
- Uncertainty of funding support for all projects, and potential investors.
- Additional costs and time delay if land acquisition required or other unanticipated cost escalations occur.

Stakeholder/Public

- Likely that key stakeholders have different priorities and preferences and may not agree with the Partner Preferred Programme.
- Public engagement indicated that slowing speeds on northbound and southbound SH1, and in the core central city area, will be controversial and bring about public debate.
- Potential to affect sites of cultural significance e.g. Anzac Avenue.
- Business Case process has raised community and stakeholder expectations that work will be undertaken, prior to funding being committed.
- Lack of clarity about impacts on specific properties.

- Proposed Parking Management, cycleway and other changes may be controversial and spark public debate.

Safety

- Difficulty in achieving lower speed limit may mean increased safety risk in locations where pedestrian activity is expected to increase significantly, in front of the new hospital.

Economic

- Investment may not offer value for money if safety and wider economic opportunities are not achieved, or if measures to reduce speed erode levels of service.

19.5 Programme Outcomes

19.5.1 Economic Report

An additional economic assessment was completed for the original Programme 1, see Appendix O. The assessment concluded that a fully implemented Programme 1 is expected to generate a net additional contribution to GDP of $59.9m in NPV over its useable lifetime. The analysis showed that the programme would sustain an additional 1901 employment job years of which 1154 occur within the first 10 years. This is dominated by employment in the construction sector in the first 5 years, peaking at 93 job year equivalents.

19.5.2 Programme Outcomes Assessment

An assessment of the Partner Preferred Programme against the Project Outcomes is provided in Table 19-1.

Table 19-1: Programme Outcomes

Benefits/Project Outcomes	Contribution of Partner Preferred Programme[20]

Improve multi-modal access to and within central city	• Minimise travel disruption and maintain city access during 6-8 years of hospital construction by:
	  ○ improving the Harbour Arterial to provide a 30% reduction in overall journey time and 100% improvement in resilience due to improved grade separated crossing of railway at St Andrew Street.
	  ○ improving public transport to achieve a 30% reduction in overall journey time through bus priority on Princes Street, a 35% increase in bus passengers on routes using Princes Street (equates to 600k new passengers), combined with improvements in fares, frequencies and infrastructure, such as real time passenger information.
	  ○ improving cycling and walking facilities to better connect the harbour routes to the Tertiary area and SH1 cycleway, extend the SH1 cycleway to the Oval, slow speeds and improve pedestrian connectivity in the central area and on Princes Street, attracting an additional 2500 people walking and 2300 people cycling.
	• Utilise disruption to trigger travel behaviour change through rapid improvements to public transport and parking management aligned with a public information campaign and incentives to promote change to achieve:
	  ○ Decrease in the percentage of people driving to work from 74% in 2018 to 60% in 2030,
	  ○ Increase in those walking, cycling and using the bus for the journey to work from 15.4% in 2018 to 27% in 2030.
	• Access via the Harbour Arterial is improved by upgrades which are estimated to reduce journey times by 30% and improve the grade separated crossing at Ward Street, reducing disruption experienced on the current route via St Andrew Street.
	• Park and Ride facilities at Mosgiel and Burnside will provide better travel options for those living to the south and west of the city and will relieve parking pressure and congestion in the central city.

[20] Note, outcomes relate to the full Programme 1, and have been assumed to apply to the Partner Preferred Programme, in the most part.

Benefits/Project Outcomes	Contribution of Partner Preferred Programme[20]
Improve attractiveness of city as place to invest, live, work and play	• Annual Wellbeing benefits estimated at $111.9m. • Liveability benefits estimated at $68.2m. • Expected to sustain an additional 1901 employment job years, with 1154 occurring in the first 10 years, primarily in the construction sector. • Expected to generate a net additional contribution to GDP of $59.9m over its lifetime.
Enhance connectivity between key destinations for all modes	• Slow speed zone and pedestrian connectivity improvements on SH1 and in the core central city area. • Cycling and pedestrian improvements on Albany Street, St Andrew Street and Princes Street.
Improve safety	• Safety improvements are expected to reduce deaths and serious injuries by 67%, in the study area from 12 to 4 (rounded).
Improve place quality and walking environment within city	• Amenity improvements on SH1 on NDH blocks • Slower speeds on both SH1 one way system routes as well as on St Andrew Street and other core central city streets will improve amenity
Improve environmental outcomes, moving towards carbon zero by 2030	• Decrease in the percentage of people driving to work from 74% in 2018 to 60% in 2030, • Increase in those walking, cycling and using the bus for the journey to work from 15.4% in 2018 to 27% in 2030. • Better land use/transport integration on Princes Street and St Andrew Street • Parking Management changes supporting lower emission modes • Allows for increased use of rail by improving grade separated crossing of Harbour Arterial at Ward Street, reducing importance of St Andrew Street at grade crossing.

19.6 Assessment Profile

The Investment Prioritisation Method for the 2021-24 NLTP has been used to assess the Partner Preferred Programme.

19.6.1 GPS Alignment

GPS alignment indicates the alignment of the Partner Preferred Programme with a GPS strategic priority and identifies the potential contribution to achieving the GPS strategic priority. The guidance states that one relevant criterion related to each expected benefit should be selected, and the rating is then based on the highest expected contribution to a single GPS strategic priority.

For the Partner Preferred Programme, the highest expected contribution is to:

Strategic Priority: Better Travel Options and Climate Change

Benefit: Impact on Mode Choice

Criterion: change in share of private passenger vehicle-based trips to other modes.

Rating: Very High

Explanation: To achieve a 'Very High' rating, the activity must forecast >6% change in share of private passenger vehicle-based trips to other modes. The Partner Preferred Programme is expected to achieve 11.6% change to other modes for the journey to work by 2030, from 2018 levels.

19.6.2 Scheduling

Scheduling indicates the criticality or interdependency of the Partner Preferred Programme with other proposed network improvements. Criticality is defined as the significance of the programme as part of the network and the degree of impact to users, particularly due to the availability of alternatives. Interdependency is defined as the degree to which an activity is necessary to unlock the benefits of

another related or integrated investment. This 'other investment' may be part of the same programme, or a separate major development or event.

The guidance states that one relevant criterion related to interdependence and criticality should be selected, and the rating is then based on the highest expected contribution to one of those factors. priority.

For the Partner Preferred Programme, the highest expected contribution is to:

Scheduling Factor: Interdependency

Criterion: Impact of non-delivery on realising the estimated benefits of the programme i.e. one or more benefits will not be achieved or will be delayed for more than 3 years.

Rating: High

Explanation: To achieve a 'High' rating, non-delivery of the proposed activity in the 2021 NLTP has a significant impact on realising the estimated benefits of the programme/package. This is the case for the Partner Preferred Programme, which must commence delivery in the 2021 NLTP in order to maintain access to the city during the construction of the $1.4B New Dunedin Hospital development, which has frontage on three national highways – SH1 northbound, SH1 southbound and SH88.

Temporary traffic management will be in place on the SH1 and SH88 routes until the completion of the hospital in 2029. The programme aims to maintain vehicle access by upgrading the Harbour Arterial, taking some of the traffic off SH1. The programme then aims to capitalize on the disruption by using it as a 'push' factor to achieve mode shift, along with the 'pull' factor of public transport improvements and cycle network connections. A Travel Demand Management programme will be designed to release key messages at appropriate times, incentivize behaviour change, and enable workplaces to support their staff and facilitate mode shift at this opportune time.

19.6.3 Efficiency

Efficiency indicates the expected return on investment and considers the whole of life costs and benefits through cost-benefit analysis. Efficiency considers monetised impacts only.

The BCR for the full P1 was calculated to be 3.2. This included monetised wider economic benefits for the city. However, the Partner Preferred Programme is not the same as Programme 1, because the costs for SH1 will be lower as only short-term interventions are being considered. Similarly, the benefits will also be lower. However, P1 gives a reasonably representative figure of the likely BCR for the Partner Preferred Programme.

19.6.4 Priority

Based on the above information, the overall priority for the Partner Preferred Programme is Priority 1.

20. Financial Case

20.1 Indicative Cost

A high-level indicative cost for activities in the Partner Preferred Programme is shown in Table 20-1. Contingency of 30% is included for all local road items, and 50% for state highway items.

Table 20-1: Partner Preferred Programme - Indicative Cost Breakdown

Theme	Activities	Total Cost	Capex	Opex
Public Transport	Bus Hub Upgrade	$2.0m	$2.0m	
	Superstop Upgrades (5)	$5.0m	$5.0m	
	Fare and Frequency Review SSBC and Implementation (increased bus fleet and operating costs). Focused on attractive fares and frequency increases.	$16.9m	$9.8m	$0.6m p.a. (12 years)
	Princes Street Bus Priority and Corridor Safety Plan SSBC and Implementation	$6.6m	$6.6m	
State Highway 88 Revocation	SH88 SSBC	$0.5m	$0.5m	
	Frederick Street Upgrade	$2.5m	$2.5m	
	St Andrew Street Upgrade	$3.0m	$3.0m	
State Highway 1	SH1 SSBC Hospital Access and Safety	$1.1m	$1.1m	
	Road to Zero Programme SH1 Short-Medium Term Improvements including Pine Hill intersection.	$16m	$16m	
	Cycle connection to Oval	$4.5m	$4.5m	
Arterial Routes	Harbour Arterial Efficiency Improvements SSBC and Implementation	$15.8m	$15.8m	
Parking	Central City Parking Management	$9.5m	$9.5m	
	Mosgiel and Burnside Park and Ride SSBC and Implementation	$10.3m	$10.3m	
Walking and Cycling	Central City Cycle and Pedestrian Improvements SSBC and Implementation – Slow speed zone, pedestrian crossing points, Albany Street	$4.2m	$4.2m	
	Central City Bike Hubs	$2.5m	$2.5m	
	Behaviour Change Programme	$1.2m		$0.2m p.a. (6 years)
	Project Delivery Resources	$1.6m	$1.6m	
Total	Rough Order Cost Estimate (rounded)	$103.2m	$94.9m	$8.3m (12 years)

Further scope detail and cost breakdown is provided for DCC projects in Appendix P. This additional information was developed to inform the DCC Councillors as part of the LTP process.

Figure 20-1 shows the cost breakdown over the 10-year period, by partner.

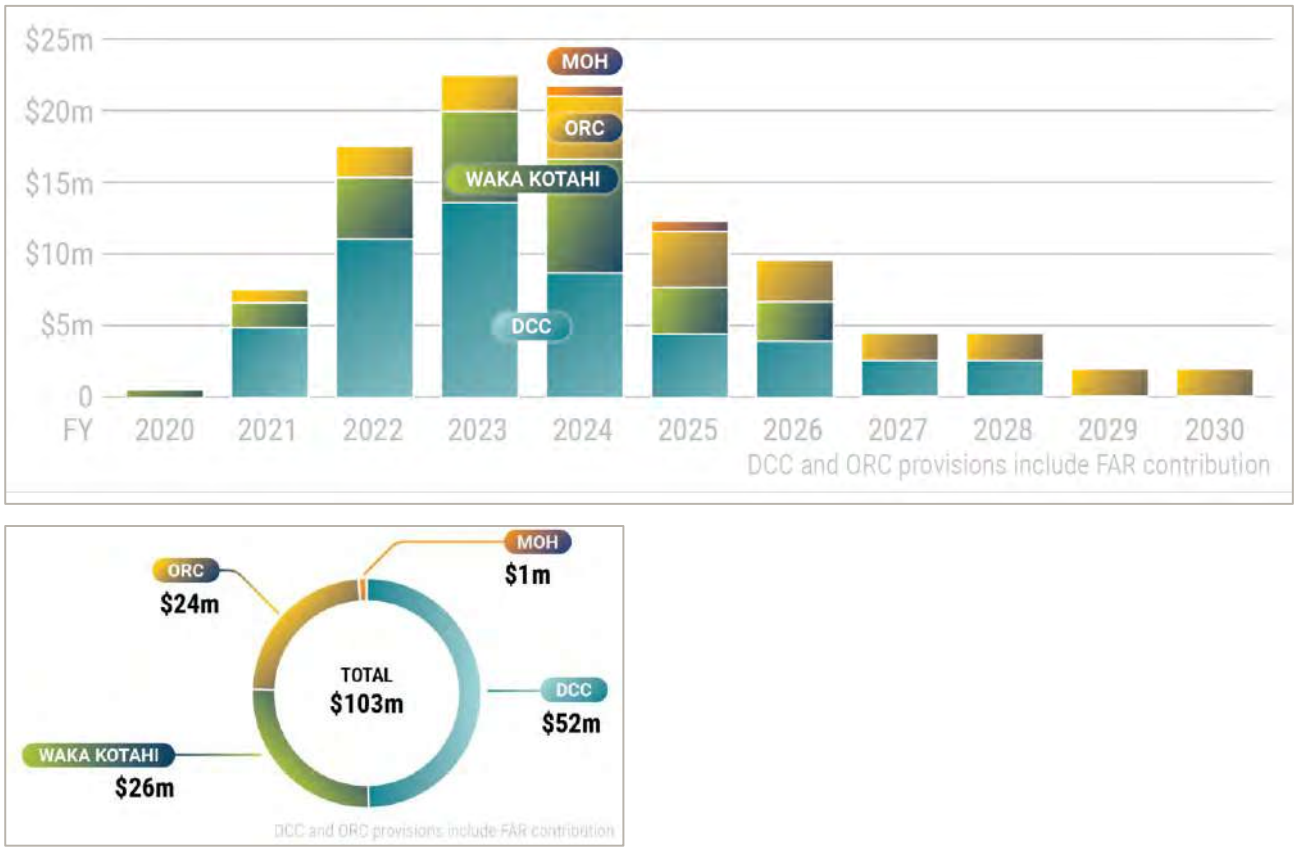


Figure 20-1: Cost by Partner and by Year (2021-2031). MoH funding is unconfirmed at the time of writing.

20.2 Funding Arrangements

Likely funding streams for the activities are shown in Table 20-2. Some activities will involve collaboration between partners – this is also indicated in the table. For note, projects identify as ORC or DCC Partner projects also attract Waka Kotahi funding of 51%.

Table 20-2: Potential Funding Streams - Partner Preferred Programme

Theme	Activities	Partner	Streams	Funding Stream
Public Transport	Bus Hub Upgrade	ORC	Infrastructure, real time information	Low-Cost Low Risk and LTP/NLTP 21-24
	Superstop Upgrades (5)	ORC		
	Fare and Frequency Review SSBC and Implementation	ORC		NLTP 21-24
	Princes Street Bus Priority and Corridor Safety Plan SSBC and Implementation	DCC, ORC	SSBC and Implementation	NLTP 21-24
			Initial low-cost works	Low-Cost Low Risk
State Highway 88 Revocation	SH88 SSBC	Waka Kotahi, DCC, MoH		NLTP 18-21
	Frederick Street Upgrade	Waka Kotahi		NLTP 21-24/WKIP
	St Andrew Street Upgrade	Waka Kotahi, DCC, MoH		NLTP 21-24, MoH, Innovating Streets, Low-Cost Low Risk

Theme	Activities	Partner	Streams	Funding Stream
State Highway 1	SH1 Short to Medium Term Improvements	Waka Kotahi, MoH, DCC	Slow speed	Road to Zero
			Pine Hill intersection	Road to Zero
			SH1 intersections with Hanover Street and St Andrew Street	Road to Zero
	SH1 Cycle Connection to Oval (SSBC Lite)	Waka Kotahi, DCC	Investigate need for and design of cycleway between Queens Gardens and Oval	NLTP 21-24
	SH1 Hospital Access SSBC	Waka Kotahi, MoH, DCC, ORC	Improvements to hospital access for all modes, amenity improvements	NLTP 24-27
Arterial Routes	Harbour Arterial Efficiency Improvements SSBC and Implementation	DCC	Signage/ITS Minor intersection upgrades	Low-Cost Low Risk
			Major intersection upgrades, Ward Street, Bridge Improvements	NLTP 21-24/LTP
Parking	Central City Parking Management	DCC	Policy, Wayfinding, Payment System Upgrades	NLTP 21-24/LTP
			Hospital Parking	LTP and MoH
	Mosgiel and Burnside Park and Ride SSBC and Implementation	DCC, ORC		NLTP 21-24/LTP
Walking and Cycling	Central City Cycle and Pedestrian Improvements SSBC and Implementation	DCC	Slow speed zone, pedestrian connectivity	Low-Cost Low Risk
			Albany Street, St Andrew Street (part)	NLTP 21-24/LTP
	Central City Bike Hubs	DCC		Low-Cost Low Risk
Promotion	Behaviour Change Programme	DCC, ORC		Low-Cost Low Risk or equivalent
Delivery	Project Delivery Resources	Waka Kotahi, DCC, ORC		NLTP (capitalised)

The SH88 SSBC is already underway as this work is required now, and funding was allocated in NLTP 21-24.

20.3 Affordability

The BCR for the Partner Preferred Programme, based on the BCR for Programme 1 is 3.2.

ORC and DCC have included budget lines in their respective LTPs to provide funding for their items. These funding streams were confirmed at the end of June 2021, when the Councils adopted their final LTPs, following consultation, hearings and deliberations.

The project is awaiting NLTP funding. There is always pressure on the NLTP budgets from across the country, however as the project is Priority 1 it will be in a good position to attract funding.

Part C – Delivering and Monitoring the Programme

21. Management Case

21.1 Programme Governance and Reporting

The Partner Preferred Programme will be delivered through a collaborative programme approach, utilising the already established 'Connecting Dunedin'(CD) entity.



Connecting Dunedin is a partnership between Waka Kotahi, DCC and ORC. Oversight of this partnership is from the Connecting Dunedin Governance Group (CDGG). This group does not have any formal decision-making responsibilities or delegations. These remain with each organisation. The Governance Group's mission is to ensure the transport programme if activities that affect Dunedin urban area and the strategic transport network are well connected and deliver a multi-modal and customer focused transport system. This includes alignment with wider strategic planning and community expectations of each organisation.

The Governance Group remains at the strategic level owning key relationships for the Connecting Dunedin programme and any escalated risks. The role of the group is to set the direction for the programme and to assist the responsible staff to manage and resolve issues related to the individual projects in the programme. The membership of the Governance Group is the Mayor, three DCC Councillors (chairs of the relevant committees), DCC and ORC's CEOs, three ORC Councillors, and the Waka Kotahi Director Regional Relationships (structure title as at 2021).

The Connecting Dunedin Governance Group is supported by the Connecting Dunedin Advisory Group (CDAG). This group consists of three senior managers, one each from DCC, ORC and Waka Kotahi. This group are responsible for the direction and scope of the SFDT Programme.

The Programme Governance and Reporting structure is shown in Figure 21-1.

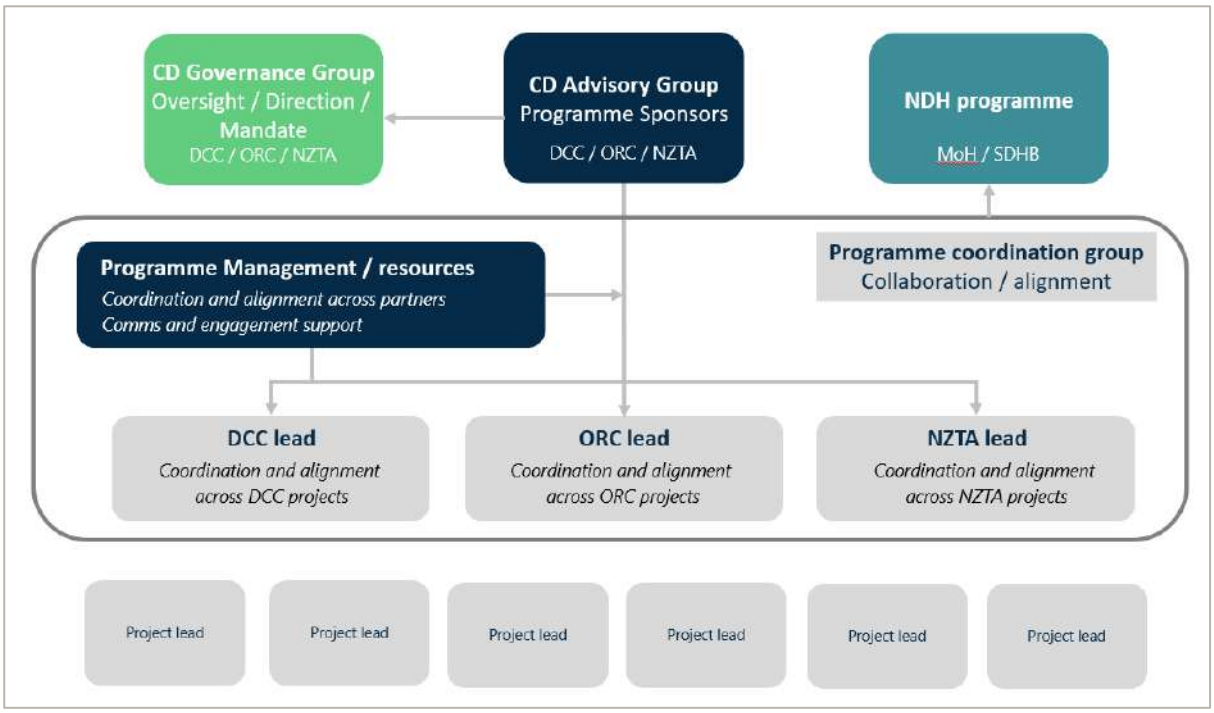


Figure 21-1: SFDT Programme Governance and Reporting

Table 21-1 explains the focus and key tasks for each role named in Figure 21-1.

Table 21-1: Focus and Tasks by Role

Role	Focus/key tasks
Programme Sponsor – Connecting Dunedin Governance Group (CDGG)	• Provide collaborative leadership • Provide project oversight • Provide and confirm direction • Approve consistent communications and engagement approach
Steering Group – Connecting Dunedin Advisory Group (CDAG)	• Accountable for partner oversight and mandate for delivery • Regular, robust reporting to CDGG • Recommend and advise CDGG • Responsible for ensuring internal reporting within each organisation occurs when decisions need to be made.
Programme Lead	• Develop and maintain programme overview • Develop and maintain risk plan • Coordination of planning and delivery across partners • Support project managers • Reports directly to the CDAG
Programme Co-ordination Group	• Work with the MoH NDH team to ensure alignment and collaboration • Consists of Partner Leads and Programme Lead.
Partner leads (DCC/ORC/Waka Kotahi)	• Member of Programme Coordination Group • Responsible for partner delivery of projects • Coordinate and manage across organisation including alignment with other initiatives • Cost management
Project leads	• Responsible for delivery of specific projects
Other	• Engagement and communications

Role	Focus/key tasks
	• Risk support • Procurement support • Network management, urban design, modelling, etc

A key risk for the governance of the business case and the Partner Preferred Programme is change in personnel at the Governance and/or Advisory Group level. Such changes can result from organisational restructures or staff turnover. Changes in key personnel can lead to a change in outcome focus, as well as delays as new staff, with different skills and experience, come up to speed.

21.2 Programme/Project Roles and Responsibilities

Project roles and responsibilities align with the funding agency or asset owner which holds the primary responsibility (Table 21-2). At a high- level responsibilities for the implementation are defined by the Land transport Management Act 2003 and the Local Government Act 2002.

Table 21-2: Asset and Service Responsibilities

Activity	DCC	Waka Kotahi	ORC
Local roads, including footpaths, cycleways, parking, bus lanes, signals and Intelligent Transport Systems	X		
State highways, including footpaths, cycleways, bus lanes, signals and Intelligent Transport Systems		X	
Public Realm	X		
Park and Ride, Public Transport infrastructure including bus stops, bus lanes, signs and markings, bus hub	X		
Public Transport Services and vehicles			X
Signal operations and Intelligent Transport Systems	X	X	
Travel demand management	X	X	X

Both DCC and Waka Kotahi have responsibility for all phases of delivery of the Partner Preferred Programme. ORC's role is limited to the public transport improvement elements. Responsibilities are shown in Table 21-3.

Table 21-3: Project Phase Responsibilities

Role	Comment
Leadership and governance	Each of the partners has a role in leadership and governance through the Connecting Dunedin partnership.
Planning and design	Leadership will normally by DCC or Waka Kotahi, depending on ownership of the affected asset. ORC will lead PT elements.
Consenting	Primary lead will be DCC or Waka Kotahi, depending on ownership of the affected asset.
Land acquisition	
Pre-implementation	Leadership will normally by DCC or Waka Kotahi, depending on ownership of the affected asset. ORC lead public transport vehicles and services.
Implementation	
Maintenance and operation	
Monitoring	The programme will be monitored to ensure it achieves the identified benefits. Each of the partners has a role in monitoring the outcomes and sharing that information through the Connecting Dunedin partnership.

21.3 Scope of Partner Preferred Programme

21.3.1 Waka Kotahi Works

- SH88 SSBC – this business case will:
  - Involve close collaboration with DCC, ORC and the NDH design team.
  - Confirm the preferred route for SH88, and the preferred arrangement for the section of St Andrew Street between Anzac Avenue and Crawford Street.
  - Complete traffic modelling required to understand the impacts of proposed changes to Frederick and St Andrew Street. This will include tests to understand possible lane configurations on St Andrew Street.
  - Provide designs for any intersection and corridor upgrades required for the new SH88 route and for changes to St Andrew Street to provide a pedestrian focus.
  - incorporate public and key stakeholder engagement.
  - Provide detailed costings and an implementation plan for the works.
  - Clarify cost sharing arrangements for the works.
- SH1 Short-Medium Term Improvements utilising Waka Kotahi's Road to Zero Programme, seeking safety improvements on the SH1 one way system including slowing speeds to 40km/h and introducing measures to ensure the speed limit is achieved. The main area of focus for slower speeds is both one-way routes between Rattray Street and Pine Hill intersection. Low- Cost Low Risk budget will be used subject to national prioritisation. Potential sites for measures such as raised tables and Barnes Dances include northbound and southbound intersections of SH1 with Hanover Street and St Andrew Street. Pine Hill intersection improvements which could include closing the through movement to North East Valley or introducing signals.
- Monitor a range of factors to allow success of Partner Preferred Programme to be measured, commencing with immediate baseline data collection. When one or more of the factors are triggered, revisit network response through an SSBC.
  - Outcome focussed reviews including annual mode shift achieved, public transport patronage changes, cycle and pedestrian counts, customer satisfaction surveys with public and active transport. If mode shift targets are not met this would be a trigger for revisiting network response.
  - Changes in Government direction or law changes that could signal a change to configuration of the one-way system.
  - Land use change through a refresh of the DCC's Spatial Plan or 2GP, that could be enabled through reconfiguring the one-way system.
  - Safety trends on the SH1 one way system to determine whether the short-medium interventions have been effective. If they have not been effective, reconfiguration may be required.
  - Effectiveness and satisfaction with pedestrian and cycling levels of service. If satisfaction does not improve, reconfiguration may be required.
- SH1 Cycleway Connection to the Oval SSBC Lite to develop any cycling connection on the highway(s) between Queens Gardens and the Oval Cycleway (if required).
- SH1 SSBC Hospital Access and Safety Improvements in 2024-27 period, to identify additional access, amenity and safety works that are required on the NDH blocks to maximise pedestrian connectivity and safety, and access to the hospital.

21.3.2 DCC Works

The DCC projects are:

- Princes Street Bus Priority and Corridor Safety Plan
- Harbour Arterial Improvements
- Central Parking Management
- Mosgiel and Burnside Park and Ride
- Central Cycle and Pedestrian Improvements
- Central Cycle Hubs

DCC developed highly detailed scopes for each of its projects, as part of the DCC Long Term Plan process. More work has been put into developing these projects, than the ORC and Waka Kotahi projects. The detailed scopes are presented in Appendix P, and provide an overview of each project, explanation of issues and project objectives, and cost breakdown by item.

21.3.3 Scope of ORC Works

A description of work packages that are ORC's responsibility:

- SSBC Fares and Frequencies – this business case will investigate the future fare structure for the Dunedin bus network as well as various bus frequency improvements, such as increasing peak frequencies and introducing express buses from Mosgiel; increased peak frequencies from Port Chalmers and Portobello; and a new service from Green Island via South Dunedin. These bus service improvements would be implemented in stages with improvements beginning in the 2021/2022 year.
- Superstop and Hub upgrades – these upgrades will provide additional seating and shelter as well as amenity upgrades such as lighting and real time information at the Dunedin bus hub. In addition, it would provide five super stops in North Dunedin, the Tertiary Precinct, Mosgiel, Green Island and South Dunedin. It is envisaged that these works would be undertaken at the rate of one per year starting in 2023/24, with preliminary works beginning in 2022/23.

ORC will need to work closely with DCC on the Princes Street Bus Priority SSBC and the Mosgiel and Burnside Park and Ride. Additionally, ORC will be involved in the cross-agency programme encouraging behaviour change.

21.3.4 Key Interdependencies

The most significant interdependencies for the Partner Preferred Programme are:

- NDH - Ongoing development of the designs for the NDH and the start of construction in 2021 as well as other project milestones. This project will have a direct impact on the timing of supporting transport projects identified in the Partner Preferred Programme.
- Waka Kotahi Speed and Infrastructure Programme – SH1 is currently part of this programme, and initial proposals are to reduce the speed limit on SH1 through Dunedin to 40km/h. This proposal has not been consulted on yet, and ancillary measures to ensure the speed limit is achieved are still being confirmed. In the next stage, improvements on SH1 to support the NDH may be taken forward through this programme or via State Highway Improvements Activity Class.
- Waka Kotahi Safety Programme – SH1 is currently part of ongoing safety works, however the scope and nature of these are not yet confirmed. The programme included safety improvements at Pine Hill intersection, however the priority of improvements at this intersection is not yet confirmed, and further investigation into the short-listed options is needed (refer to Appendix B for more information). Waka Kotahi have identified a new project 'Dunedin Urban Safety Improvements' for the 2027-30 period, however the scope of this is not confirmed.
- Central City Plan, George Street – The Do Minimum assumes a slower speed on the four blocks of George Street which are being upgraded as part of the Retail Precinct Upgrade. The interconnections with this project primarily relate to communications and engagement, as it is important that the public and stakeholders are presented with a 'joined up' story.
- Central City Plan, Tertiary Precinct Upgrade – The Do Minimum assumes slower speeds in the Tertiary Precinct.
- Future Housing Needs – The DCC are currently looking at future housing needs in the city, in response to the National Policy Statement on Urban Development. There is likely to be a need to identify more areas of the central city that would be suitable for higher density housing. In its current form, the SH1 one way system is not ideally suited to this type of development, primarily due to noise but also poor amenity. However, higher density housing in the city centre would support the DCC to move more rapidly towards the Zero Carbon 2030 target. DCC's final response to the GPS could be a driver to revisit a two-way system, with arterial traffic consolidated on a single road, and the other road relieved of traffic, creating a quality environment for higher density residential development. This opportunity would require more investigation including commercial feasibility assessment.

21.4 Key Issues for Successful Delivery of Programme

Successful delivery of the programme relies on:

- State highway 88 revocation – the assumption is that SH88 (St Andrew Street) will be revoked to a local road from Anzac Avenue to Crawford Street. This will allow for the conversation of St Andrew Street to a pedestrian focus, cycleway and to meet other needs of the NDH which still need to be worked through. In order for this revocation to take place, an agreement will be required between Waka Kotahi and DCC on the form of the road that is handed over and the funding support that will be given for the operation of the road. It will also require coordination with other stakeholders' projects and interdependencies to achieve a complete alternative route. Normally the revocation process will include some physical work to ensure that the road functions as a local road rather than a state highway before it is handed over. Agreeing these terms can take some time, and the process initiated as soon as possible. A further complicating factor is the role of MoH in this process. The cost estimates assume any costs for redesigning St Andrew Street fall equally to DCC, Waka Kotahi and MoH, however no agreement to this effect has been drawn up or signed.
- Development of a more detailed Programme Plan which can be easily followed by all partners and allows for data collection and regular reporting and communication to Connecting Dunedin Advisory and Governance Groups to be built in at the outset. This will enable ongoing collaboration between and commitment by the Connecting Dunedin Partners, and with the NDH team and other key stakeholders.
- Delivery of all identified programme workstreams. In particular, the interplay between public transport and parking management changes needs to be recognised and utilised to achieve the project outcomes. Similarly, maintaining access in the face of travel disruption needs to be achieved by prioritising improvements along the Harbour Arterial, Public Transport SSBC and Implementation, and a behaviour change campaign to ensure seamless delivery of messages and infrastructure.
- Effective, clear and regular/ongoing engagement with the community to streamline implementation of projects and maximise buy-in. To assist with this, a clear concise story should be developed that can be used for all each project, with the end 'vision' articulated, so people can easily understand the purpose and outcomes for each project, and how it fits within the bigger picture of the SFDT projects.

21.5 Future Stages of the Preferred Programme

The future stages of the programme may be subject to change, depending on each Council's LTP process, Waka Kotahi's prioritisation process and funding availability. Table 21-4 summarises each work package, the next stage, responsibility, timing (for the next stage) and funding/approval.

Table 21-4: Next Stage of Work-by-Work Package

Work Package	Next Stage	Responsibility	Timing of next step	Funding/Approval
SH1 Safety Improvements (including Pine Hill and Safer Speed measures)	Road to Zero Programme	Waka Kotahi	Under-way	Existing budgets / LCLR
SH88 Revocation, including Frederick Street and St Andrew Street changes	SSBC	Waka Kotahi, with DCC and MoH	2021	Committed activity
Traffic Management during NDH construction	Strategy	Waka Kotahi	2021	Existing budgets
Revisit SH1 configuration	Monitor triggers	Waka Kotahi	On-going	Apply for funding when triggers met.
Harbour Arterial Upgrade -- Major upgrades and Ward Street extension	SSBC	DCC	2021	LTP and submitted to NLTP. Funding not confirmed.
Harbour Arterial - Minor intersection Upgrades, real time signs and wayfinding	Minor Improvements	DCC	2021	Existing budget
Public Transport Review	SSBC	ORC	2021	LTP and submitted to NLTP. Funding not confirmed.
Prince Street Bus Priority and Safety Upgrade	SSBC	DCC	2021	

Work Package	Next Stage	Responsibility	Timing of next step	Funding/Approval
SH1 Cycle Connection to the Oval	SSBC lite	Waka Kotahi	2024-27	
Central City Parking Management	Policy and Plan, NDH alignment	DCC	2021	LTP
Behaviour Change Programme for mode shift	Identified in DCC continuous programme	DCC	2021	LTP and submitted to NLTP. Funding not confirmed.
Park and Ride x2	SSBC	DCC	2022	
Slow Speed Zone and pedestrian improvements	Minor improvements	DCC	2022	Existing budget
Albany Street cycleway (connecting to Tertiary Precinct)	SSBC	DCC	2022	LTP and submitted to NLTP. Funding not confirmed.
Bicycle Hubs	Minor improvements	DCC	2022	
SH1 Hospital Access, Safety and Amenity	SSBC	Waka Kotahi	2024	NLTP 24-27 Funding not confirmed.
Bus hub and superstop upgrades	Minor improvements	ORC	2023	LTP and submitted to NLTP. Funding not confirmed.

21.5.1 Investment triggers

In the long-term, changes to the one-way system are possible. These would be at a time when one or more of the following trigger points are met:

- Outcome focussed reviews e.g. if mode shift targets are not met solutions further up the intervention hierarchy could be explored
- Changes in Government direction or law changes
- Land use change. The Connecting Dunedin partners wish to actively engage with the DCC Strategic refresh including the Spatial Plan.
- Safety trends
- Effectiveness and satisfaction with pedestrian levels of service (particularly east-west movements).

Future investigations may explore options which have not been considered to date e.g. road pricing, and such options may or may not include the options investigated as part of this Programme Business Case. The wider impacts on the local road network would need to be further explored as part of this work.

21.6 Stakeholder Engagement and Communications Plan

A detailed engagement and communications plan will be developed to support implementation through the programme lifecycle. It will be the responsibility of the Programme Lead to develop the plan, with support from communications specialists. The plan will be jointly owned by the partners. The plan will include reporting on monitoring, so the SH triggers and mode shift achievement can be clearly understood and monitored.

The programme will continue to use the 'Shaping Future Dunedin Transport' name badge, as maximise simplicity and consistency, and to avoid confusion.

21.7 Assurance and Acceptance

The business case has been subject to internal review by the Connecting Dunedin partners and the consultant team. The NZIER Liveability work was subjected to an external peer review by Ernst and Young in September 2020.

The project assurance deliverables for the pre-implementation and implementation phases are set out in Table 21-5.

Table 21-5: Project Assurance

Item	Component	Description	Owner
Funding	Approval by DCC, Waka Kotahi and ORC	Internal approvals for each of the projects, and approval in LTP and NLTP	DCC, Waka Kotahi, ORC
Safety audit	Independent safety audits	Detailed design audit and issues resolved, for each project, pre-implementation. Post construction safety audit.	DCC/Waka Kotahi By independent consultant.
System optimisation review	Operation of new systems	Signal changes and real time signage will be operated by Wellington Traffic Operations Centre (WTOC), and designs audited for operational issues.	WTOC DCC/Waka Kotahi
Property	Acquisition	Internal approvals required for property purchase. Must follow all relevant legal processes.	DCC/Waka Kotahi
Legal and planning review	Revocation process review	Peer review of the revocation process to ensure issues are identified and managed.	DCC/Waka Kotahi By independent consultant.
Cost estimate peer review		Independent peer review of cost estimates for pre-implementation.	DCC/Waka Kotahi By independent consultant.
Economic peer review		Independent peer review of economic assessment for pre-implementation.	DCC/Waka Kotahi. By independent consultant.
Detailed design	Design elements	Internal approvals of design standards.	DCC/Waka Kotahi
Technical assurance	Specification and value for money	Independent technical assurance of projects design quality and assurance.	DCC/Waka Kotahi
Construction	Oversee construction and sign off for completion	Internal procurements and contractual processes to be followed.	DCC/Waka Kotahi
	Health and Safety	Appropriate Health and Safety Plans.	DCC/Waka Kotahi, contractor
	MSQA	Independent external provider to provide quality assurance.	To be engaged.

21.8 Change Control

As the Partner Preferred Programme is an inter-connected and integrated programme, any changes to scope by the partners on individual projects needs to be approved through the Connecting Dunedin Advisory Group and Governance Group.

At the start of each phase of each work package, the scope of work will be clearly defined and direction agreed between the project partners and between the client and consultant/contractor. This phase will be the responsibility of the Programme Lead, who will need to enable the reporting and sign off for this scope by the Connecting Dunedin Advisory and Governance Groups. This will ensure that any change that has happened during project development is identified and communicated early before it has an impact.

Any change in the scope of a work package will be managed by the Project Manager and reported through to the Programme Lead and escalated to the Connecting Dunedin Advisory and Governance Group for sign off. A change control register for each project and across the programme will ensure this process is managed effectively. Change can be related to funding, scope, risk, quality and benefits.

The change control register will sit alongside the risk register. Any risk of a change in the project that will result in an adjustment of cost, programme or quality will be subject to approval by the programme governance.

21.9 Benefits Realisation Management

The benefits of the business case will be measured against targets agreed with the partners. Benefits will be developed further as the individual projects are developed.

A monitoring programme will be developed based on the outcomes and measures in this business case (see section 20.13). The outcomes and KPIs are shown in Table 21-6. Also required are regular (quarterly) updates from the Connecting Dunedin partners on individual work packages, as well as from the MoH NDH team on their design process and key milestone dates. There are data gaps for many of the benefits shown in Table 21-6, and it is recommended that a monitoring plan is developed by the partners, and information collected to populate the baseline.

The triggers identified for considering further future changes to the SH1 system also need to be monitored. Most of these are covered in Table 21-6 (mode shift, safety and pedestrian levels of service/access around the NDH), however the following also should be monitored:

- Spatial Plan/2GP or other Council land use initiatives
- Government guidance/law changes

Table 21-6: Key Performance Indicators

Project Outcome	KPI
Improve safety	Injury crashes at Pine Hill/Great King Street
	DSIs on the SH1 one way system
	DSIs on Princes Street
	DSIs on Harbour Arterial
	DSIs on Albany Street
Increase multi-modal access to the central city	% using active transport for work/study
	% using public transport for work/study
	Bus patronage (contracted services)
	Cycle and pedestrian counts at key locations: SH1: NDH blocks, S bends, Queens Gardens Princes Street Albany Street St Andrew Street,
Improve place quality and walking environment in the central city	Traffic and freight volumes Cumberland Street NDH frontage
	PERS score Cumberland Street NDH frontage
	Pedestrian level of service at SH1 intersections in core, midblock NDH frontage
	Pedestrian and cycling satisfaction surveys for SH1, Princes Street, Albany Street, St Andrew Street.
Improve attractiveness of city as place to live, work, play and invest	Parking supply and occupancy at key locations, customer satisfaction with parking
	Journey times on Harbour Arterial, SH1 one way system, Princes Street by mode, peak and off peak
	Length of protected cycle network (study area)

Project Outcome	KPI
Enhance connectivity between key destinations for active modes	Network with 30km/h speed limit or slower (study area)
Move towards DCC's Zero Carbon 2030 target	Estimate of carbon emissions from land transport in Dunedin, from Dunedin Community Carbon Footprint. Note draft Climate Change Commission targets – By 2030, increase walking by 25%, cycling by 95% and bus use by 120%, and overall reduction in vehicle kilometres travelled per person of 7%.

21.10 Risk Management Planning

Table 21-7 summarises the key risks for the next stages of delivery at a management level. Other risks remain for each project which will be managed at a project level e.g. technical, cost, engagement, etc. It is expected that each project will commence with a risk workshop and develop a risk register which will be kept up to date throughout the project. Risks that are 'high' or 'critical' will be reported through the project governance with regular monthly reports.

Table 21-7: Key Programme Management Risks

Risk	Cause	Score	Owner	Mitigation approach
That the funding available to implement the Partner Preferred Programme does not align with what is required.	Future budget drivers and decisions are based on a range of factors outside the scope of this programme.	Critical	DCC, Waka Kotahi, ORC	Parties to signal funding priorities as early as possible. Governance is involved in managing the impact of any significant changes.
That external decision making is poor or slow.	Decision makers are not aligned or not prepared to commit to change.	Critical	Connecting Dunedin / Programme Lead	Maintain contact in Waka Kotahi, ORC and DCC. Reinforce requirement for timely decisions.
That the NDH desired outcomes and budget does not align with the Partner Preferred Programme	NDH aspirations for parking and changes to St Andrew Street and Cumberland Street are evolving and may not align with partner views.	Critical	Connecting Dunedin Governance / Programme Lead	Regular meetings between Programme Lead and NDH design team are required, as well as regular reporting from NDH design team to Connecting Dunedin Governance Group to keep communication open.
That the projects lose community support	Community progressively understand more about the projects and their impacts.	Critical	Connecting Dunedin Governance / Programme Lead	Develop engagement strategy with frequent community updates and information sharing.
That mode shift targets may not be achieved, which would result in increased disruption and delay on the network, and putt DCC's Zero Carbon 2030 target at risk.	'Push' factors not sufficient to result in behaviour change	Critical	Programme Lead	Monitor mode shift and communicate to decision makers that change is critical to manage delays and ensure access.

Risk	Cause	Score	Owner	Mitigation approach
That speed reduction work on SH1 is not supported by the community or cannot be achieved without unpopular measures.	Community consultation	Critical	Waka Kotahi/Connecting Dunedin Governance Group	Consultation strategy communicates the purpose and vision for the speed limit changes and engages well.
That slower speeds on SH1 one way system result in greater than expected traffic diversion to Harbour Arterial and other local roads, and these roads cannot manage the additional traffic.	Unexpected impact	Critical	Programme Lead/DCC	Monitoring of local road impacts to understand if this is happening. Public campaign to include this possibility so people are prepared.
That delay in improving public transport and the harbour arterial will mean hospital construction will cause significant disruption and loss of access	Slow decision making and project progression.	Critical	DCC and ORC	Project Managers to be made aware how critical these elements are to maintaining access to Dunedin.
That personnel experienced in this project may leave the relevant roles.	People move on for variety of reasons.	High	ORC, Waka Kotahi, DCC managers	Each partner to have a backup team member who is appropriately informed and current.

21.11 Cost Management

Cost estimates have been developed at a high level, with DCC project costs further interrogated and developed to support the LTP process. It is likely that costs will change as each project progresses. Once funding for each activity is confirmed within the individual partner organisations budgets, responsibly for monitoring programme cost and progress will sit with Connecting Dunedin and is to be managed by the Programme Lead and each Project Manager.

To enable effective cost management, consultants/contractors must provide detailed financial information in accordance with relevant procedures to DCC, Waka Kotahi and ORC Project Managers monthly and highlight issues arising immediately. Cost estimates will be refined for each package of work as it progresses towards detailed design.

21.12 Procurement

Each partner will be responsible for procuring the activities for which they are the lead [show this in earlier table, in bold]. Partners will be bound by their individual procurement strategies. It is likely that the DCC will procure services through the DCC Professional Services Panel. ORC and Waka Kotahi will procure using their normal procurement processes.

The SH88 SSBC has already been procured.

In addition, the following pieces of work need to be procured or completed urgently:

- Engagement and Communication Plan for SFDT, to communicate the key messages from this piece of work, and the next steps, as well as develop the approach for the lifecycle of the programme.
- PT SSBC to review fares and improve frequencies on key routes, with a view to implementing the changes as early as possible in 2022 to ensure services are in place in time to help manage traffic disruption.
- Development of aligned TDM programme to manage traffic disruption (2022) and promote public transport services as the key alternative.

- Princes Street Bus Priority and Corridor Safety Plan SSBC and low-cost works, to fast track the installation of the bus priority routes from the south, which will be needed to ensure public transport is an attractive alternative to driving. For detailed scope for this activity see Appendix P.
- Harbour Arterial SSBC and low-cost works, to fast-track completion of the route so that it can start to provide additional support once disruption starts on SH1 in the central city. For detailed scope for this activity see Appendix P.
- Parking Management Policy, to initiate a conversation with the community about parking and improve parking management tools, wayfinding and pricing structures. For more detailed scope for this activity see Appendix P.
- Identify opportunity for trials, which could be used to gain public input to projects and ultimately improve public buy-in. Trials may be able to be linked to the temporary traffic management required for the hospital build. For example, different layouts could be trialled on St Andrew Street, on SH1 in front of the new hospital, on Albany Street and to test out different incentives for the behaviour change programme.

21.13 Next Steps

Figure 21-2 shows the immediate next steps by partner.

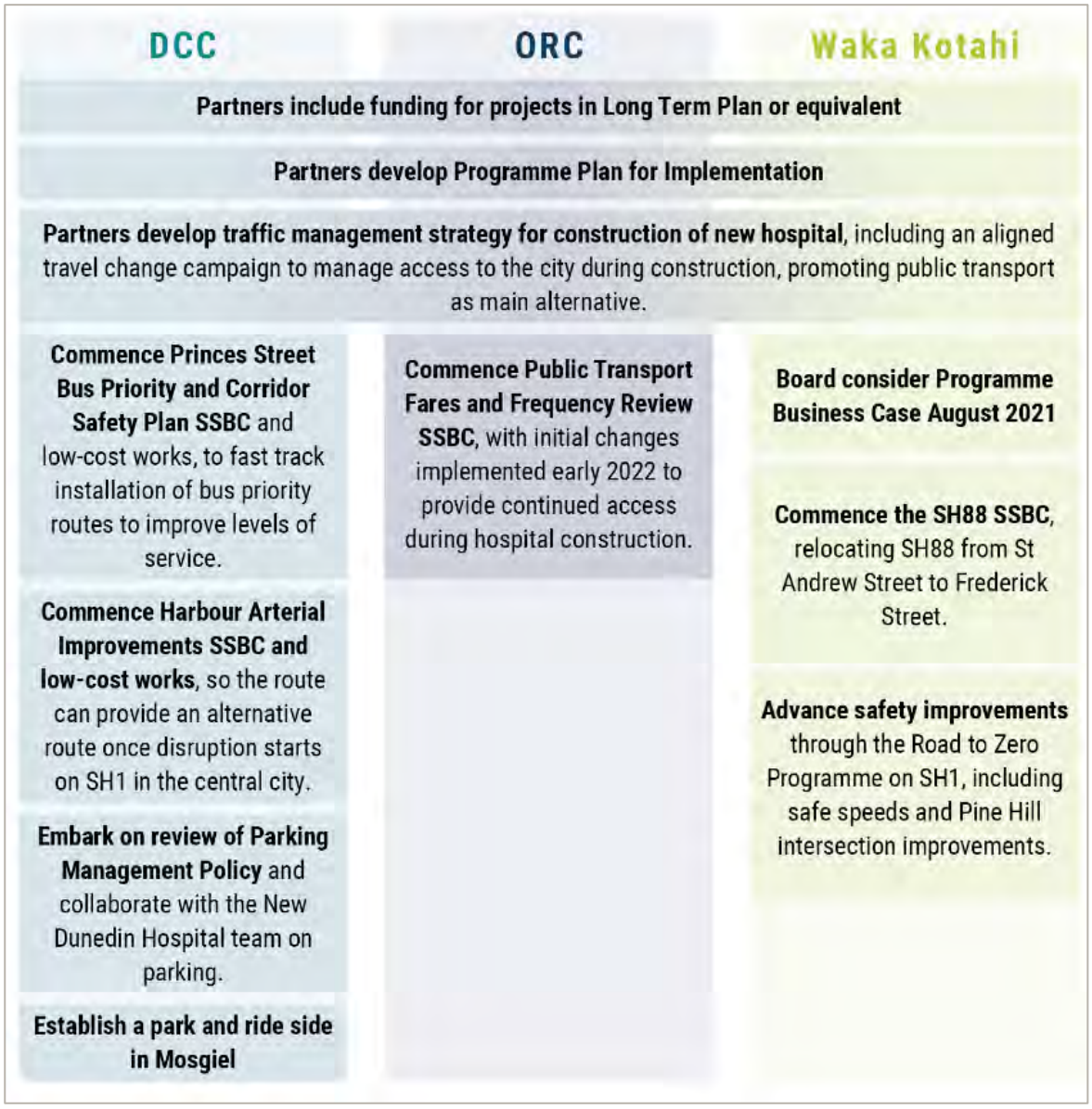


Figure 21-2: Next Steps by Partner



Appendices

Appendix A Long List of Options

Alternative		Option	TDM Sub Programme	Comments/explanation if excluded
SH1 Network Configuration	1	1 way: Option B2 from previous PBC		
	2	2 way: Option C2 from previous PBC		
	3	2 way: Option C2/E from previous PBC)		Option C2 but where Harbour Arterial prioritised to become state highway
		Hybrid a: South 2 way; North/Central 1 way		Excluded: With the hospital as the main driver this would not give the desired outcome on Cumberland Street. Most of the place/movement conflicts are in the central section. It could be a staging option.
		Hybrid b: South & North 2 way; Central 1 way		Excluded: Does not address issues at Hospital for access; legibility difficult; does not provide much additional capacity as the north and south sections are constrained.
		Hybrid c: South & Central 2 way; North 1 way		Excluded: Although 2 waying South and Central sections offers significant benefits for hospital access and reduces severance around Waterfront/Warehouse, it does not provide any outcomes for reducing severance to the Tertiary Precinct and enhancing the University's wellness corridor. It could be a staging option.
		All other hybrid combinations		Excluded: From early work it appears most benefits and least negative efficiency effects would be experienced in the south section. We therefore built up hybrids starting from south section only and ensuring south was always included. Thus other hybrids are excluded.
Public Realm Improvements	6	Targetted improvements 1		Mid block crossings and urban design on Cumberland and St Andrew hospital frontages, slow speeds as per B2 and C2
	7	Targetted improvements 2:		Mid block crossings and urban design at additional key locations eg Queens Gardens, University, Pine Hill, Railway Station, current SB SH1 plus slow speeds as per B2 and C2
	8	High quality corridor enhancements (kerbs do not remain same) full length current NB SH1, and St Andrew Street		Create high quality active and PT mode/place spine (Anzac-George)
	9	Corridor enhancements (kerbs remain same) full length current NB SH1, and St Andrew Street		Create quality active and PT mode/place spine (Anzac-George)
	10	Close High Street at Queens Gardens and improve place		Excluded: Under the 2 way option High Street would be part of the 2 way local road and it would not work to close this route. It does not work for the 1 way option either as it is part of the northbound carriageway.
Harbour Arterial	11	Sign route and minor improvements		Sign route for through traffic (real time route display signs promoting this route when SH1 congested), minor improvements e.g. lane widths, markings
	12	Improve surface, some intersection upgrades		
	13	Take SH1 out of city altogether and upgrade Harbour Arterial to become SH1		
Travel Demand Management [Creating material change only, not minor interventions]				
Public Transport	14	PT Sub-programme		Use sub-prog (a) where road capacity not much altered, and sub-prog (b) where need more mode shift to make the roading work where a) no harbour arterial upgrade b) extent of 2 waying more signficant and likely to lead to congestion.
		Phase 2 of ORC Bus Network improvements (10 yr plan)	X	
		More frequent and direct bus service to Mosgiel	X	
		RTPI via phone or app	X	Do Minimum
		Modest expansion of bus fleet	a	More direct services from southern residential areas; modest service/frequency improvements, express service from Mosgiel, smaller buses for loops
		Bus Priority at signals	a	NOF to confirm routes and signal operations
		Travel incentives targetted at commuters	a	Assume part of Travel Management Association initiatives e.g. Tertiary Pass; workplace passes etc
		School shuttle from hub to school clusters	a	Morning and evening, free transfers.
		Retain 2GP policy to locate new residential development where bus services exist	a	
		Flat Fare $2	b	DCC looking into hypothecating and subsidising fares; ORC looking at fare review.
		RTPI all main stops	b	
		Improve brand, perception and quality of bus services	b	e.g. shelter, timetables, fleet quality, all new buses are electric
		Commuter Park & Ride (bus or train) in Mosgiel and/or Burnside	b	Challenges around ownership and operation ORC and DCC. Assess in economics rail vs bus plus 1 site vs 2 sites - and clarify the option. Mosgiel site for Mosgiel, Outram, Saddle Hill; Burnside site for Abbotsford, Mosgiel, GI, Brighton, Waldronville
		Significant expansion bus fleet	b	More express services for longer journeys, significant service/frequency improvements eg Port Chalmers, Peninsula, Green Island, Waldronville, Brighton. 15 min freq on more routes - targetted to south/peninsula. Tighten up timetables so services are faster.
		Bus Priority measures	b	Bus lanes, bus priority at signals
		All new buses electric		Excluded: Incoporated in brand perception option.

		Water bus services eg harbour communities		Excluded: Ferry is around 10 times the cost of bus. There is a lot of scope to improve buses first and increase patronage on them.
		Port Chalmers commuter rail service		Excluded: There are not enough residents in Port Chalmers and vicinity to make this viable. Train can run for Cruise Ships passengers but we that will not help reduce the commuter peak.
Parking	15	Parking Sub-Programme		Use same Parking sub-prog as PT sub-prog otherwise the parking will undermine PT ops. The two work together for revenue hypothecation also.
		Regulate all on street parking between town belt an harbour via restricted parking zone	a	Over 20 year period constrain free commuter parking (move it further out) but provide for shoppers and residents and gradual extension of paid parking area.
		Simplify parking management system and zone structure - 2 zones only	a	
		Rationalise leased and paid parking prices	a	Ensure leased spaces are more expensive than other paid parking, and reduce supply.
		Review 2GP parking requirements for central zones	a	
		Introduce real time parking display signs at buildings and on routes, consistent signage	a	
		Use ITS for parking enforcement	a	
		Modest commuter parking revenue increase (20%)	a	Use increase to fund PT.
		10 minute grace period at all parking meters, reduce no of free time restricted parking spaces, demand based pricing to support marginal areas	b	
		Higher commuter parking revenue increase (40%)	b	Use increase to fund PT.
		Remove time restrictions for paid parking and use price escalator to discourage longer stays	b	
		Gradually relocate central city car parks to edges of	b	
		First half hour free for paid parking		Excluded: Contradicts mode shift objective. Already have 70+ parking scheme and disabled parking schemes to provide for those in need.
Cycling & Walking	16	Cycling/Walking sub-programme		Reason: Varies only depending on 1 way vs 2 way. With 2 way you can arrange differently.
		Construct Ped/Cycle bridge from Qns Gdns to	X	Do minimum
		Gradually introduce more cycle parking in city centre	X	Do minimum
		Slower speeds in centre through Place/Movement Framework e.g. on George Street	X	Assume just George Street
		Retain protected facility on SH1 as current	X	With one way options
		Provide discount or free bus travel for passengers bring bicycles up to Hill suburbs	a	To remove barrier to those living on the hills.
		Extend protected cycle network to connect to Harbour circuit route	a	
		Dedicated lime scooter and cycle parking areas	a	
		Allow lime scooters to use bike lanes legally	a	
		Next 2GP review aim to introduce more higher density housing within 2km of centre	a	
		Give priority to active modes in off peak times at signals, using NOF/NOP	a	Low Cost Low Risk budget
		More Barnes Dance intersections, consistent and well-designed mid-block crossings	a	Low Cost Low Risk budget
		Gradually improve quality of key walking commuter	a	Low Cost Low Risk budget
		Complete off-road route to Mosgiel and Green Island via Tunnels	b	$23m includes SSBC for Tunnels but no certainty of construction funding.
		Extend protected cycle network into southern suburbs and NEV	b	

		Create active mode spine on NB SH1 and St Andrew which ties in to Harbour circuit, NEV and South Dunedin/St Clair/St Kilda routes	b	Only works with 2 way option.
		Provide protected cycle connections to Harbour Circuit from nearby residential suburbs	b	
		Construct central city Cycle Hub facility providing covered parking, maintenance, showers, café etc	b	
		Provide cycle lift to Highgate	b	
		Develop Park & Cycle sites with bike hire		Excluded: Leave to commercial operator - one is looking at bike hire scheme for Dunedin which could include Park & Cycle.
		E-bike purchase		Excluded: Covered under the Travel Management Association
Behaviour Change	17	Behaviour Change Sub-Programme		Use do minimum unless constraining road network in which case use sub-programme a to stimulate more mode shift.
		DCC to establish Travel Management Association wih major employers:	X	Do minimum. Significant investment in employer travel plans for behaviour change with money saving incentives, work from home/flexible start finish times etc, free PT pass $$$
		Regular marketing and promotion messages and activities by Council and partners	a	
		High quality information and tools e.g. journey planning software	a	
		Significant investment in active travel to school and school sport activities by the Council	b	School travel plans with Council contribution, safe routes to school infrastructure by bike and on foot, cycle skills training, cycle parking at schools.
		Travel Smart (area based travel planning) projects to achieve mode shift	b	Complete in targetted suburbs eg NEV, South/central
		Congestion charging		Excluded: Not supported politically in NZ at the moment. Requires national direction and legislation.

Appendix B Pine Hill Issues and Options



SHAPING FUTURE DUNEDIN TRANSPORT - PINE HILL INTERSECTION – ISSUES AND OPTIONS

PREPARED FOR WAKA KOTAHI NZ TRANSPORT AGENCY

September 2020

Stantec

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REVISION SCHEDULE

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2	29/7/21	Final	SL	SC	SC	GO

Executive Summary

The intersection of Pine Hill Road and Great King Street is at the northern confluence of the one-way system in Dunedin. It has a high collective risk rating with a DSI equivalent of 1.63 (2015-19) and has been the subject of numerous studies and safety investigations over the past 25 years, due to its continually high risk ranking in Dunedin and when compared nationally to other intersections. Due to the intersection configuration, the main crash movement is one which is most likely to result in death and serious injury.

The purpose of this report is to identify the current issues at the intersection and present the preferred option to address those issues. Rough order costs and benefits are provided for the preferred option, and next steps are identified. Ultimately the preferred option is expected to be progressed through the Waka Kotahi Safety Improvement Programme.

Problems and Benefits

The intersection was the subject of a draft Strategic Case completed in 2017. The Strategic Case identified three problem statements (with weightings indicated in brackets) presented below.

Problem 1: The current intersection layout and road user behaviour create an increased risk that crashes will result in deaths and serious injuries (50%)

Problem 2: The intersection does not have provisions for current and future pedestrians and cyclists which results in compromised accessibility and connectivity (35%)

Problem 3: The intersection control and volume of traffic sometimes using the intersection result in delays and rat running that impact the efficiency of a national highway (15%)

These problem statements were reviewed in light of current evidence. The review showed strong evidence in support of Problems 1 and 2, and weak evidence for Problem 3 – although noting that observations and experience show that there are delays in the evening peak. The key evidence in support of Problems 1 and 2 is:

- High traffic volumes (around 10,000 vehicles per day on all legs).
- 321 pedestrians were observed crossing at the intersection on a typical day, with the dominant crossing movement being between the city and North East Valley on Great King Street, which accounted for 80% of total crossing movements.
- 77 cyclists were observed using the intersection on a typical day, of which 74% were on the road and the remainder on the footpath (note this does not include those on the footpath who did not cross the road).
- The most common movement for cyclists was using the on-road cycle lane to make a through movement from Great King Street to Great King Street North, towards North East Valley, with 65% of cyclists performing this movement.
- Multiple issues with sightlines and layout.
- Intersection has high collective risk with six injury crashes in last five years including one serious pedestrian injury and two truck loss of control crashes.
- Intersection appeared on the Waka Kotahi top 100 high risk intersections at number 28 (2014) and is ranked 128 (2019) on Mega Maps II (Road to Zero).
- DSI equivalent of 1.63 based on data from the last five years (2015-19), which falls into the high collective risk band (above 1.6).
- Strong desire lines for active mode users due to proximity to number of key destinations including three schools, Dunedin Botanic Gardens, Gardens Sports Ground, Gardens shopping centre and higher density residential areas in North East Valley and North Dunedin.
- Crossing points for active mode users were improved in 2019 for the SH1 Cycleway but are still convoluted – involving four separate crossing movements, intimidating due to horizonal and vertical approach geometry and vehicle mix/speeds. Survey data showed the majority (85%) of cyclists use the on-road cycle lanes that pass through the intersection to reach North East Valley, rather than the shared path crossing.

- This section provides a weak link for cyclists travelling on the SH1 Cycleway to North East Valley.
- Footpaths and cycleways are missing on some approaches.

The benefits (with weightings shown in brackets) that would accrue through addressing the problems are:

- Improved Safety (45%) – this is the main driver for any improvements, with a specific outcome to reduce deaths and serious injury crashes. The safety issue for the through movement must be addressed and improvements for trucks that experience loss of control on descent should be implemented. This aligns with Road to Zero and the GPS, as well as DCC's Integrated Transport Strategy.
- Improved Connectivity (active modes) (40%) – providing better protection for vulnerable road users using the intersection would support people walking and cycling and have positive safety outcomes. This is particularly true for the east and westbound movements on Great King Street, which represents the strongest pedestrian and cyclist demand.
- Reliable Travel Time (15%) – this benefit has the lowest rating and evidence to support lack of efficiency on the state highway was not strong. However, reliable travel times are important in ensuring good access to destinations and to avoid delays, which can be frustrating and lead to risk taking.

Option Development

A long list of seven options and three sub-options were developed and discussed at a stakeholder workshop in July 2020. These ranged from restricting various movements at the intersection through to introducing traffic signals, a roundabout or grade separation. The sub-options included measures to address truck loss of control crashes, and a pedestrian/cycle overbridge. Some options aligned with a one-way SH1 system, and some with the two-way system being considered through the Shaping Future Dunedin Programme Business Case. Work on that PBC was the trigger for this investigation.

A multicriteria analysis was completed following the workshop, which scored each option against the following eight criteria: safety, connectivity (active modes), mode shift, travel time, achievability, affordability, carbon emissions and property impacts.

Option 8a (one way) and 8b (two way) Grade Separation was the preferred option in the multicriteria analysis and at the stakeholder workshop. It offers the most benefits for safety and addresses all the issues at the intersection. A truck arrester system or similar would need to be incorporated in the design. This option scored highest with equal weighted criteria, and when the safety criteria had a weighting of 50%.

A back up option that did not score as well but which was lower cost was Option 5a (one-way) and 5b (two-way) Traffic Signals. However, there were concerns around how safely traffic signals could operate given the approach gradient from the north, combined with queueing at a red light. Intelligent traffic systems and signage would be needed to ensure existing risks were not compounded. Further assessment of this option is required to confirm whether it is feasible.

Preferred Option

The preferred option is Grade Separation, with the Great King Street route to North East Valley at grade, and the Pine Hill Road/SH1 route elevated for around 300m to around the intersection with Duke Street. A high-level concept design is provided. This option provides the safest solution and can improve safety and access for active modes users as well. The estimated cost for this option is $25m for the one-way option, which requires an on ramp, and $20m for the two-way option, where no on ramp is required. The benefit cost ratio for a 60-year period with 4% discount rate based on safety benefits alone is 0.35 for the one-way option and 0.43 for the two-way option.

Risks

Risks include difficulties associated with works in close proximity to the Water of Leith, the Dunedin Botanic Gardens, Gardens Sports Ground and the Town Belt.

Next Steps

The intersection is currently on Waka Kotahi's Safer Networks Programme under Low-Cost Low Risk, with a budget of $440k in 2021-24. It is recommended that the project progresses to an SSBC to fully evaluate the preferred option in more detail, alongside other options. This will include additional traffic modelling to

confirm the expected benefits to travel times and vehicle operating costs, as well as any wider benefits. A suitable truck arrester system will need to be confirmed and incorporated in the designs.

Abbreviations

2GP	Second Generation District Plan
AADT	Average annual daily traffic
AM	Morning (ante meridian)
BCR	Benefit cost ratio
DSI	Death and serious injury
IP	Interpeak
MCA	Multicriteria Analysis
PBC	Programme Business Case
PM	Evening (post meridian)
SH1	State highway 1
SFDT	Shaping Future Dunedin Transport
SSBC	Single Stage Business Case
Waka Kotahi	Waka Kotahi NZ Transport Agency

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APPENDICES

Appendix A Long List of Options
Appendix B Economic Assessment

1. Introduction

The intersection of Pine Hill Road and Great King Street is at the northern confluence of the one-way system in Dunedin. It has a high collective risk rating with a DSI equivalent of 1.63 and has been the subject of numerous studies over the past 25 years. The intersection was included in the Waka Kotahi's top 100 high risk intersections ranked number 28 (2014) and due to the intersection configuration, the main crash movement is one which is most likely to result in death and serious injury, being when one vehicle is hit at right angles by another.

The purpose of this report is to identify the current issues at the intersection and present the preferred option to address the issues. Rough order costs and benefits are provided for the preferred option, and next steps are identified. Ultimately the preferred option is expected to be progressed through the Waka Kotahi Safer Networks Programme.

The study area is shown in Figure 1-1.

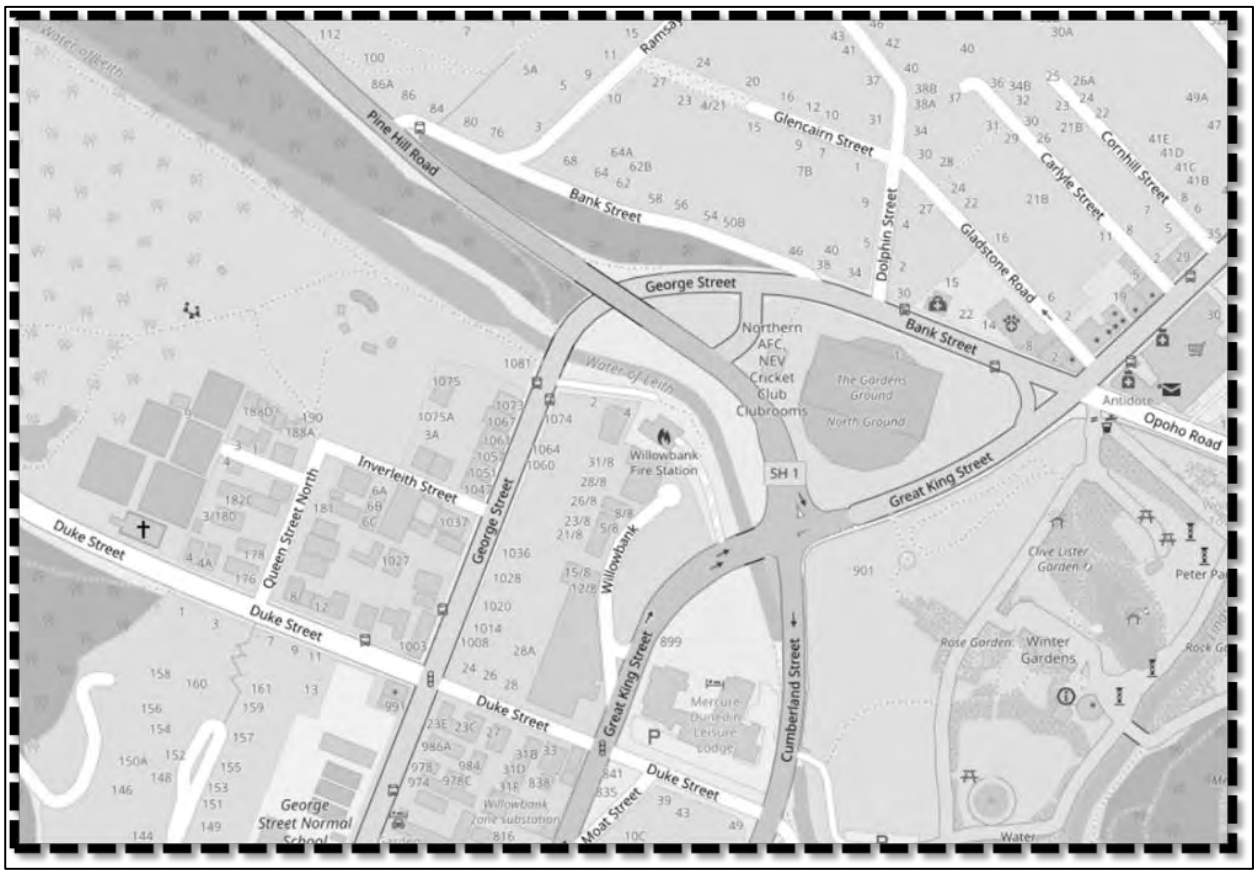


Figure 1-1: Study Area

2. Background

The intersection is located at the northern confluence of the one-way system (SH1) and comprises three state highway legs and one local authority road, Great King Street North, which is managed and maintained by the Dunedin City Council.

The intersection forms the main northern gateway into and out of Dunedin with the majority of traffic entering and exiting Dunedin passing through it. SH1 is a national route at this location and is the major freight route to the north of the city.

The site is located at the base of a steep incline and there are concerns about visibility constraints on some approaches. There has also been a risk of heavy vehicle roll over just north of the intersection, with heavy vehicles coming to a stop at or just past the intersection.

South of the intersection each of the one-way roads consist of two lanes with a separated cycleway along with footpaths and on street parking in some locations. The major intersections along the one-way system are signal controlled and priority is given to highway traffic at minor side roads and accessways.

The catalyst for this study is the Shaping Future Dunedin Programme Business Case, which identifies a preferred programme for the transport network in central Dunedin, to support future growth, liveability and placemaking opportunities.

2.1 Previous Studies (2003 onwards)

2.1.1 Strategic Corridor Study (2003)

This study looked at and modelled multiple options for the future Dunedin transport network. An alternative corridor was recommended which envisaged converting the one-way pair to two way, upgrading the harbour arterial and providing a gyratory interchange to replace the Jetty Street overbridge, and providing grade separation with on and off ramps at the Great King Street/Pine Hill Road intersection.

2.1.2 Scheme Assessment Report (2006)

This study focussed primarily on the truck rollover issue. At the time this resulted from brakes overheating as trucks descended a total of 630m from the Kilmog into Dunedin on the northern motorway (SH1). Overheating led to brake fade or failure, with loss of control on the low radius curve south of the George Street overbridge. Risks associated with loss of control were compounded by the stop-controlled intersection at Great King Street. The study considered arrester beds in different locations, safety barriers and safety improvements in the layby north of the intersection prior to the final descent.

The report reviewed 5 options and recommended 2 for further investigation:

- Option 1: Tangential arrester bed between Bank Street and the George Street overbridge, safety barrier in the sports ground, low-cost improvements at safety layby.
- Option 2: Safety barrier and gravel bed with partial arresting ability in the sports ground, low-cost improvements at safety layby.

Use of the playing field was unpalatable to the DCC. No infrastructure changes have been made as improvements as other locations have had a higher priority. Waka Kotahi focused on vehicle and operator compliance, driver training and education, and enforcement. Along with truck braking system improvements, there have been fewer loss of control incidents recently.

The issue was considered at the time of the SH1 cycleway installation in 2019. At that time a shorter arrester bed was considered which would continue the alignment of Pine Hill Road into the Gardens Sports Ground. A dragnet vehicle arresting barrier system was also identified as a possibility.

The two short listed options from the Scheme Assessment Report as well as the shorter arrester bed considered in 2019 are shown in Figure 2-1.

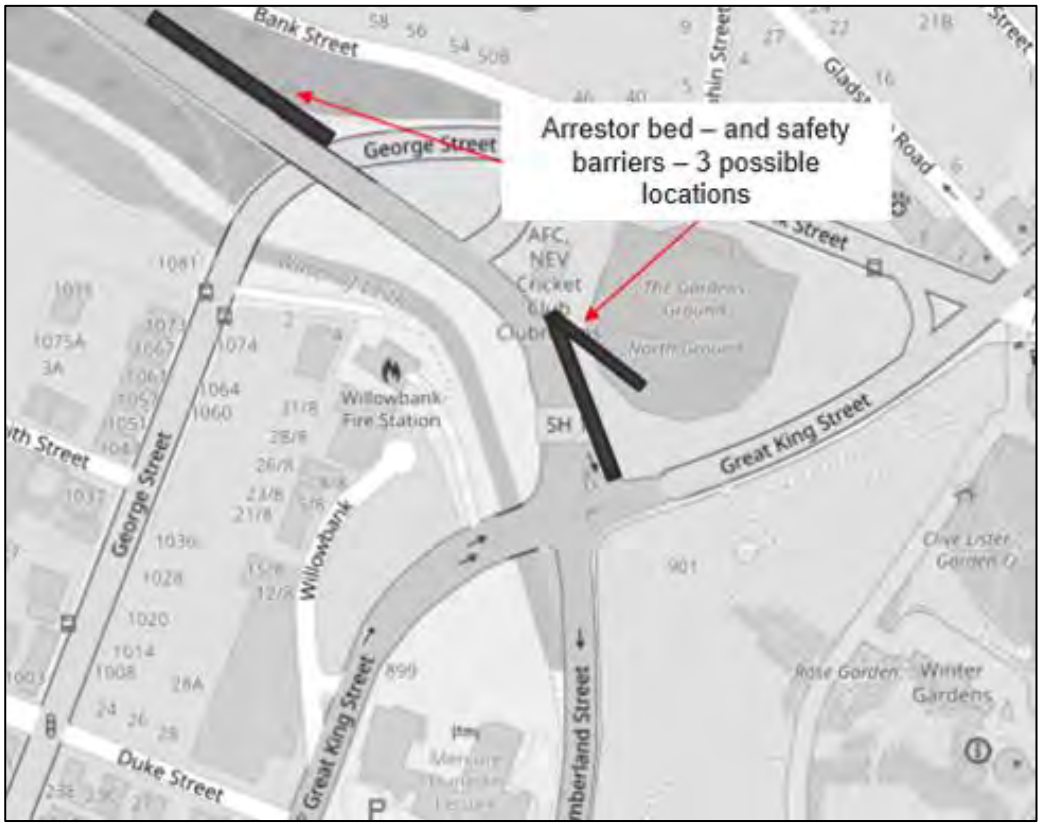


Figure 2-1: Possible arrester bed and safety barrier locations

2.1.3 Draft Great King/Pine Hill Intersection Strategic Case (2017)

A draft Strategic Case was completed in 2017. The agreed Investment Logic Map is shown in Figure 2-2.

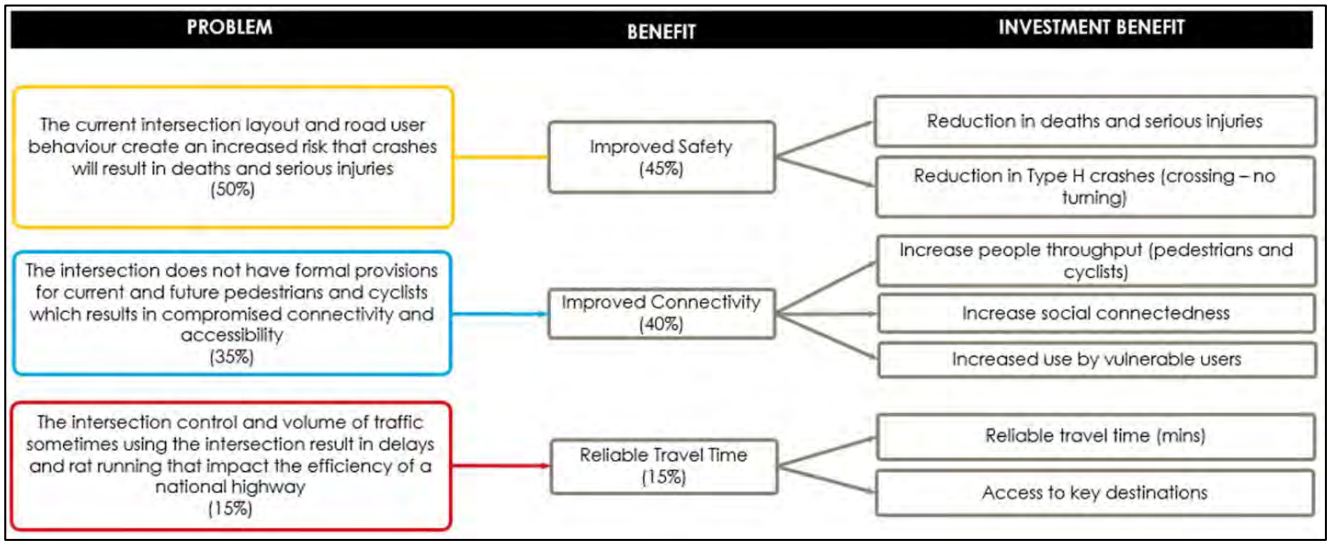


Figure 2-2: Investment Logic Map

The evidence that was used to support these problem statements was reviewed as part of this study, and up to date evidence is presented in this report.

2.1.4 Shaping Future Dunedin Programme Business Case (2020)

The objective of the Shaping Future Dunedin Transport project is to identify changes to the Dunedin transport network which will best support the location of the New Dunedin Hospital, while at the same time providing a future focused, accessible transport system enabling placemaking and liveability outcomes for the city.

The short-listed programmes include the following interventions:

- Moderate investment in Harbour Arterial route to provide bypass of central city area and alternative route for traffic during hospital construction, maintaining good access to the Port from the south
- Significant investment in public transport, cycling and walking to achieve mode shift to ensure continued access during construction, reduce carbon emissions from transport and make more efficient use of road network
- Investment in amenity improvements at targeted locations on SH1 to enhance their place value.

A key difference between the programmes is whether the one-way system remains or is returned to a two-way system. Reducing the number of arterial roads from two to one will reduce severance between key central city precincts such as the CBD, bus hub and the New Dunedin hospital, and the University campus and health sciences precinct.

The Pine Hill Road intersection would be fundamentally changed if a two-way system is preferred. For the purposes of this report, both one-way and two-way options are considered.

2.2 Land Use Context

Land use and zoning from the district plan in the vicinity of the intersection is shown in Figure 2-3.

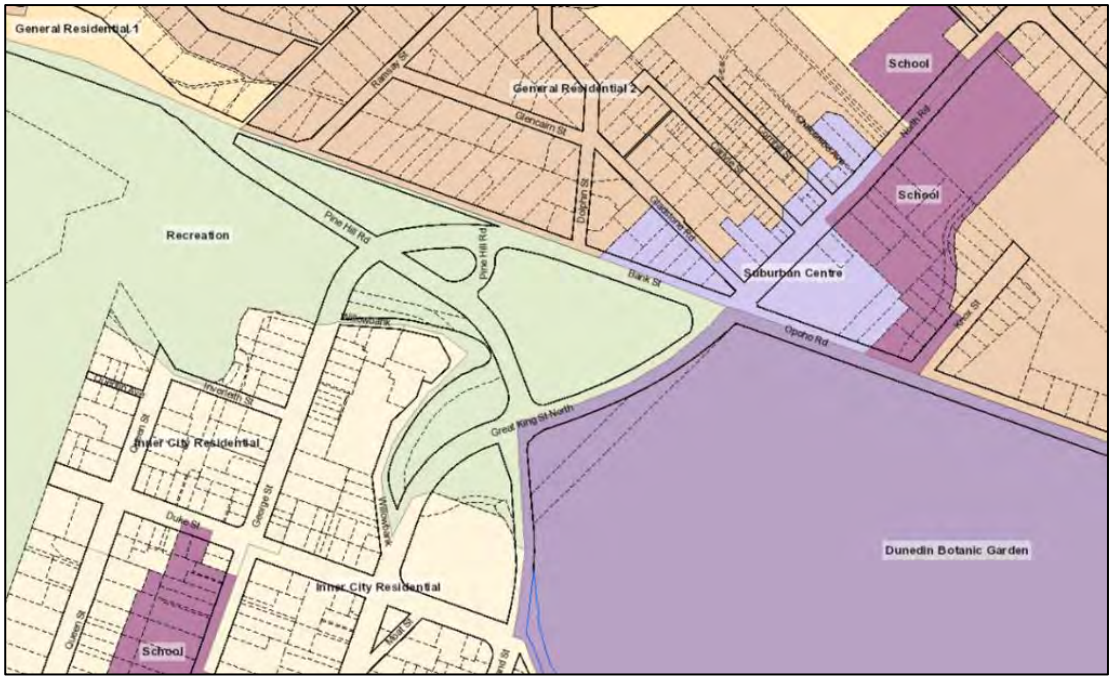


Figure 2-3: Land Use from the DCC Second Generation District Plan

The intersection is bordered on all sides by Recreation Zone land, including the Gardens Sports Ground (and cricket sheds), Town Belt and Dunedin Botanic Garden. To the north and south are higher density residential areas. The Gardens suburban centre is to the north. George Street Normal School is to the south, and Dunedin North Intermediate and Sacred Heart Primary School to the north.

The land use in the vicinity contributes to the transport demands through the intersection. North East Valley is a large suburb close to the city centre which generates many trips by all modes of transport. Pedestrian demands are high due to the location of schools, recreational areas and the shopping centre. Great King Street, Cumberland Street and George Street provide the transport connections between North East Valley and the city centre.

2.3 Stakeholders

The following key stakeholders will need to be involved in any future work relating to the intersection:

- Dunedin Botanic Garden, Friends of the Dunedin Botanic Garden
- Transport Department, Parks and Recreation Department - Dunedin City Council

- Sports Ground users
- Dunedin Amenities Society (Town Belt)
- George Street Normal School, Dunedin North Intermediate, Sacred Heart Primary School
- Businesses in Gardens Shopping Centre
- Residents in North East Valley and North Dunedin
- Bus and Tour Coach Operators
- Heavy haulage
- Automobile Association and Small Passenger Service Operators
- Emergency Services including Willowbank Fire Station
- Walking and Cycling Advocacy Groups eg Spokes
- Otago Regional Council

3. Case for Investment

The original Investment Logic Map shown in Figure 2-2 was reviewed, and evidence updated. The problems, evidence and benefits are presented below. Weightings are indicated in brackets.

3.1 Problem 1: Safety

Problem Statement: The current intersection layout and road user behaviour create an increased risk that crashes will result in deaths and serious injuries (50%)

A review of the evidence found that there is strong evidence to support this problem statement. The Intersection continually meets the criteria and is ranked nationally against other high risk intersections. It was on Waka Kotahi's list of 100 high risk intersections at number 28 (2014) and is currently 128 (2019) on Mega Maps III (Road to Zero). The DSI equivalent for the last five years at the intersection is 1.63 which falls in the high collective risk band (above 1.6). Since 1990, the DSI equivalent has been above 1.6 in 18 years out of 29, demonstrating a long-standing safety issue and elevated risk level. This problem has the highest weighting at 50%, and this is supported by the evidence as presented below.

3.1.1 Crash History

Table 3-1 shows reported crashes by severity over the last five years[1]. There have been 20 crashes, two resulting in serious injuries and six in minor injuries. A crash involving a pedestrian in 2018 resulted in serious injury, and it is noted there was a further serious injury crash involving a pedestrian in 2020.

Table 3-1: Crashes by severity at Pine Hill Intersection (2015-19)

2015-2019	Fatal	Serious	Minor	Non-Injury	TOTAL
Pine Hill Road/Great King Street Intersection	0	2	6	12	20

Two of the crashes involved trucks that lost control heading downhill. All other crashes involved vehicles failing to give way when crossing Pine Hill Road, as shown in Figure 3-1. In half of these crashes the vehicle stopped and then failed to give way, in the others the at fault vehicle did not stop at the intersection.



Figure 3-1: Crash locations

[1] Crash data for this report is for the 2015-19 period. This was current when the report was drafted in 2020. During the next stage of work, updated data will be available for assessment

3.1.2 Contributing factors

There are a number of factors at play contributing to these crashes.

3.1.2.1 Sightlines

There are several issues with sightlines at the intersection as a result of the intersection layout and road alignment. These are shown in Figure 3-2 and explained below.

- Forward visibility when travelling on Great King Street is limited by a horizontal curve which ends at the intersection – location [1] on Figure 3-2.
- Sight lines at the stop sign to and from the north are compromised by the alignment, vegetation (recently improved) and northbound traffic, especially trucks, blocking the view of the southbound traffic. Difficult for downhill traffic to take evasive action. Location [2] on Figure 3-2.
- Alignment angle at stop limit line – on some vehicles the windscreen pillar obscures the sight line towards oncoming traffic from the left. Believed to be a common causal factor – location [3] on Figure 3-2.

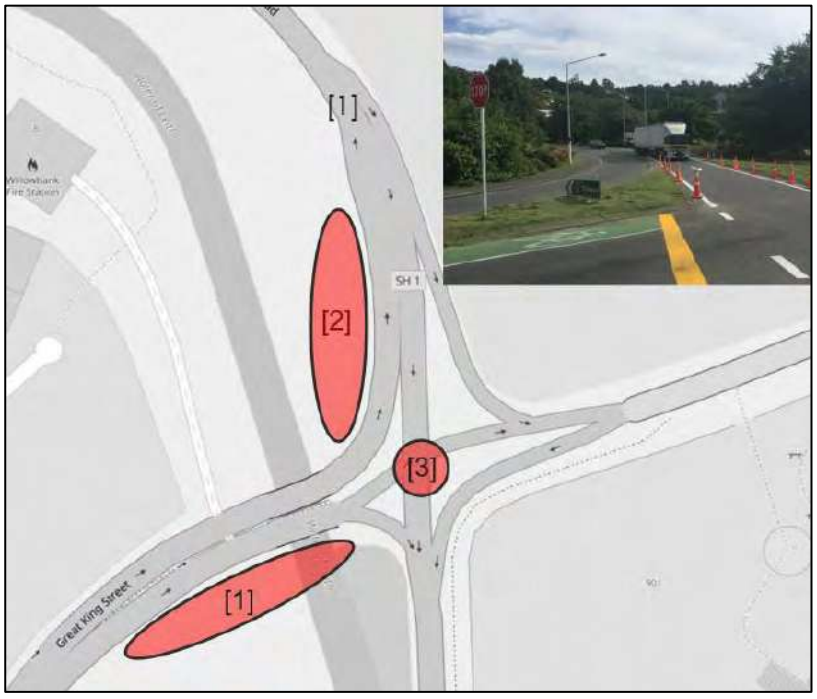


Figure 3-2: Issues with sightlines

3.1.2.2 Signage and Layout

- There is poor wayfinding signage on the Great King Street approach to the intersection and it can be unclear which lane drivers need to be in for the northern motorway or North East Valley. Signage on the northern approach on SH1 is also poor/missing signage and signs are too close to the intersection to allow safe and timely decisions. Waka Kotahi have a plan to address this issue in future.
- The layout is confusing for new/unfamiliar users and is unusual with the one-way approaches. More than one driver involved in a crash here has stated that it appeared similar to the entrance to a roundabout.
- Intersection is inconsistent with surrounding intersections which are signalised, or priority controlled.
- The Willowbank Fire Station exit point is located approximately 50m to the south of the intersection. This means that fire engines travelling to North East Valley and the central city must cross to the far lane which can be difficult.

3.1.3 Truck rollovers/loss of control

There have been a number of truck rollover crashes at the intersection, where trucks have lost control due to brake fade or failure on the combined 630m descent into Dunedin from the Kilmog and on the northern

motorway. Examples are shown in Figure 3-3. In the last five years there have been two truck rollover/loss of control crashes:

- 2015: Truck lost its brakes coming down hill, went through the left turn slip lane and hit two streetlights and a number of signs, coming to rest on the footpath against the fence at the Botanic Gardens. Driver was seriously injured. The truck was 13 years old and the brakes may have been out of adjustment.
- 2017: Similar incident although truck rolled on to its side and came to rest in the intersection (top photo) with the driver receiving minor injuries. This crash was blamed on a combination of driver inexperience and lack of vehicle maintenance.



Figure 3-3: Truck rollover crashes at Pine Hill intersection. Top image is 2017 crash, lower image is crash from earlier period (2001)

3.1.4 Safety Risk

Actual crash numbers fluctuate year on year. Figure 3-4 shows the actual number of injury crashes for each year since 1985, along with the five-year rolling average of DSI equivalents.

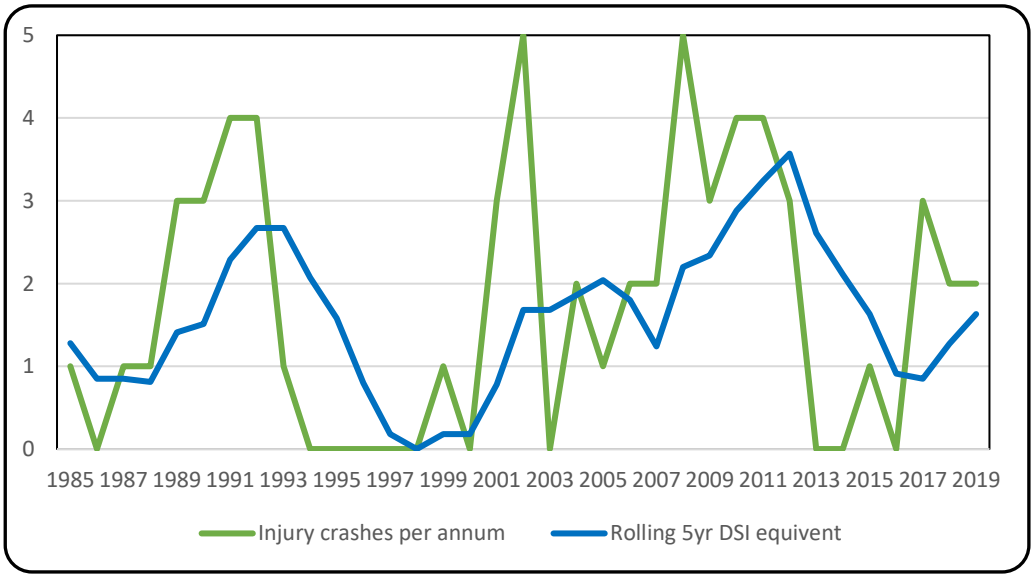


Figure 3-4: Historical Injury Crashes at Pine Hill/Great King Street Intersection (1985-2019)

Collective Risk is based on the number of fatal and serious crashes per kilometre in a (generally) five-year period. It can also be described as crash density. This metric highlights which road links have a high number of fatal and serious crashes on them, which can be used to help determine where the greatest road safety gains can be made from investment in engineering.

Figure 3-5 shows the Collective Risk at the intersection. The roads approaching the intersection have a High Collective Risk due to the high crash density at the intersection.

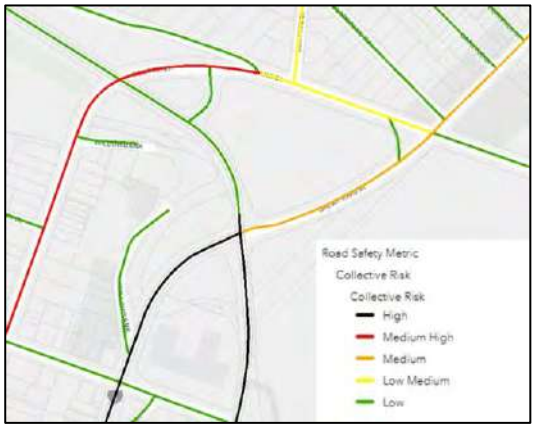


Figure 3-5: Collective Risk Map (from MegaMaps, mid-2020)

In 2014 the intersection was ranked number 28 on Waka Kotahi's top 100 high risk intersections list based on crash and injury severity data from 2003-2012. This list was replaced under Road to Zero by a Mega Maps (current version number III). Mega Maps uses a different system to rank risk, and shows the intersection at number 128 nationally. .

A calculation of DSI equivalents using the established method (detailed in the High-Risk Intersection Guide) gave a figure of 1.63 for the intersection over the latest five-year period. This method considers the injury crash types at an intersection and provides an index based on historic data which reflects how likely that injury type is to result in a death or serious injury. Table 3-2 shows the results, using the indices for a T intersection – although the intersection is a crossroads the one-way nature of both approaches means that it does not have the normal characteristics of a crossroads and a T intersection is considered more suitable for this calculation.

Table 3-2: Crash types and numbers, index and DSI equivalent (2015-19)

Crash Type	Number of crashes	Index	Value (crashes x index)
C – lost control (straight)	1	0.25	0.25
D – lost control cornering	1	0.24	0.24
H – Crossing movement (right angle)	5	0.18	0.9
N – Pedestrians crossing road	1	0.24	0.24
DSI Equivalent			1.63

The collective risk bands are shown in Table 3-3. Based on the last five years data the intersection has a high collective risk.

Table 3-3: Collective Risk Bands

Collective risk level	Estimated DSI equivalents (5 years)
High	>= 1.6
Medium-high	1.1 – <1.6.
Medium	0.6 – <1.1
Low medium	0.3 – <0.6
Low	< 0.3

3.2 Problem 2: Connectivity for Active Modes

Problem Statement: The intersection does not have provisions for current and future pedestrians and cyclists which results in compromised accessibility and connectivity (35%)

Pedestrian and cyclist desire lines pass through the intersection due to the proximity to three schools (one to the south and two to the north), recreation areas including the Botanic Gardens and Gardens Sports Ground, the Gardens shopping area to the north and higher density residential areas to the north (North East Valley, Pine Hill) and south (North Dunedin).

Since the Strategic Case was completed in 2017, some improvements for active mode users have been completed as part of the construction of the SH1 Separated Cycleway in 2019. However, facilities for active modes follow a convoluted route, are missing in some locations, and the intersection remains intimidating with no formal protection for vulnerable users.

There was only one crash involving a pedestrian in the 2015-19 period, and no cycle crashes. This crash is difficult to put into context as there are no pedestrian or cycle counts available, so it is unclear if vulnerable users were avoiding the intersection and using alternative routes such as George Street or they pass through or adjacent to the Botanic Gardens instead. However, a site visit in July 2020 showed that there is demand with pedestrians and cyclists observed passing through the intersection regularly. Some used the facilities provided and some did not.

3.2.1 Pedestrians

3.2.1.1 Pedestrian Facilities

Pedestrian facilities are shown in Figure 3-6. These consist of footpaths and informal crossing points via a series of refuges.

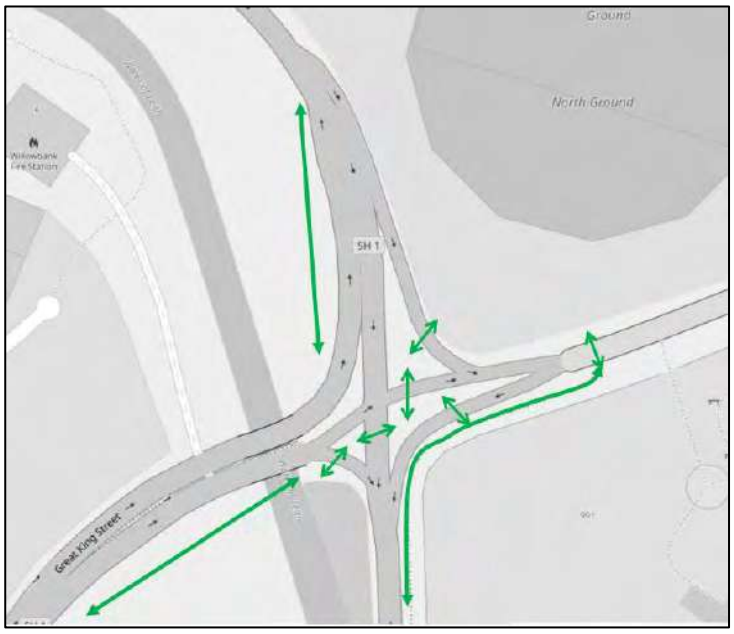


Figure 3-6: Footpaths and pedestrian crossing points

Issues for pedestrians at the intersection include:

- No protected crossing facilities. Tactile pavers and symbols and drop kerbs mark a convoluted route. While attempts have been made to improve levels of service, as shown above, some pedestrian crossing movements are not provided for.
- Crossing is uncomfortable due to horizontal and vertical approach geometry and vehicle speeds.
- No footpath on north side of Great King Street or around Sports Ground.
- Not all pedestrians observed used designated crossing points.

3.2.1.2 Pedestrian Counts

The Council completed surveys on two days during August 2020. The proportions crossing in each direction were similar on each day. The crossing movements on Day 1, 7am to 6pm, are illustrated in Figure 3-7.

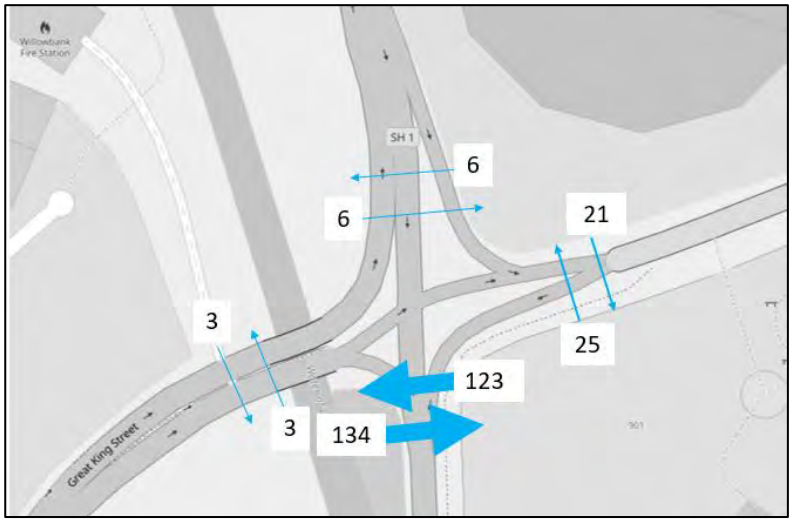


Figure 3-7: Pedestrian crossing movements day 1 (arrow locations are indicative only) (Source: Miovision)

The figures show that during the period 7am to 6pm on a typical day:

- A total of 321 pedestrian crossing movements were recorded at the intersection.
- 80% of crossing movements were across Cumberland Street, reflecting demand between North East Valley and the central city.
- A small proportion (3%) of pedestrians cross where there are no crossing facilities (Pine Hill Road and Great King Street to the west of the intersection)

3.2.2 Cyclists

3.2.2.1 Cycle Facilities

The location of cycle routes is shown in Figure 3-8.



Figure 3-8: Cycle lanes, Shared Paths and Crossing Points for Cyclists

The approach from the city is initially on the SH1 separated cycleway, however this disappears opposite the Willowbank Fire Station access and cyclists are directed onto a shared path which crosses the intersection at a designated crossing point with four crossing movements. The route then joins an on-road cycle lane to continue to the north. Alternatively, cyclists can traverse the live traffic lane to a cycle lane via which they can ride through the 'stop' controlled intersection. This part of the cycle network is a weak link between the SH1 separated cycleway and North East Valley cycle lanes.

Cyclists going north up Pine Hill can use a shared path on the left-hand side of the road, but cyclists travelling southbound down Pine Hill Road towards the intersection with Great King Street are not provided for and must use the carriageway.

At a site visit in July 2020, some cyclists were observed passing through the intersection on road and some used the facilities provided.

3.2.2.2 Cyclist Counts

The Council completed surveys on two days during August 2020. The cyclist movements were similar on each day. The cyclist movements on Day 1, 7am to 6pm, are illustrated in Figure 3-9.

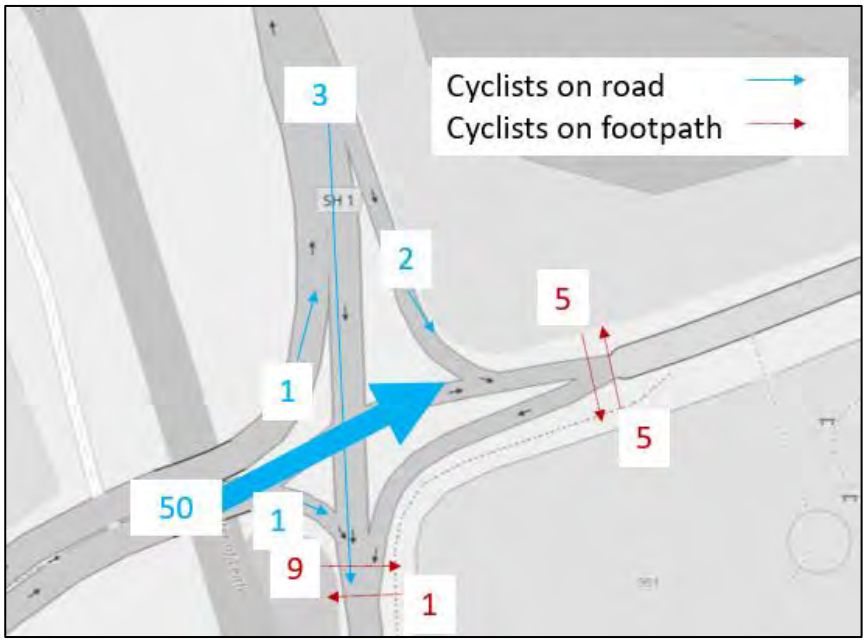


Figure 3-9: Cyclist movements day 1 (arrow locations indicative only) (Source: Miovision)

The figures show that during the period 7am to 6pm on a typical day:

- A total of 77 cyclists were observed using the intersection
- The majority (74%) were cycling on the road, with the remainder on the footpath (note the counts do not include cyclists who cycled on the footpath but did not cross any road)
- Of those cycling on the road, the dominant movement (88%) was cyclists using the cycle lane which provides for the eastbound movement to North East Valley from the city.
- The shared path crossing facilities which were provided as part of the SH1 Separated Cycle Facility were only used by 9 cyclists with 50 preferring the on-road facilities at the intersection.
- Very small numbers of cyclists were observed making other movements at the intersection.

The survey was limited to counting, and did not include feedback from cyclists.

3.3 Problem 3: Congestion

Problem Statement: The intersection control and volume of traffic sometimes using the intersection result in delays and rat running that impact the efficiency of a national highway (15%)

3.3.1 Traffic Movements

Figure 3-10 shows traffic volumes, percentage of freight and turn movements (from the Dunedin Paramics model for 2017). The data demonstrate that this is a busy intersection with high vehicle volumes on all approaches.

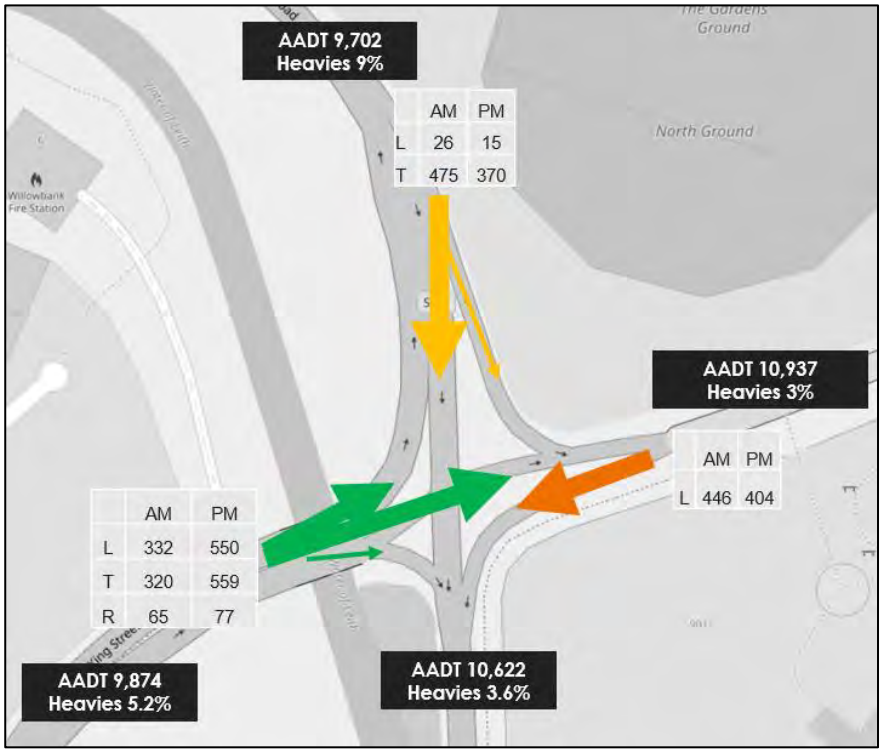


Figure 3-10: Traffic volumes and turn movements

The dominant movements at the intersection are:

- Left turn from North East Valley to city on SH1 (orange arrow)
- Through movement to city on SH1 (north to south) (yellow arrow)
- Left and through movement from city to north/SH1 and North East Valley (green arrows)

The highest flow is the evening peak flow to North East Valley and SH1 northern motorway.

3.3.2 Congestion

Despite the fact that this is a busy intersection with high traffic volumes, there is not strong evidence to demonstrate an efficiency problem. The Dunedin Paramics modelling completed for the Shaping Future Dunedin Programme Business Case for this intersection and the Gardens intersection is shown in Table 3-4. This shows that the intersection is currently at level of service A in the morning and inter peak, and level of service B in the evening peak, and delays are minimal.

Table 3-4: Dunedin Paramics Model Level of Service Output by time period, for Do Minimum and each of the Shaping Future Dunedin Programmes 1 and 2.

	AM			IP			PM		
Intersection	Do Min	P1 2027	P2 2027	Do Min	P1 2027	P2 2027	Do Min	P1 2027	P2 2027
North Rd/Great King/Opoho Rd	C 26 s	C 26s	C 31s	C 21 s	C 21s	B 20s	C 35s	D 36s	D 39s
Great King St/SH1	A 10 s	B 11s	B 17s	A 7s	A 6s	B 18s	B 15s	B 15s	C 24s

However, congestion is an issue to be aware of when considering any solutions because it has been observed and can influence driver behaviour. Observations are that congestion occurs on Great King Street in the evening peak period, as the through movement must give way to traffic coming into the city

on the northern motorway. Queues can quickly form extending as far as Duke Street if there is a stream of traffic from the north.

When the intersection is congested, some drivers take the left lane at the intersection, travel a short distance on Pine Hill Road and then turn right to use the off ramp to George Street. There is no right turn bay provided for this movement.

3.4 Benefits

3.4.1 Improve Safety (45%)

The main driver for improvements is to improve safety at the intersection. There is strong evidence demonstrating a safety issue at the intersection and possible improvements have been investigated over many years. This benefit therefore has the highest weighting. The specific outcome sought is a reduction in deaths and serious injuries. To achieve this benefit, the safety issue for the through movement must be addressed, and safety improved for trucks that could experience loss of control on the descent into Dunedin from the north.

Improving safety has a close alignment with the Government's Road to Zero approach, and this is reflected in the Government Policy Statement on Land Transport as well as Dunedin City Council's Integrated Transport Strategy (2013).

3.4.2 Improve Connectivity (40%)

This benefit relates to connectivity for pedestrians and cyclists and reflects the fact that the facilities for pedestrians and cyclists in the vicinity of the intersection are not well connected or easy to use. Protection for these vulnerable road users is absent despite the fact that there are many destinations within a short walking distance. Currently the intersection divides the city from North East Valley, and although there are alternative routes for pedestrians and cyclists which may be less intimidating, in some cases these will be longer and less direct.

3.4.3 Reliable Travel Time (15%)

This benefit has the lowest rating and evidence to support lack of efficiency on the highway was not strong. However, reliable travel times are important in ensuring good access to destinations and delays can be frustrating and lead to risk taking.

3.5 Risks and Constraints

Figure 3-11 shows the overlay zones and mapped areas from the 2GP in the vicinity of the intersection.

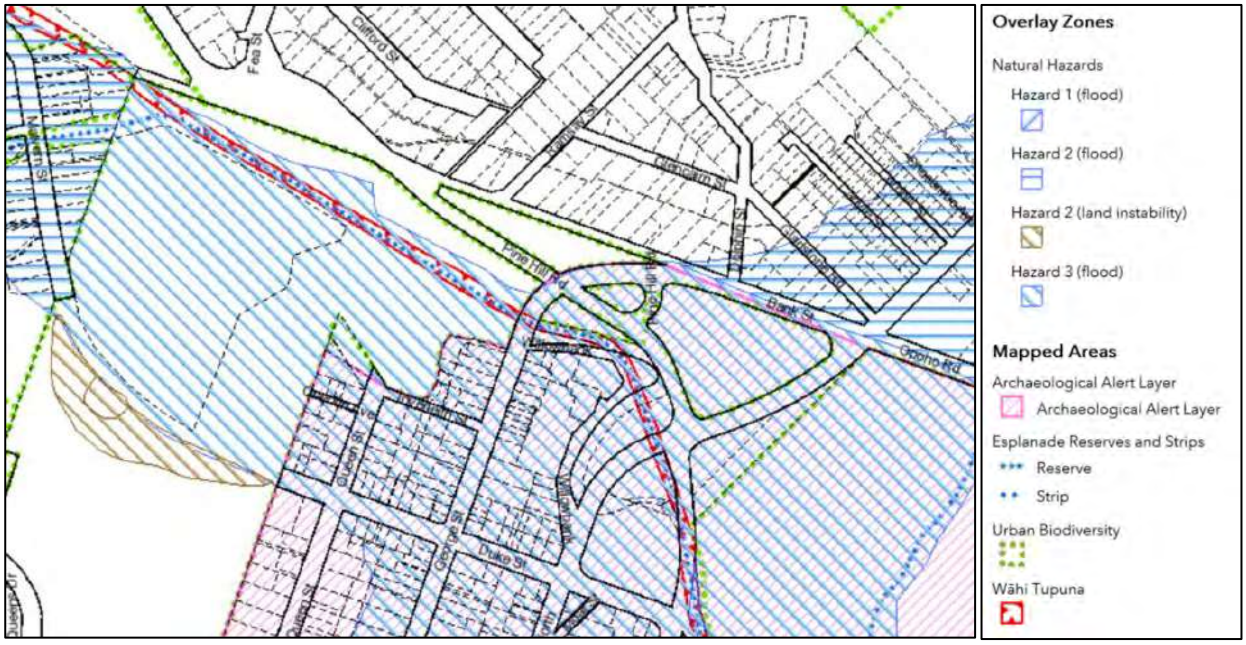


Figure 3-11: Overlay Zones and Mapped Areas from 2GP

The maps highlight a number of risks and constraints that need to be considered when looking at any changes to the intersection. Several constraints and risks relate to the Water of Leith, including flood risk, esplanade reserve status, and it is identified as a place of significance to Maori (Wahi Tupuna). In addition, the presence of the waterway may restrict options and/or add expense to solutions.

The intersection is adjacent to the Town Belt Urban Biodiversity Area which may also constrain options. The Archaeological Alert Layer highlights that there may be historical and/or cultural artefacts uncovered during any earthworks, which will be a risk during construction.

In addition to these risks and constraints identified in the District Plan, two further constraints have been identified:

- The route to North Road in North East Valley is an over-dimension route for over-height vehicles, due to a number of low bridges on the northern motorway. Over-height vehicles access SH1at Waitati via North Road and Mount Cargill Road. This needs to be considered in any future designs or changes to the intersection.
- The Gardens Sports Ground abuts the intersection. The Council have advised that the sports ground is in high demand all year round and there is a shortage of recreation space in Dunedin. It would be difficult for the Council to give up part of the sports ground for safety improvements at the intersection.

4. Part B: Developing the Preferred Option

4.1 Long List of Options

4.1.1 Shaping Future Dunedin Transport Programme Business Case

The objective of the Shaping Future Dunedin Transport project is to identify changes to the Dunedin transport network which will best support the location of the New Dunedin Hospital, while at the same time providing a future focused, accessible transport system enabling placemaking and liveability outcomes for the city.

Two programmes have been identified through the business case process.

4.1.1.1 Programme 1

- One-way pair as existing with through traffic able to use SH1 and harbour arterial.
- Cycleway on SH1 as existing (may change side)
- Bus routes as existing (via George Street to north)
- Investment in travel demand management and harbour arterial.

4.1.1.2 Programme 2

- Two-way system with a main arterial through route (current SH1 southbound) and a local road (current SH1 northbound).
- Cycleway on local road, not arterial.
- Bus routes via Great King Street to north
- Investment in travel demand management and harbour arterial.

The programmes have many similarities, but the key difference is that Programme 1 retains the SH1 one-way system and Programme 2 replaces the one-way system with a two-way arterial and a two-way local road. The Pine Hill Road intersection is pivotal in any change to a two-way system, as this is where the one-way system starts/finishes at the north end of the city. An option for Pine Hill Road was identified for Programme 2, and this option is included in the long list below.

As a decision is yet to be made on whether Programme 1 or 2 is preferred, both one way and two-way options have been considered for the Pine Hill Road intersection.

4.1.2 Excluded Options

The following options were excluded:

- An arrester bed or other truck loss of control safety system - not sufficient evidence to support this option proceeding alone. However, it should be further investigated fully through the business case process and accommodated in any redesign.
- Grade separation for vulnerable road users – not sufficient evidence to support this option proceeding alone. Vulnerable users are not over-represented in the statistics, although this may be due to avoidance, as they can use routes through the Botanic Gardens or on George Street.
- Grade separation below ground – this is precluded due to proximity to the Water of Leith.
- Grade separation with Great King Street Road traversing Pine Hill Road – this has been discounted because there are more benefits in reducing the existing gradient of the northern motorway by elevating this section of Pine Hill Road, rather than keeping the existing, steeper gradient. This has also been discounted to minimise the impact on the row of trees on the southern side of the sports field and allows for the continuation of the pedestrian and cycle network towards North East Valley.

4.1.3 Long List

A long list was developed by the project team and discussed at an issues and options workshop attended by stakeholders in July 2020. The following alternatives were considered:

4.1.3.1 Maintenance/minor

- Minor improvement to alignment
- Vegetation control
- Signs and markings

4.1.3.2 Intersection Control

- Signals, with advance amber warning for downhill traffic
- Roundabout
- Grade separation

4.1.3.3 Movements at intersection

- Restrict movements for some/all

4.1.3.4 Active modes and public transport

- Protection
- Direct route/amenity

These were developed into the following long list:

	Description	
1	Do Minimum – address maintenance issues.	• Manage vegetation, improve signs and markings, address any outstanding maintenance issues, investigate minor realignment
2	Restrict Movements (1)	• Ban through movement and divert all traffic via Duke - George - Bank route
3	Restrict Movements (2)	• Ban through movement for vehicles • Allow pedestrians, cyclists and buses to continue through movement
4	Restrict Movements (3)	• For two-way option, make left in/left out only and divert traffic via Duke - George - Bank AND new arterial route
5	Traffic Signals	• Traffic signals, with advance warning
6	SFDT Programme 2	• Traffic signals, with advance warning • Buses and active modes can make through movement, divert general traffic via George/Duke/Bank
7	Roundabout	• Roundabout
8	Grade Separation	• Grade Separation
Sub-Options (not standalone)		
i	Safety improvements to address truck issue	• Arrester bed or other system - accommodate in any redesign but no evidence to support this alone
ii	Grade separation for pedestrians/cyclists	

	Description	
iii	Close ramp from Pine Hill Road to George Street	

Images illustrating each option can be found in Appendix A.

4.2 Assessment of Options

4.2.1 Stakeholder Workshop

A stakeholder workshop was held in July 2020 to:

- Present the land use and transport context in the vicinity of the intersection
- Present a summary of previous work that has been completed, including the Strategic Case
- Discuss the existing issues at the intersection, and their relative importance, based on the evidence
- Discuss the long list of options and see if attendees had further ideas that could be developed into additional options
- Consider assessment criteria for the multi-criteria analysis
- Consider each option in turn and discuss advantages, disadvantages, risks and constraints from a wide range of perspectives

No new options were identified at the workshop, and the attendees provided useful feedback on the options. The results of this discussion formed the basis of the multi-criteria analysis of options.

4.2.2 Multi-criteria Analysis

Assessment criteria were developed by considering:

1. Evidence from the Strategic Case. This showed the following benefits were important:
    - Safety - Reduce crash risk for all users including pedestrians/cyclists
    - Connectivity (active modes) - Improve connectivity for pedestrians and cyclists
    - Travel Time - Maintain/improve travel times
2. Reviewing Shaping Future Dunedin Investment Objectives to identify additional areas of importance:
    - Mode Shift - Increase use of active/public transport
    - Carbon Emissions - Reduce carbon emissions
3. Waka Kotahi Investment Decision Making Framework requirements not already covered:
    - Achievability - Potential achievability (technical, safety and design, consentability)
    - Affordability - Potential affordability
    - Property impacts

Eight criteria were confirmed at the workshop: safety, connectivity, travel time, mode shift, carbon emissions, achievability, affordability and property impacts.

A standard seven-point scoring system was used to score each option against the criteria. The scoring system is shown in Figure 4-1.

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernable or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

Figure 4-1: MCA Scoring System

4.2.3 Do Minimum

Each option was scored in relation to the Do Minimum. The Do Minimum was confirmed in the workshop as:

- addressing maintenance issues
- managing vegetation
- improving signs and markings
- investigating minor realignment to improve visibility at the stop sign.

4.2.4 MCA Results

Table 4-1 shows the scores given for each option when considered against each criteria. The scores were based on discussion at the workshop, and the multi-criteria analysis scores allocated following the workshop and then reviewed by the client and project team for consistency and alignment. A total score and a weighted score (with safety weighted 50%) are also shown and discussed below.

Table 4-1: Multi-criteria analysis scores and explanation

		Enduring Outcomes					IDMF			Score		
	Option Details	Safety	Connectivity (active modes)	Mode Shift	Travel Time	Carbon Emissions	Achievability	Affordability	Property Impacts	Total (equal)	Total (safety)	Explanation for scores
1	Do Minimum											
2(i)(iii)	Restrict 1 - through movement diverted to George Street, one-way SH1. Pedestrians still cross. Cyclists off road shared path only.	1	-1	-1	-2	-2	-1	-2	-1	-9	-3	Truck system gives some safety benefit but otherwise safety problem moves to George Street. Connectivity and mode shift slightly worse than do nothing as cyclists off road only. Travel times longer and carbon emissions worse due to diversion and discouragement of active mode use. Achievability may be hampered by public opposition. Costs low for the intersection but need to include closing the ramp and arrester bed, plus costs to mitigate issues on Duke - George - Bank route. Property impacts for arrester bed.
3(i)(iii)	Restrict 2 - general traffic through movement diverted to George. Active modes, buses, trucks, motorbikes, taxis can make through movement. One-way SH1.	0	0	1	-2	-1	-1	-2	-1	-6	-5	Although truck system provides some safety benefit, outweighed by moving safety issues to George Street. Risk higher than for other options as some vehicles are making the through movement unprotected. Connectivity, carbon and mode shift better than 2 as these modes can make movement. Other scores same as 2.
4(i)(iii)	Restrict 3 - left in/left out only and through traffic uses George (ie no right turn or through movement for new local road). Two-way SH1.	1	-1	-1	-2	-2	-1	-2	-1	-9	-3	Safety - performs same as 2, for same reasons.

		Enduring Outcomes					IDMF			Score		
	Option Details	Safety	Connectivity (active modes)	Mode Shift	Travel Time	Carbon Emissions	Achievability	Affordability	Property Impacts	Total (equal)	Total (safety)	Explanation for scores
5a(i)	Traffic Signals, one-way SH1	2	2	2	0	1	-2	-2	-1	2	13	Safety improved as movements controlled, but still some doubt over whether heavy vehicles can stop in time especially if there is a queue back up the hill waiting for the green light. Arrester bed partial improvement in safety. Connectivity and mode shift supported through protected crossing. Assume travel times same as existing. Achievability score reflects truck issues and traffic lights not popular in Dunedin.
5b(i)	Traffic Signals, two-way SH1	2	2	3	0	1	-2	-2	-1	3	13	As for 5a but better for mode shift as buses more direct and closer to University.
6(i)	SDFT Prog 2 - Traffic Signals, general traffic through movement diverted to George. Active modes, buses, trucks, motorbikes, taxis can make through movement. Two-way SH1.	1	2	3	0	1	-3	-2	-1	1	6	Similar to 5b and 4. But likely to not be achievable as investment in traffic signals and diverting general traffic will be hard to sell to public as best solution. Shifts problems to alternative route.
7a(i)	Roundabout, one-way SH1 - assume land required so that turning can be achieved for southbound trucks	2	0	0	1	0	-2	-2	-3	-4	7	Speeds slower so safety improved. No improvement for active modes/connectivity or carbon. Travel times likely to be better. Achievability affected by consenting (with Water of Leith), land availability, which also add to affordability issues. Property impacts likely to be difficult with Sports Ground issues.
7b(i)	Roundabout, two-way SH1 - assumption as above	2	0	0	1	0	-2	-2	-3	-4	7	Same as 7a.
8a(i)	Grade Separation (SH1 over), one-way SH1	3	3	3	3	1	-2	-3	-3	5	21	Safest, most connected, likely to achieve significant mode shift. Some carbon reduction due to more active mode use but may lead. Issues similar to roundabout for achievability and property. Likely to be more expensive than roundabout option. Reduces gradient from northern motorway.

		Enduring Outcomes					IDMF			Score		
	Option Details	Safety	Connectivity (active modes)	Mode Shift	Travel Time	Carbon Emissions	Achievability	Affordability	Property Impacts	Total (equal)	Total (safety)	Explanation for scores
8b(i)	Grade Separation (SH1 over, local road under), two-way SH1	3	3	3	3	1	-2	-3	-3	5	21	Same as 8a.
	Sub-Options (not standalone)											
i	Truck System	1	0	0	0	0	-1	-1	-2	-3	3	Truck system offers safety benefits but may be will require land which may be challenging.
ii	Grade Separation for pedestrians and cyclists	0	3	2	0	1	-1	-2	-1	2	2	Option good for connectivity, mode shift and carbon, but does not address safety problem at intersection so would not do as standalone. Likely to not stack up due to costs and because there are alternative routes nearby for pedestrians.
iii	Close ramp SH1 to George Street	1	0	0	-1	0	-1	0	0	-1	4	Not a standalone option but would be safer as right turn currently sometimes queues back creating hazard.

4.2.5 Sensitivity Testing

Two weighting systems were tested:

- Equal weightings – where each of the eight criteria were weighted equally (12.5% per criteria)
- Safety weighting – safety weighted 50%, all other criteria equal (7.14% per criteria)

The two weighting systems gave the same results:

- Grade Separation + Truck System (8a(i) and 8b(i)) scored highest
- Traffic Signals + Truck System (5a(i) and 5b(i)) scored second highest

It is noted that the safety score for 'traffic signals' requires further investigation as the ability for traffic to stop at signals on the northern motorway descent to the Pine Hill Road intersection requires further investigation. At this stage it has been assumed that this is feasible.

4.2.6 Recommendations

The results of the assessment are that Grade Separation with an added truck system is the preferred option, with a truck safety system incorporated in the designs. This is preferred for both a one way and a two-way system. However, as this is a high-cost option, it is recommended that traffic signals and related intersection improvements are also taken forward as these may offer an interim option. However, it is noted the safety of any traffic signal intervention and related intersection improvements needs further assessment to provide confidence that signals a safe solution will be achieved, and not present added risk as vehicles queue at the red light on the northern motorway.

4.3 Preferred Option

4.3.1 Scope – One Way SH1

Figure 4-2 shows a high-level design concept for grade separation for the one-way system. For this option:

- Pine Hill Road/Cumberland Street would be elevated from the existing bridge over George Street south, reaching at grade just south of the intersection with Duke Street. This is a distance of approximately 300m.
- The existing northbound on ramp would need to be retained to provide for traffic heading north on SH1. This would need to be elevated to join the main elevated carriageway.
- Duke Street would be closed at the intersection with Cumberland Street, as it is anticipated Cumberland Street would still be raised at this point. Depending on the height of the bridge it may be possible for pedestrians/cyclists to continue to pass beneath on Duke Street.
- The existing access to the car park for the Botanic Gardens (33 spaces) would need to be relocated, and this may require construction of a new bridge across the Water of Leith. This cost is not included in the estimates.
- Great King Street would become one way from Opoho Road intersection south, as the southbound on ramp would need to be removed. It is highly unlikely that an on ramp could be achieved in this location due to proximity to the Botanic Gardens on this curve. Southbound traffic from North East Valley would use George Street, or access SH1 via the George Street ramp.
- Minor efficiency improvements could be possible at the Opoho/North Road intersection as Great King Street becomes one way outside the Gardens.
- Options exist for cycleway facilities on Great King Street – this could be via a shared path or contraflow separated cycleway which could pass under the new bridge. Alternatively, it may be possible to provide a cycle on ramp for Cumberland Street, as this would not require as much land as a full vehicle on ramp.
- A truck barrier would be provided on the bridge curve to improve truck safety. Improvements further up the hill should also be explored.
- Safety improvements would be made to the Pine Hill Road – George Street on/off ramp e.g. right turn bays.

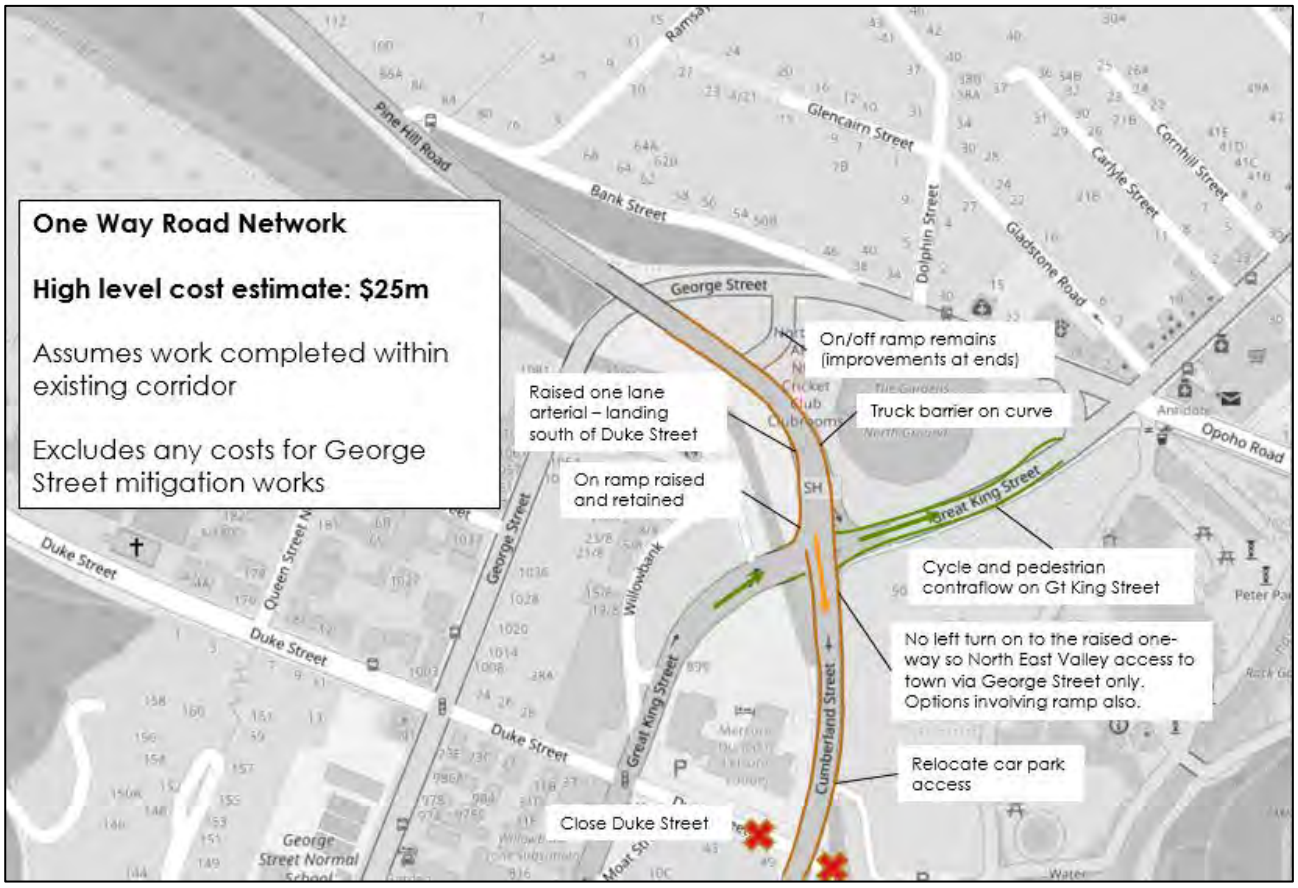


Figure 4-2: Grade Separation – One-way SH1

A high-level cost estimate for this is in the region of $25m, based on costs of similar facilities in Auckland. This assumes work is completed within the existing corridor. It does not include costs for mitigation works to ameliorate the impact of increased traffic on George Street which is expected with this configuration.

4.3.2 Scope – Two Way Network

Figure 4-3 shows a high-level concept for a two-way network with Grade Separation. This is similar to the one-way option but with the following key differences:

- The raised arterial is two lane rather than one lane.
- No on ramp is required from Great King Street North to Pine Hill Road. Traffic heading north to the northern motorway would already be on the grade separated arterial.
- Great King Street would become two way for its length, and cycle facilities provided in each direction which would connect to existing facilities on North Road.

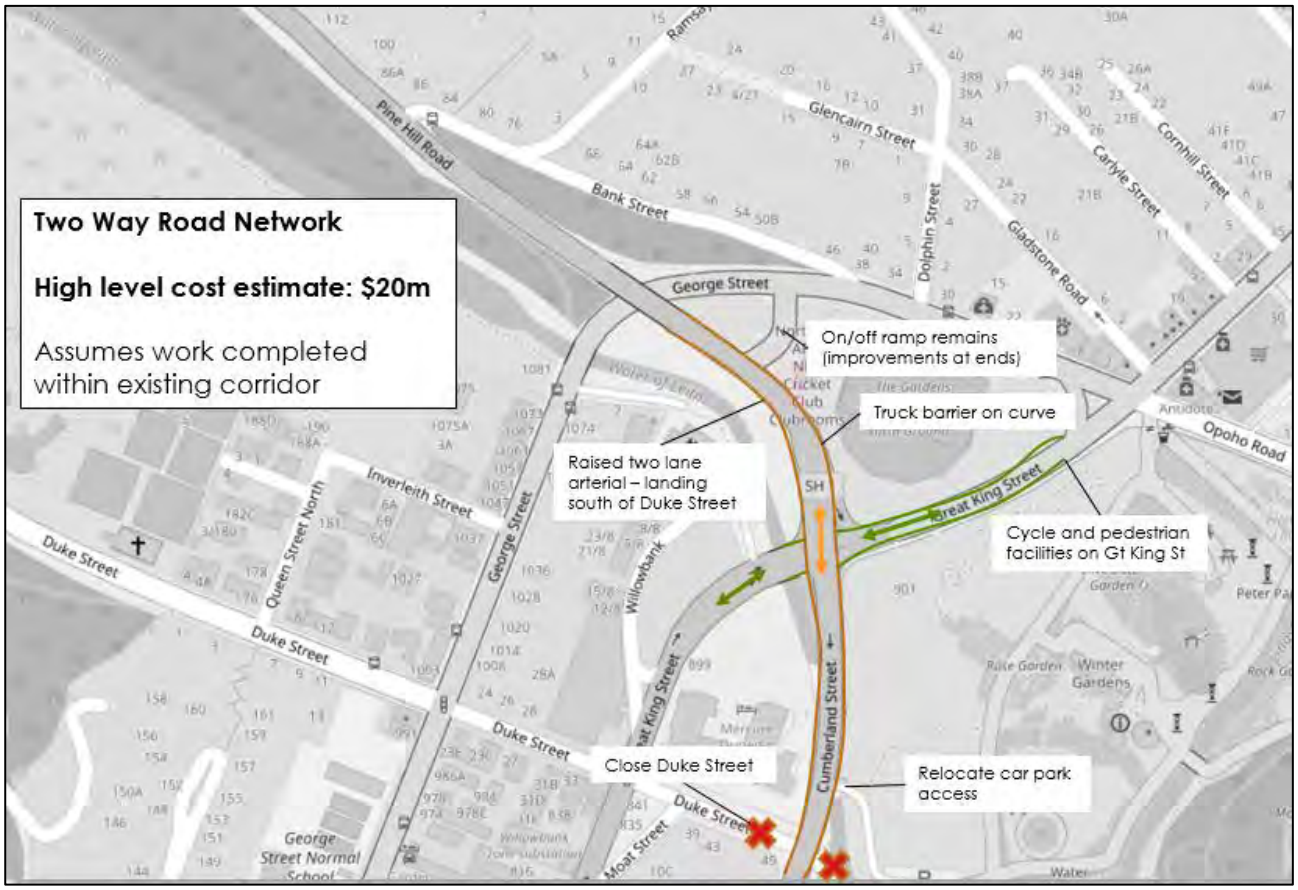


Figure 4-3: Grade Separation – Two-way SH1

It is anticipated that the high-level cost estimate for this option would be $20m, due to savings in not providing an on-ramp. Again, this assumes work is completed within the existing corridor.

4.3.3 Costs

The cost estimates are:

- Option 8a (one way configuration) $25m
- Option 8b (two-way configuration) $20m

Cost estimates assume:

- Pedestrians and cyclists have alternative routes
- These ramps can be designed to a minimum standard where some level of risk is acceptable i.e. not all the design guidelines are to be met.
- Excludes any property purchase or land acquisition
- No remediation is required to the Leith flood protection works

4.3.4 Benefits

A high-level economic evaluation has been undertaken in accordance with the procedures from the Waka Kotahi "Economic Evaluation Manual" (EEM).

A safety assessment has been completed to understand the safety benefits of grade separation. In the 2015 to 2019 five-year crash period there were 2 serious, 6 minor and 13 non-injury crashes at the intersection and approaches that could be addressed via the grade separation and other improvements.

A crash-by-crash analysis has been undertaken to determine the initial benefits.

For both option configurations, there would be a 100% reduction on the crossing/direct crash movements which is the predominant crash movement at the intersection. An assumption has been made to reduce

pedestrian crashes by 90% with vulnerable road users proposed to be redirected via Great King Street under the state highway, allowing for a small risk to remain. Similarly, the reported truck lost control on and off-road crashes in the five-year period have been assessed to have a 40% reduction with barriers provided on the curve however the risk remains should a truck experience brake fade or failure on a grade separated alignment. The one rear end queuing crash has been reduced by 90% allowing for a small risk to remain should there be any queuing in peak times in this area.

At this initial stage, only the crash cost (safety) benefits have been assessed. However, it is recommended that in the next stage, modelling should be completed to understand travel time and vehicle operating cost benefits for grade separation, as these are likely to be reasonable particularly for the two-way option. Any disbenefits on the George Street route for the one-way option will also need to be considered. Also walking and cycling benefits could be assessed at the next stage to determine any additional benefits.

4.3.5 Value for Money

High level BCRs for each option for the required period and discount rate are shown in Table 4-2. These BCRs are based purely on safety benefits and calculated for the two scenarios:

- 40-year analysis period with 6% discount rate as per the existing EEM procedures
- 60-year analysis period with 4% discount rate as per the proposed Monetised Benefits and Costs Manual (MBCM) and the Investment Decision Making Review (IDMF).

Table 4-2: Benefit Cost Ratios for Grade Separation Options

Option	BCR - 40 years + 6% discount rate	BCR - 60 years + 4% discount rate
Grade Separation + Retain One-way	0.23	0.35
Grade Separation + Convert to Two-way	0.28	0.43

BCRs are positive but are currently below 1.0 because the implementation costs are large. This is expected with building such elevated structures.

The full economic assessment is shown in Appendix B. It is assumed that construction works would commence in Year 1 with the capital costs spread over a couple of years. The benefits would be realised at Year 2.5. These assumptions on project timings can be updated during the next stage.

5. Next Steps

The intersection is currently on Waka Kotahi's Safer Networks Programme under Low-Cost Low Risk, with a budget of $440k in 2021-24. It is recommended that the project progresses to an SSBC to fully evaluate the preferred option in more detail, alongside other options and in light of any additional data.

This SSBC will also include additional traffic modelling to understand queueing and flow effects if traffic diverts via George Street, and test wider network implications eg safety. Modelling will also confirm the expected benefits to travel times and vehicle operating costs, as well as any wider benefits. A suitable truck arrester system will need to be confirmed and incorporated in the designs.

Appendices



Appendix A Long List of Options

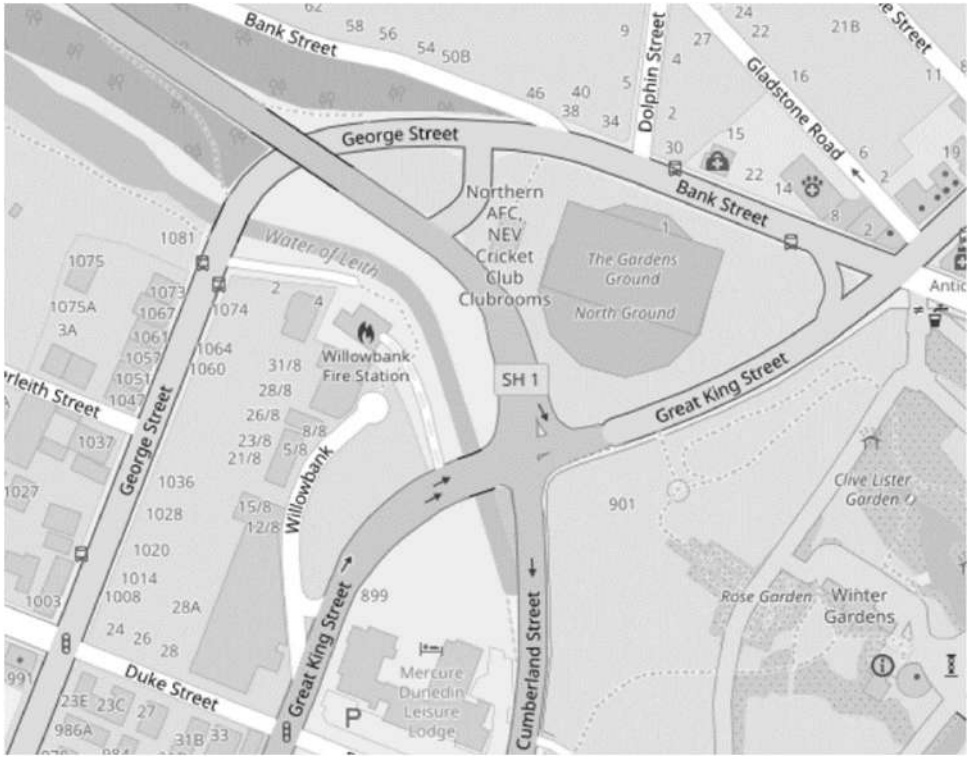
Long List of Options – Summary

	Description	
1	Do Minimum – address maintenance issues.	• Manage vegetation, improve signs and markings, address any outstanding maintenance issues, investigate minor realignment
2	Restrict Movements (1)	• Ban through movement and divert all traffic via Duke - George -Bank Road route
3	Restrict Movements (2)	• Ban through movement for vehicles • Allow pedestrians, cyclists and buses to continue through movement
4	Restrict Movements (3)	• For 2 way option, make left in/left out only and divert traffic via Duke - George - Bank Road AND new arterial route
5	Traffic Signals	• Traffic signals
6	SFDT Programme 2	• Traffic signals • Buses and active modes can make through movement, divert general traffic via George/Duke/Bank
7	Roundabout	• Roundabout
8	Grade Separation	• Grade Separation
	Sub-Option for truck issue	• Arrestor bed or other system - accommodate in any redesign but no evidence to support this alone – not high priority
	Others?	

Long List

Option 1a (one way) and 1b (two way)
Do Minimum

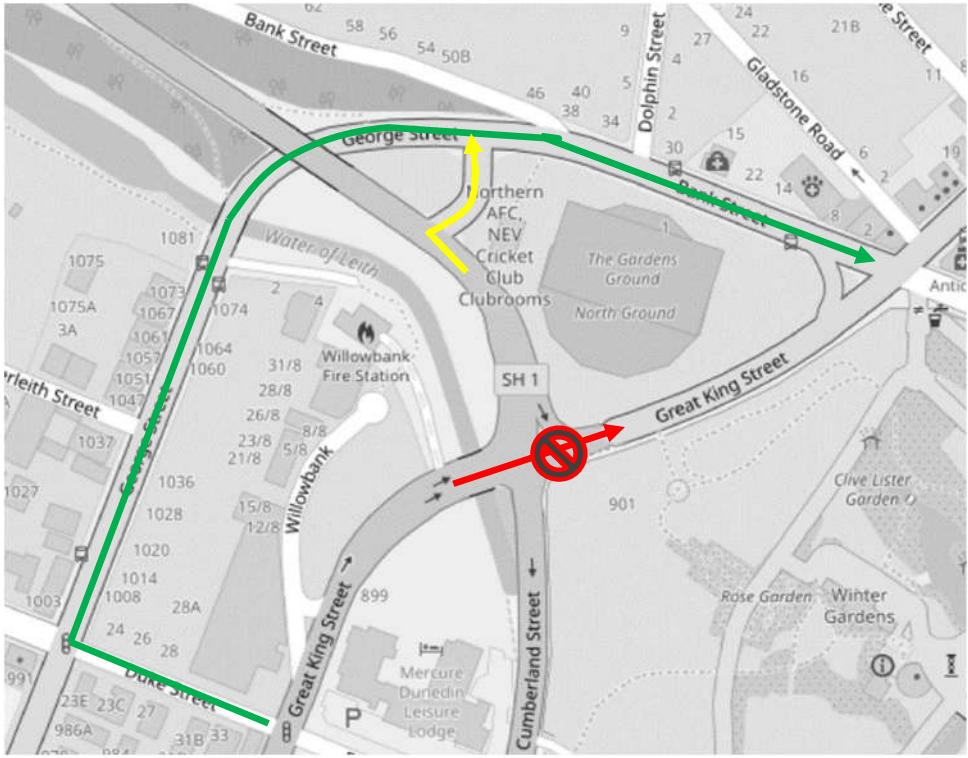
- Manage vegetation
- Improve signs and markings
- Address any outstanding maintenance issues
- Investigate minor realignment



Long List

Option 2a (one way) and 2b (two way)
Restrict movements (1)

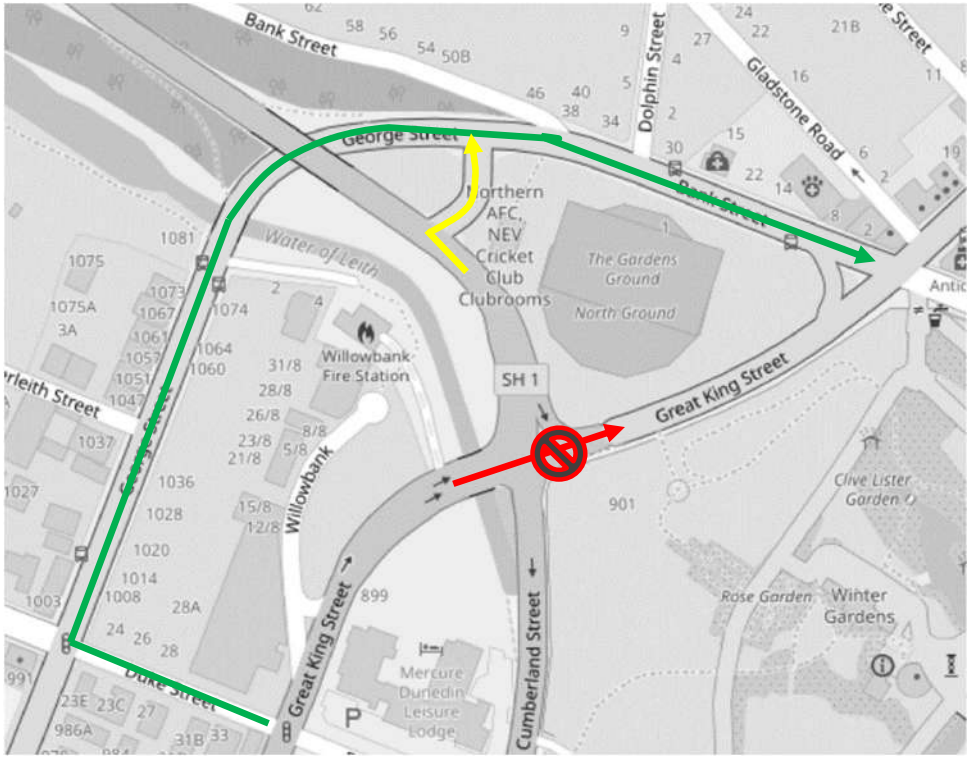
- No through movement to North East Valley, divert all modes via George Street



Long List

Option 3a (one way) and 3b (two way)
Restrict movements (2)

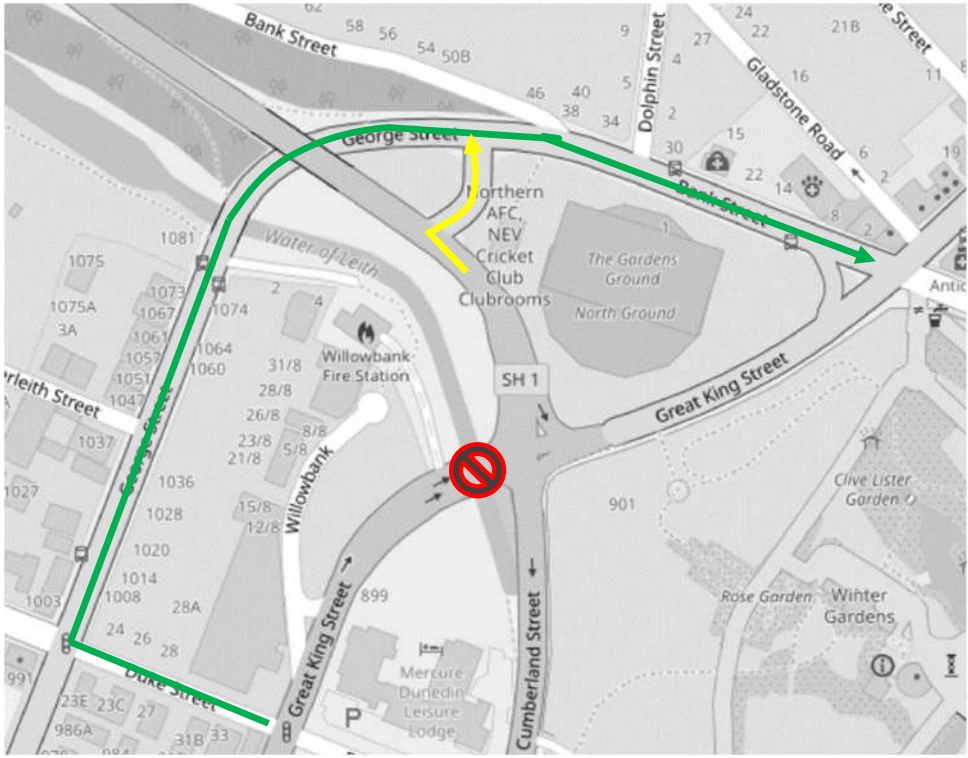
- No general traffic through movement to North East Valley, divert via George Street
- Allow pedestrians, cyclists and buses to continue to use intersection



Long List

Option 4b (two way only)
Restrict (3)

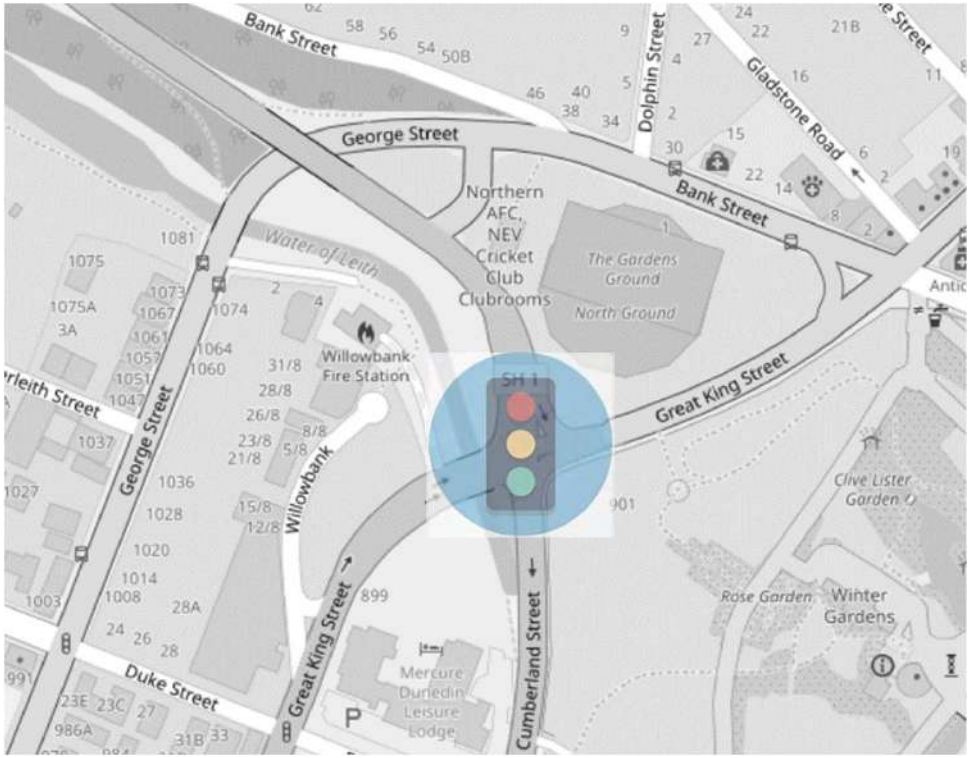
- Only allow left in / left out for Great King Street North.
- Removes all potential conflicting movements.



Long List

Option 5a (one way) and 5b (two way)
Traffic Signals

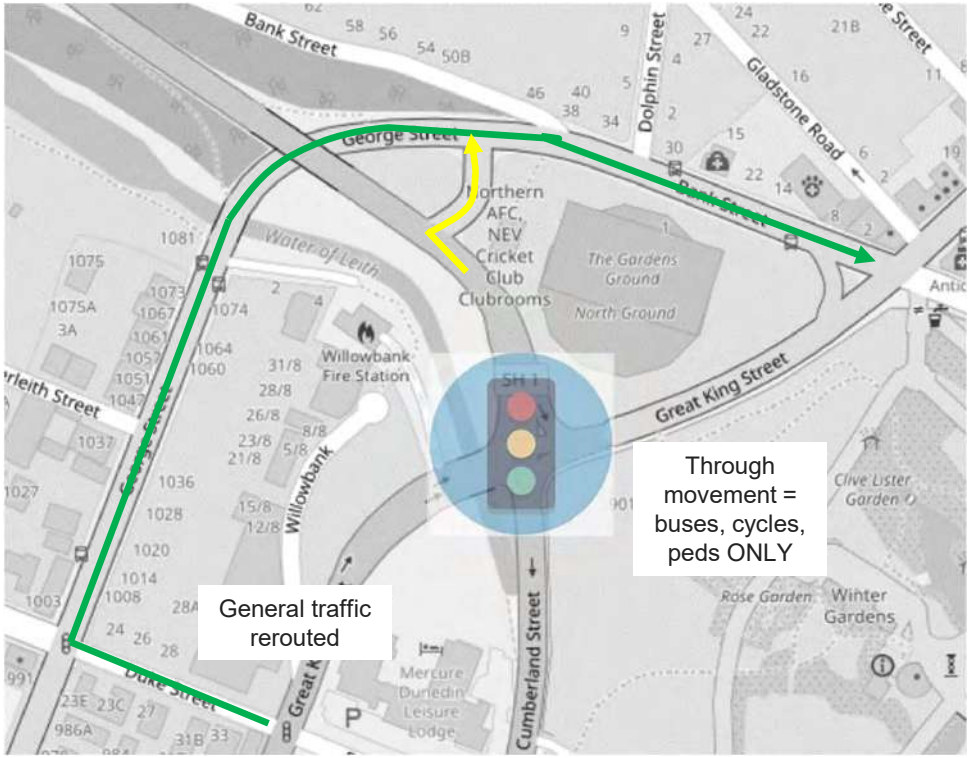
- Traffic Signals
  - Can trucks stop in time?
  - Intelligent transport system control



Long List

Option 6a (one way) and 6b (two way)
SFDT Programme 2 [Safety + Mode Shift]

- Traffic signals
- No through movement to North East Valley for general traffic – diverted via George Street
- Through movement allowed for buses, taxis, cycles, pedestrians crossing



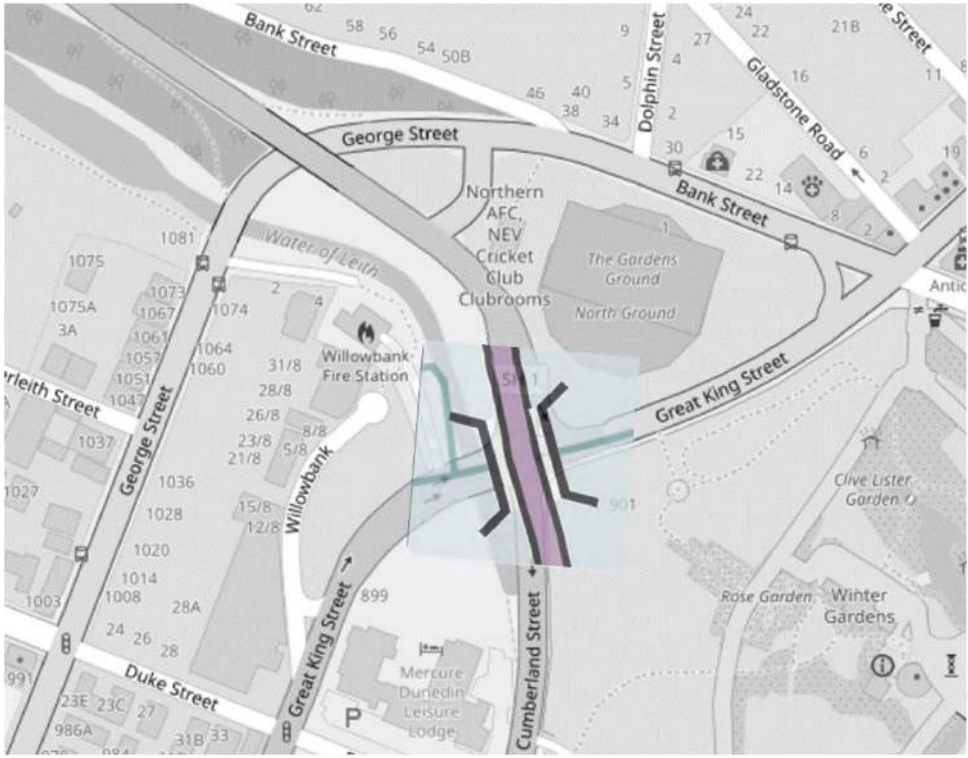
Long List

Option 7a (one way) and 7b (two way)
Roundabout



Long List

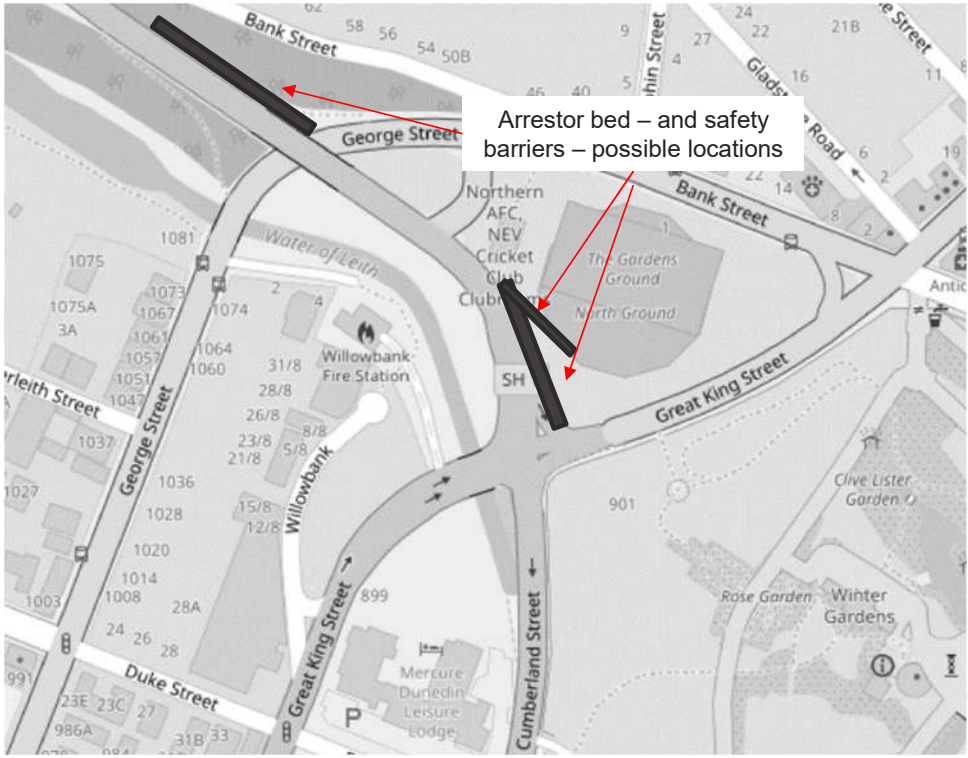
Option 8a (one way) and 8b (two way)
Grade Separation



Long List

Sub Option
Arrester bed or other system

- Arrestor bed
- Safety barriers
- Dragnet system



Appendix B Economic Assessment

SH1 Pine Hill Intersection
Benefit Cost Analysis of the Option

40 Years & 6% Discount Rate	Present Value Benefits ($)					Net Benefits ($)					PV Capital Costs ($)	BCR
Option	TT/VOC	Vehicle Emissions	Safety	Walking & Cycling	Total	TT/VOC	Vehicle Emissions	Safety	Walking & Cycling	TOTAL		
Do Minimum			$8,515,452		$8,515,452							
Grade Separation + Retain One Way			$3,403,475		$3,403,475			$5,111,977		$5,111,977	$21,774,202	**0.23**
Grade Separation + Convert to Two Way			$3,403,475		$3,403,475			$5,111,977		$5,111,977	$18,063,039	**0.28**

60 Years & 4% Discount Rate	Present Value Benefits ($)					Net Benefits ($)					PV Capital Costs ($)	BCR
Option	TT/VOC	Vehicle Emissions	Safety	Walking & Cycling	Total	TT/VOC	Vehicle Emissions	Safety	Walking & Cycling	TOTAL		
Do Minimum			$12,655,508		$12,655,508							
Grade Separation + Retain One Way			$4,643,341		$4,643,341			$8,012,168		$8,012,168	$22,778,903	**0.35**
Grade Separation + Convert to Two Way			$4,643,341		$4,643,341			$8,012,168		$8,012,168	$18,674,222	**0.43**

SH1 Pine Hill Intersection
Discounting - 40 Years & 6% Discount Rate

Description	Initial Amount	Start Time	End Time	Growth Rate	USPWF (s years)	USPWF (e years)	AGPWF (s years)	AGPWF (e years)	SPPWF	PV	Update Factor	Adjusted PV	Total	
Do Minimum - Pine Hill intersection														
Crash Costs														
Do Minimum cost	501,185	0	41	0.000	0.000	15.588	0.000	202.977		7,812,341	1.09	8,515,452	**8,515,452**	
Maintenance Costs														
Annual Maintenance	0	2.5	41	0.000	2.326	15.588	2.837	202.977		0	1.00	0	**0**	
Option - Pine Hill intersection + One Way														
Crash Costs														
Do Minimum cost	501,185	0	2.5	0.000	0.000	2.326	0.000	2.837		1,165,976	1.09	1,270,913		
Option cost	147,533	2.5	41	0.000	2.326	15.588	2.837	202.977		1,956,478	1.09	2,132,561	**3,403,475**	
Maintenance Costs														
Annual Maintenance	0	0	2.5	0.010	0.000	2.326	0.000	2.837		0	1.00	0		
Annual Maintenance	0	2.5	41	0.010	2.326	15.588	2.837	202.977		0	1.00	0	**0**	
Capital Costs														
Design fees	0	0.5							0.9713	0	1.00	0		*100% Design fees*
Land Costs	0	0.5							0.9713	0	1.00	0		*100% Land Costs*
Construction & fees (four laning)	12,500,000	2							0.8900	11,124,956	1.00	11,124,956		*50% Construct 50% MSQA Fees*
Construction & fees (four laning)	12,500,000	2.75							0.8519	10,649,247	1.00	10,649,247	**21,774,202**	*50% Construct 50% MSQA Fees*
	25,000,000													
Option - Pine Hill intersection + Two Way														
Crash Costs														
Do Minimum cost	501,185	0	2.5	0.000	0.000	2.326	0.000	2.837		1,165,976	1.09	1,270,913		
Option cost	147,533	2.5	41	0.000	2.326	15.588	2.837	202.977		1,956,478	1.09	2,132,561	**3,403,475**	
Maintenance Costs														
Annual Maintenance	0	0	2.5	0.010	0.000	2.326	0.000	2.837		0	1.00	0		
Annual Maintenance	0	2.5	41	0.010	2.326	15.588	2.837	202.977		0	1.00	0	**0**	
Capital Costs														
Design fees	0	0.5							0.9713	0	1.00	0		*100% Design fees*
Land Costs	0	0.5							0.9713	0	1.00	0		*100% Land Costs*
Construction & fees (four laning)	10,000,000	1.5							0.9163	9,163,074	1.00	9,163,074		*50% Construct 50% MSQA Fees*
Construction & fees (four laning)	10,000,000	2							0.8900	8,899,964	1.00	8,899,964	**18,063,039**	*50% Construct 50% MSQA Fees*
	20,000,000													

#REF!

Discounting - 60 Years & 4% Discount Rate

Description	Initial Amount	Start Time	End Time	Growth Rate	USPWF (s years)	USPWF (e years)	AGPWF (s years)	AGPWF (e years)	SPPWF	PV	Update Factor	Adjusted PV	Total	
Do Minimum - Pine Hill intersection														
Crash Costs														
Do Minimum cost	501,185	0	61	0.000	0.000	23.166	0.000	448.502		11,610,558	1.09	12,655,508	**12,655,508**	
Maintenance Costs														
Annual Maintenance	0	2.5	61	0.000	2.381	23.166	2.928	448.502		0	1.00	0	**0**	
Option - Pine Hill intersection + One Way														
Crash Costs														
Do Minimum cost	501,185	0	2.5	0.000	0.000	2.381	0.000	2.928		1,193,494	1.09	1,300,908		
Option cost	147,533	2.5	61	0.000	2.381	23.166	2.928	448.502		3,066,452	1.09	3,342,432	**4,643,341**	
Maintenance Costs														
Annual Maintenance	0	0	2.5	0.010	0.000	2.381	0.000	2.928		0	1.00	0		
Annual Maintenance	0	2.5	61	0.010	2.381	23.166	2.928	448.502		0	1.00	0	**0**	
Capital Costs														
Design fees	0	0.5							0.9806	0	1.00	0		*100% Design fees*
Land Costs	0	0.5							0.9806	0	1.00	0		*100% Land Costs*
Construction & fees (four laning)	12,500,000	2							0.9246	11,556,953	1.00	11,556,953		*50% Construct 50% MSQA Fees*
Construction & fees (four laning)	12,500,000	2.75							0.8978	11,221,950	1.00	11,221,950	**22,778,903**	*50% Construct 50% MSQA Fees*
	25,000,000													
Option - Pine Hill intersection + Two Way														
Crash Costs														
Do Minimum cost	501,185	0	2.5	0.000	0.000	2.381	0.000	2.928		1,193,494	1.09	1,300,908		
Option cost	147,533	2.5	61	0.000	2.381	23.166	2.928	448.502		3,066,452	1.09	3,342,432	**4,643,341**	
Maintenance Costs														
Annual Maintenance	0	0	2.5	0.010	0.000	2.381	0.000	2.928		0	1.00	0		
Annual Maintenance	0	2.5	61	0.010	2.381	23.166	2.928	448.502		0	1.00	0	**0**	
Capital Costs														
Design fees	0	0.5							0.9806	0	1.00	0		*100% Design fees*
Land Costs	0	0.5							0.9806	0	1.00	0		*100% Land Costs*
Construction & fees (four laning)	10,000,000	1.5							0.9429	9,428,660	1.00	9,428,660		*50% Construct 50% MSQA Fees*
Construction & fees (four laning)	10,000,000	2							0.9246	9,245,562	1.00	9,245,562	**18,674,222**	*50% Construct 50% MSQA Fees*
	20,000,000													

SH1 Pine Hill Intersection
Reported Crashes

2015 to 2019

Movement Code	Movement Category	Crash Severity				Total
		Fatal	Serious	Minor	Non-Injury	
AB, B	Head On					0
E	Hit Object					0
AD, CB, CC, CO, D	Lost Control off Road		1			1
CA	Lost Control on Road			1		1
AA, AC, AE-AO, GE, GF	Overtaking					0
FB, FC, GD	Rear End, Crossing					0
FD, FE, FF, FO	Rear End, Queuing				1	1
FA, GA-GC, Go	Rear End, Slow Vehicle					0
H	Crossing, Direct			5	12	17
J, K, L ,M	Crossing, turning					0
N, P	Pedestrian		1			1
Q	Miscellaneous					0
Total		**0**	**2**	**6**	**13**	**21**

Notes:
1. F = fatal, S = serious injury, M = minor injury, N = non-injury.

Summary of Crash Costs

Intersection	DO MINIMUM				OPTION
	Number of Crashes over 5 Years	Number of Injury Crashes over 5 Years	Number of Injury Crashes Per Year	Do Minimum Crash Costs	Option Crash Costs (1 & 2 Way)
Pine Hill Intersection	21	8	1.6	$501,185	$147,533

SH1 Pine Hill Intersection

Do Minimum Crash & Option - Crash-by-Crash Analysis

1.0%

Vehicle	Movement Category	Severity	TCR Period (yrs)	Reported Ax	F/S Ratio Factor Table A6.19(a-c)	Adjusted Reported Ax	Reported Ax Rate (Ax/yr)	Traffic Growth Factor Table A6.1(a)	Adjusted Ax Rate (Ax/yr)	Site Injury Ax Rate (Ax/yr)	Unreport Factor Table A6.20(a)	Estimated Ax Rate (Ax/yr)	Crash Costs ($/Ax) 50 km/h Table A6.21(a-d)	Crash Costs ($/Ax) 100 km/h Table A6.21(e-h)	Mean Speed (km/h)	Mean Speed Factor	Crash Cost ($/Ax)	DM Annual Crash Cost ($/Ax/yr)	DM Annual Cost ($/yr)	Crash Reduction Factor	OPT Annual Crash Cost ($/Ax/yr)	OPT Annual Cost ($/yr)
Truck	***Lost Control On Road (CA)***																					
		Fatal	5		0.05	0.00	0.00	0.86	0.00	***0.17***	1.0	0.00	4,150,000	4,750,000	55	0.1	4,210,000	0	***12,913***	40%	0	***7,748***
		Serious			0.95	0.00	0.00		0.00		1.5	0.00	485,000	505,000			487,000	0		40%	0	
		Minor		1		1.00	0.20		0.17		2.75	0.47	27,000	30,000			27,300	12,913		40%	7,748	
		Non-injury				0.00	0.00		0.00		7.0	0.00	7,300	8,900			7,460	0		40%	0	
Truck	***Lost Control Off Road (DG)***																					
		Fatal	5		0.13	0.13	0.03	0.86	0.02	***0.17***	1.0	0.02	4,150,000	4,300,000	55	0.1	4,165,000	93,129	***205,808***	40%	55,878	***123,485***
		Serious		1	0.87	0.87	0.17		0.15		1.5	0.22	505,000	475,000			502,000	112,679		40%	67,607	
		Minor				0.00	0.00		0.00		2.75	0.00	26,000	26,000			26,000	0		40%	0	
		Non-injury				0.00	0.00		0.00		7.0	0.00	7,000	8,400			7,140	0		40%	0	
Car, Van, Other	***Rear End, Queuing (FD)***																					
		Fatal	5		0.07	0.00	0.00	0.86	0.00	***0.00***	1.0	0.00	4,800,000	4,950,000	55	0.1	4,815,000	0	***3,215***	90%	0	***321***
		Serious			0.93	0.00	0.00		0.00		1.5	0.00	460,000	525,000			466,500	0		90%	0	
		Minor				0.00	0.00		0.00		2.75	0.00	29,000	31,000			29,200	0		90%	0	
		Non-injury		1		1.00	0.20		0.17		7.0	1.20	2,600	3,300			2,670	3,215		90%	321	
Car, Van, Other	***Crossing , Direct (H)***																					
		Fatal	5		0.05	0.00	0.00	0.86	0.00	***0.69***	1.0	0.00	4,950,000	4,650,000	55	0.1	4,920,000	0	***95,281***	100%	0	***0***
		Serious			0.95	0.00	0.00		0.00		1.5	0.00	520,000	595,000			527,500	0		100%	0	
		Minor		4		4.00	0.80		0.69		2.75	1.89	31,000	37,000			31,600	59,787		100%	0	
		Non-injury		11		11.00	2.20		1.89		7.0	13.24	2,600	3,400			2,680	35,494		100%	0	
Truck	***Crossing , Direct (H)***																					
		Fatal	5		0.05	0.00	0.00	0.86	0.00	***0.17***	1.0	0.00	4,150,000	4,150,000	55	0.1	4,150,000	0	***24,181***	100%	0	***0***
		Serious			0.95	0.00	0.00		0.00		1.5	0.00	490,000	520,000			493,000	0		100%	0	
		Minor		1		1.00	0.20		0.17		2.75	0.47	30,000	32,000			30,200	14,285		100%	0	
		Non-injury		1		1.00	0.20		0.17		7.0	1.20	8,000	10,200			8,220	9,897		100%	0	
Car, Van, Other	***Pedestrian (N,P)***																					
		Fatal	5		0.08	0.08	0.02	0.86	0.01	***0.17***	1.0	0.01	4,100,000	4,100,000	55	0.1	4,100,000	56,416	***159,786***	90%	5,642	***15,979***
		Serious		1	0.92	0.92	0.18		0.16		1.5	0.24	435,000	440,000			435,500	103,370		90%	10,337	
		Minor				0.00	0.00		0.00		4.50	0.00	24,000	24,000			24,000	0		90%	0	
		Non-injury				0.00	0.00		0.00		7.0	0.00	1,500	1,900			1,540	0		90%	0	
	Totals		***21***			***21.00***	***4.20***		***3.61***	***1.38***		***18.99***							***501,185***			***147,533***

Fatal	0
Serious	2
Minor	6
Non-injury	13
Total	**21**

SH1 Pine Hill Intersection
Capital Costs

1.000

Option	Construction			Fees D&PD, NZTA Managed Costs	Fees (MSQA, Consents, NZTA Managed Costs)	Fees Total	Land	Total
	Base	Contingency	Total					
Grade Separation + One Way Pair Retained			25,000,000			0		25,000,000
Grade Separation + Conversion to Two Way Operation			20,000,000			0		20,000,000

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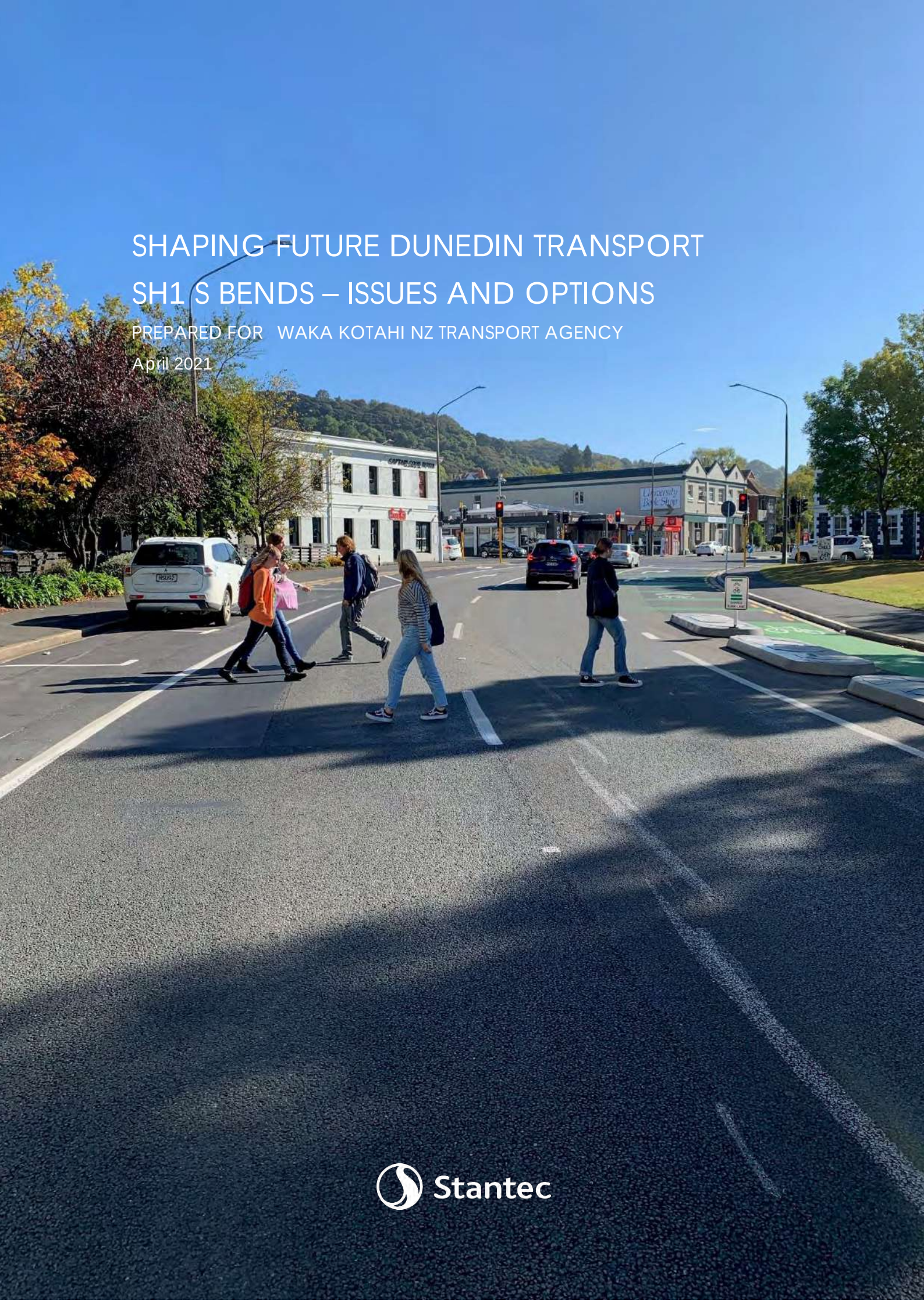
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Appendix C S Bends Issues and Options

SHAPING FUTURE DUNEDIN TRANSPORT
SH1 S BENDS – ISSUES AND OPTIONS

PREPARED FOR WAKA KOTAHI NZ TRANSPORT AGENCY

April 2021



Stantec

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CHECKED BY		
Jeremy Byfield		18/3/2021
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APPROVED FOR ISSUE BY		
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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
1	16/03/21	Draft for review	SC	JB	GO	GO
2	30/04/21	Final	SC	JB	GO	GO

Executive Summary

The S Bends[1] have been identified by the University of Otago as a barrier to pedestrian connectivity between the main campus, the Health Sciences Precinct (around Great King Street), and the rest of the city. This severance effect has also been identified in the Council's Central City Plan, Shaping Future Dunedin Transport Programme Business Case, Tertiary Precinct Plan and University of Otago Master plan.

This report examines the issues at the S Bends, presents a long list of options, completes an assessment of the options, incorporates findings from a stakeholder workshop, and presents recommendations.

Issues

The primary issues at the S bends relates to pedestrian severance and an unpleasant pedestrian environment. At the S bends high volumes of traffic on both northbound and southbound SH1 routes intersect with high volumes of pedestrians. There are multiple pedestrian desire lines due to adjacent land uses such as the campus, Health Sciences Precinct, shopping centre, Otago Museum, residential areas, and the CBD. At peak times (lunchtime) there are more pedestrians than motor vehicles passing through the Albany/Malcolm Street intersection.

The University Masterplan (2010) identified it was difficult to develop awkwardly shaped land parcels adjacent to the S Bends. However, the University has since identified it has sufficient land for future development to 2037, so this is not currently an issue, although it has been considered in the assessment.

Option Assessment

Seven main options were presented and discussed at a workshop with University staff and the Health Sciences Precinct planners. The long list of options considered those that retained the one-way system and those that introduced a two-way system. The options were then scored against four criteria: pedestrian connectivity, land use development, achievability and affordability.

Recommendations

The recommendations from the workshop and assessment are:

- Short term: Implement Option 1a (Do Minimum):
  - Slower speeds on both SH1 routes
  - Barnes Dances at Malcolm Street/Frederick Street and Gowland Street/Frederick Street signalised intersections
  - Cycleway on Albany Street.
- Medium term: Further Investigate to understand traffic implications and costs for:
  - Option 1b: Shaping Future Dunedin Transport Programme Business Case Programme 2v3 - consolidate arterial traffic on a two-way state highway on existing southbound SH1 and create a two-way local road with slow speeds and pedestrian focus on existing northbound SH1.
  - Option 2: Pedestrian bridge or underpass
  - Option 5: Two-way partial grid
  - Option 6: Two-way partial grid to south.

The University of Otago's preferred option is Option 1b, as it will significantly improve the pedestrian connection between the main campus and the Health Sciences Precinct. The progress of this option is subject to wider SFDT outcomes and decision making.

[1] The S Bends in this report refer to two sections of the SH1 one way system in Dunedin. Both northbound and southbound SH1 routes have, for one block, a curved section.

Waka Kotahi NZ Transport Agency

SH1 S Bends – Issues and Options

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1. Introduction

The S Bends in this report refer to two sections of the SH1 one way system in Dunedin. Both northbound and southbound SH1 routes have, for one block, a curved section, as shown in Figure 1-1.

In the northbound direction the street name of SH1 changes from Cumberland Street to Great King Street via the one curved block which is Malcolm Street. In the southbound direction the curved section is Gowland Street which connects Cumberland Street to the north to Castle Street to the south.



Figure 1-1: Location of S Bends in Central Dunedin

The S Bends have been identified by the University of Otago as a barrier to pedestrian connectivity between the main campus and the rest of the city. This severance effect has also been identified in other pieces of strategic work, such as the Council's Central City Plan, Shaping Future Dunedin Transport Programme Business Case (PBC), the Tertiary Precinct Plan and the University of Otago Masterplan.

The purpose of this report is to identify the current issues at the S Bends, present a long list of options, complete a high-level assessment of the options incorporating findings from a workshop discussion with stakeholders, and present recommendations.

2. Background

The catalyst for this study was the Shaping Future Dunedin Transport Programme Business Case, which identifies a preferred programme of work for the Dunedin transport system to support the location of the New Dunedin Hospital, while at the same time providing a future focused, accessible transport system enabling placemaking and liveability outcomes for the city.

2.1 S Bends - Previous Work

2.1.1 Strategic Corridor Study (2003)

The Strategic Corridor Study recommended introducing a two-way system for Dunedin with an arterial route on Cumberland Street passing straight through the S Bends using Emily Siedeberg Place and adjacent land. An option was also considered which introduced a tunnel under the campus along Cumberland Street from Dundas to Albany Street.

2.1.2 Tertiary Precinct Plan (2006), University Masterplan (2009/10)

These plans identified that:

- removing the S Bends would result in a much higher density development ratio and increase the total amount of floor area available after development. As the University are the main landowner, the benefit of this would be for University development.
- the one-way pair and the S Bends in particular create severance, reducing connectivity and pedestrian access between the campus, hospital and central city

The plans proposed to remove the S Bends and revert to a grid system to address the fragmented relationship between the University and city centre.

2.1.3 S Bend Issues and Options Report (2011)

The purpose of this report was to review previous work relating to the S Bends and recommend options that would address issues with pedestrian connectivity, safety, and under-utilised land in terms of future development and landscaping.

Three options were identified:

a. Grid: Remove northbound S Bend and reopen Great King Street as a two-way street, with Emily Siedeberg Place to become a one-way road.
b. Raised Development constructed over northbound S-Bend.
c. Tunnel under the university campus on Cumberland Street from Albany Street to the Alhambra Rugby Football Ground. This option was estimated to cost $100m and was discounted due to cost and because it does not address the S Bends issues.

2.1.4 Shaping Future Dunedin Transport Programme Business Case (2020)

The objective of the Shaping Future Dunedin Transport project is to identify changes to the Dunedin transport network which will best support the location of the New Dunedin Hospital, while at the same time providing a future focused, accessible transport system enabling placemaking and a liveable city.

The short-listed programmes include the following interventions:

- Moderate investment in Harbour Arterial route to provide bypass of central city area and alternative route for traffic during hospital construction, maintaining good access to the Port from the south
- Significant investment in public transport, cycling and walking to achieve mode shift to ensure continued access during construction, reduce carbon emissions from transport and make more efficient use of road network
- Investment in amenity improvements at targeted locations on SH1 to enhance their place value

A key difference between the programmes is whether the one-way system remains as it is or is returned to a two-way system. Reducing the number of arterial roads from two to one will remove severance between key central city precincts such as the CBD, bus hub and the New Dunedin Hospital, and the University campus and health sciences precinct.

There are opportunities to explore options to address the issues at the S Bends with both a one-way system and a two-way system. For the purposes of this report, both one way and two options are considered.

2.2 Land Use Context

Land use and zoning from the Dunedin District Plan in the vicinity of the S Bends is shown in Figure 2-1.

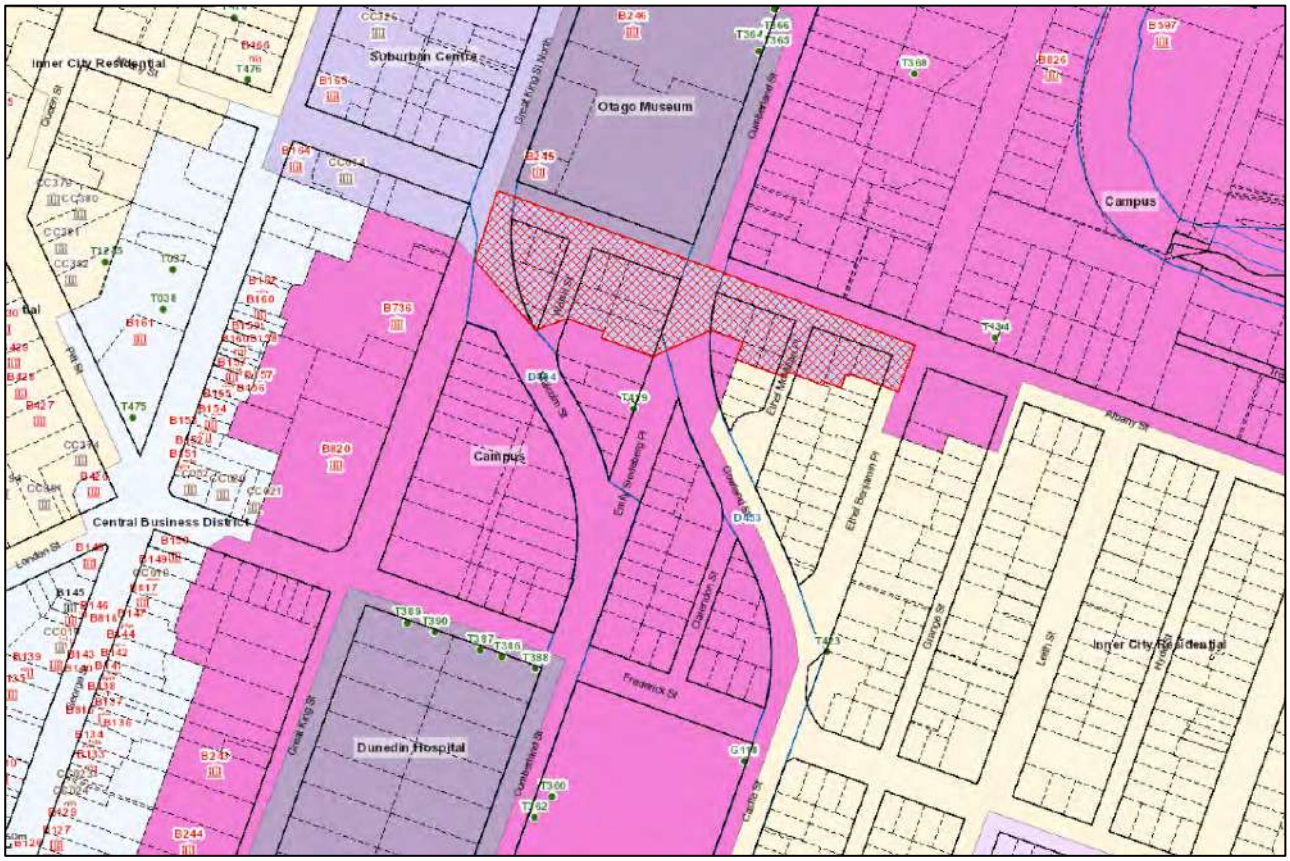


Figure 2-1: Land Use from the DCC Second Generation District Plan

As the map shows, there are a number of key destinations which make this a very busy part of the city for pedestrians and motor vehicles. Pedestrian desire lines traverse the S Bends in multiple locations, as people walk between Campus sites, to the Otago Museum, Dunedin Hospital and the suburban centre. There are also several off-street carparks in the area. There is Inner City Residential zoning to the east and west of the S Bends, and further north.

2.3 Constraints

There are two heritage buildings on the Otago Museum site which may act as a constraint to future solutions. There are scheduled trees on Frederick and Emily Siedeberg Streets.

2.4 Stakeholders

Due to the location and surrounding land uses the following key stakeholders have been identified:

- Otago Museum
- University of Otago
- Student Health Services
- Student Association
- Local shops and businesses e.g. Allpress, Ombrellos, University Bookshop, ANZ, Westpac
- Southern District Health Board

- Inner city residents
- Wilsons Car Parking
- Heavy haulage
- Automobile Association
- Otago Regional Council
- Dunedin City Council

Stakeholders will need to be involved in any future work relating to the S Bends.

3. Issues

3.1 Traffic Environment

The speed limit on all the roads in the area is currently 50km/h. Figure 3-1 shows the average annual daily traffic volume on each street in the vicinity of the S Bends. Some streets are one-way and some are two way, as indicated by the arrows. One-way streets are Malcolm, Gowland, Walsh and Clarendon Streets.

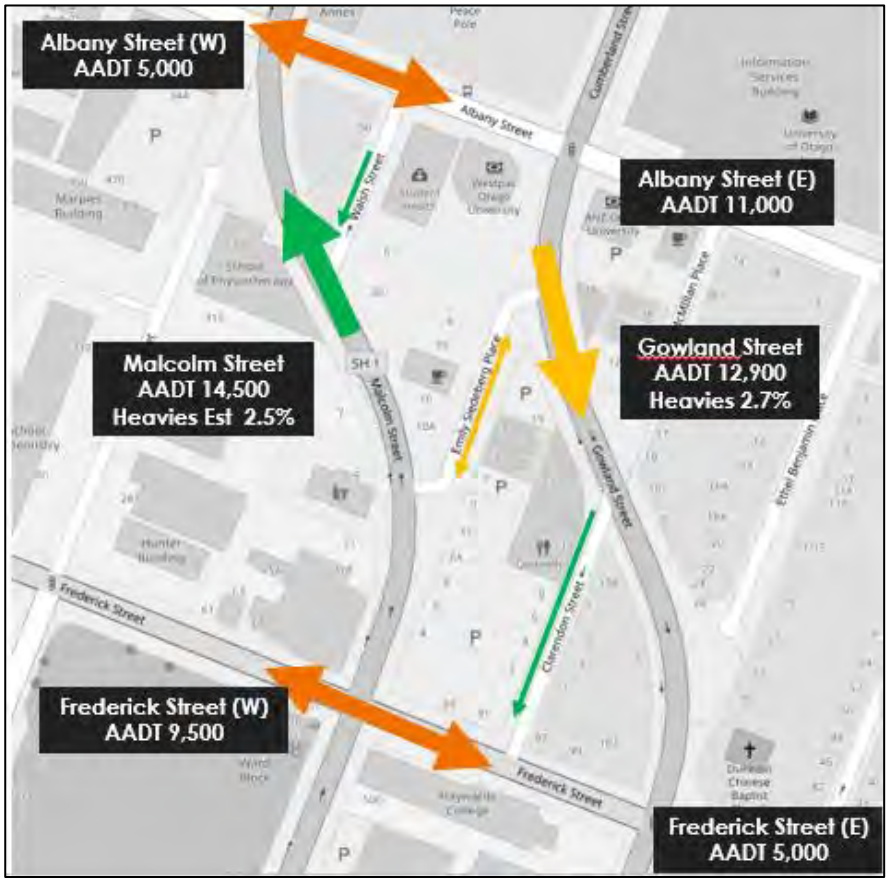


Figure 3-1: Traffic Volumes (from RAMM and NZTA website, for 2019)

Malcolm Street northbound has the highest traffic volumes. The volumes on Albany and Frederick Streets are also high but these drop off further away from the S Bends.

Any changes at the S Bends could affect traffic flow on Great King and Cumberland Streets to the north, including at the Pine Hill Road intersection, and Cumberland and Castle Streets to the south, as well as affecting traffic flows in the vicinity of the S Bends.

3.2 Crash History

Midblock there have been five crashes in the last five years, three on Malcolm Street and two on Gowland Street. All were minor or non-injury except one which resulted in serious injury when the driver had a medical event or fell asleep and left the road hitting a pole.

Intersection crashes in the last five years are shown in Table 3-1. All crashes were minor or non-injury except for at Albany Street/Malcolm Street where there was a serious injury to a cyclist when a driver failed to give way to them when turning.

Table 3-1: Intersection Crashes (2015-19)

Intersection	Total crashes
Malcolm Street/Frederick Street	9
Malcolm Street/Albany Street	5

Intersection	Total crashes
Gowland Street/Frederick Street	3
Gowland Street/Albany Street	6

Although the crash history shows relatively few crashes in the last five years, both Malcolm and Gowland Streets have High Collective Risk.

3.3 Pedestrian Environment

Campus activities generate significant pedestrian flows, especially on Albany Street, as shown in Figure 3-2, which shows the 15-minute peak counts for both pedestrians and vehicles. This shows that at certain times of day, some intersections have higher pedestrian movements than vehicle movements.

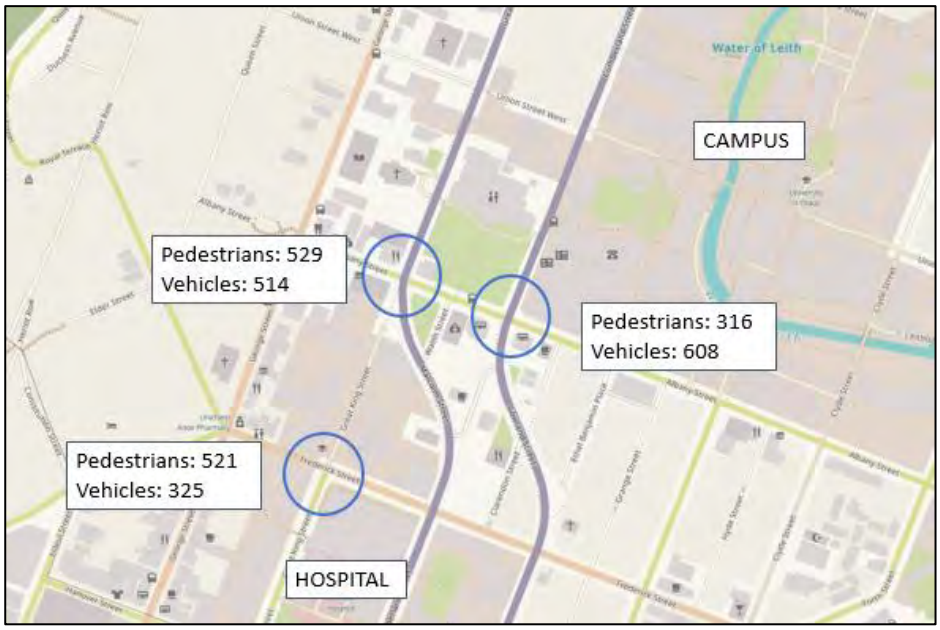


Figure 3-2: Pedestrian and Vehicle Peak Counts

The University, with around 20,000 students and 3,500 staff, needs safe and convenient routes between residential areas, the campus, health sciences precinct, Dunedin Hospital and the CBD. The Otago Museum will also benefit from safe and convenient walking routes.

There are very high pedestrian volumes and strong desire lines across the S Bends. The desire lines and formal crossing points do not always align. Figure 3-3 shows the desire lines, which are at the intersections of SH1 with Albany Street and Frederick Street, as well as many mid-block locations where no crossing facilities are provided.

Crossing demand at the signalised intersections is high, with peak hour counts highest around lunchtime on a weekday, with around 1400 pedestrian crossing movements at this time of day at the Albany/Malcolm Street intersection. This is primarily due to staff and students moving between the main campus area and the health sciences precinct (on and around Great King Street)/CBD.



Intersection	Direction	Peak Hour Count
Albany/ Malcolm (SH1 north)	East/ west	12-1pm (453)
	North/ south	12-1pm (921)
Albany/ Gowland (SH1 south)	East/ west	12-1pm (345)
	North/ south	12-1pm (494)
Frederick/Gt King Street (one block west)	East/west	11.30-12.30 (896)
	North/south	11.30-12.30 (353)

Figure 3-3: Pedestrian Volumes and Desire Lines

The map shows midblock crossing desire lines. On Malcolm Street, these tend to align with Walsh Street and Emily Siedeberg Place, as pedestrians using those side streets emerge onto Malcolm Street. On Gowland Street the midblock crossing desire lines tend to extend along the whole street as people access the residential areas to the east.

These midblock desire lines lead to frequent informal crossing, as shown in Figure 3-4. Pedestrians wait for gaps in traffic caused by traffic signal phasing, and then cross. Where pedestrians cross when moving between Walsh Street and Great King Street, they tend to wait on the cycle separators very close to moving traffic, which is a safety risk.



Figure 3-4: Pedestrians crossing midblock on Malcolm and Gowland Streets

Minor improvements have been made over the last ten years to improve pedestrian connectivity and safety. Most of these changes were a result of partnership work between the University, Dunedin City Council and Waka Kotahi. This included:

- Reversing the direction of traffic flow on Walsh Street, due to concerns about the safety of the previous arrangement, where vehicles travelling at 50km/h on Malcolm Street were able to turn right into Walsh Street and would still be travelling at speed immediately in front of the Student Health Services building, where large numbers of pedestrians would be crossing Walsh Street.

- Barnes Dance signal phasing was installed at both Malcolm/Albany Street and Gowland/Albany Street intersections as part of the SH1 separated cycleway project. Waka Kotahi have confirmed these will become permanent after the end of the trial.
- Introducing kerb build outs and removing a number of on-street parking spaces to provide a safer mid-block crossing point over Malcolm Street, between Walsh Street and Great King Street, where many people cross. However, this improvement was removed when the separated cycleway was installed on Malcolm Street, partly because the pedestrian level of service was improved at the Malcolm Street/Albany Street intersection through Barnes Dance phasing.

3.4 Cycling

A separated cycleway is provided on both Malcolm and Gowland Streets. Cycle counts are only available for the northbound cycle lane as shown in Figure 3-5. The graph shows that counts are higher on Great King Street north of Malcolm Street than they are on Cumberland Street south of Malcolm Street.

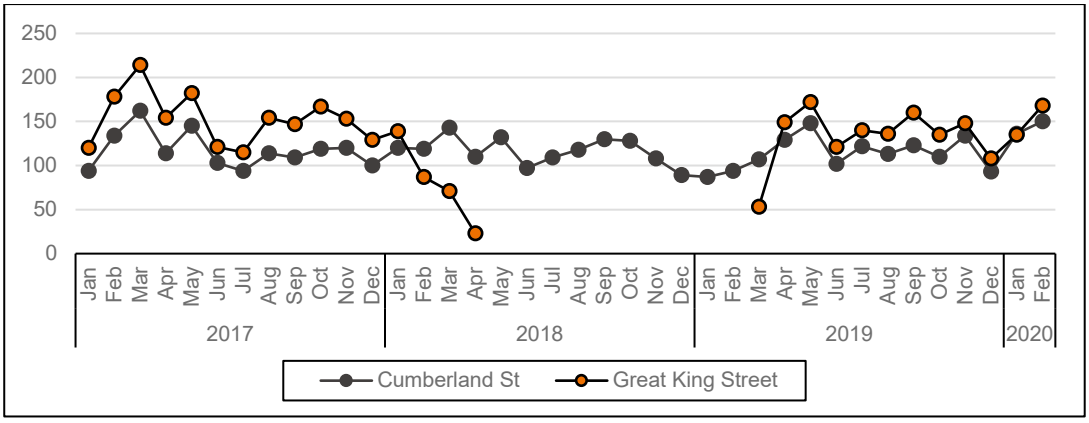


Figure 3-5: Cycle counts on SH1

There is no observable trend since the cycleway was installed, with around 150 cyclists per day. These numbers are lower than would be expected and there are several possible reasons for this:

- High traffic volumes and many trucks in traffic stream put people off cycling
- There are no cycle facilities on east-west routes that would connect to the SH1 cycleways
- There are limited cycle facilities (painted cycle lane only) and connection issues to residential areas to the north
- There are currently no cycle facilities on Albany Street or Frederick Street, although the Council are developing plans for a cycleway on Albany Street
- At the Albany Street/Gowland Street intersection, cyclists on the SH1 separated cycleway must cross diagonally as the cycleway changes to the opposite side of the road. This is because the cycleway changes side – to the north it is adjacent to the University, and further south it is closer to the CBD. The signals are designed to accommodate this, with the Barnes Dance including cycle aspects as well as pedestrian.

3.5 On-street parking

Parking is provided on both sides of Malcolm and Gowland Streets. This can add to the risk as people perform parking manoeuvres in the live traffic lane.

A further risk associated with on-street parking is that the curve in both roads means visibility can be restricted when pulling out.

4. Identifying the Preferred Option

4.1 Long List of Options

4.1.1 Shaping Future Dunedin Transport Programme Business Case

The objective of the Shaping Future Dunedin Transport project is to identify changes to the Dunedin transport network which will best support the location of the New Dunedin Hospital, while at the same time providing a future focused, accessible transport system enabling placemaking and liveability outcomes for the city.

Two programmes have been identified through the business case process.

Programme 1

- One-way pair as existing with through traffic able to use SH1 and harbour arterial (informal bypass route on Thomas Burns Street around the harbour).
- Cycleway on SH1 as existing (may change side)
- Bus routes as existing (via George Street to the north)
- Investment in travel demand management and harbour arterial.

In the vicinity of the S Bends:

- Both SH1 routes remain one-way
- Signals as current
- Lower speed limit on both SH1 routes (40km/h), with threshold treatments, indented parking, plantings
- Albany Street becomes a slower movement street with cycleway
- St Andrew Street is currently SH88, but this will change be relocated to Frederick Street, because a pedestrian focused street is required between the new hospital buildings.
- Barnes Dance crossings are provided at Frederick Street on both SH1 routes
- There is no change to the informal crossing between Walsh Street and Great King Street.

Programme 2

- Two-way system with a main arterial through route (current SH1 southbound) and a local road (current SH1 northbound).
- Cycleway on local road, not arterial.
- Bus routes via Great King Street to the north
- Investment in travel demand management and harbour arterial.

In the vicinity of the S Bends:

- SH1 southbound becomes a two-way arterial (50km/h)
- SH1 northbound becomes a two-way local road with slow speeds (30km/h)
- Signals remain at all four intersections
- Albany Street has slow street environment and cycleway
- Frederick Street as main arterial (SH88)
- Local road to have Barnes Dances at all intersections, and refuges for mid-block crossing on every block. Informal crossing at Walsh Street to be formalised (e.g. zebra/signals)
- Arterial has Barnes Dances at Frederick Street

The programmes have many similarities, but the key difference is that Programme 1 retains the SH1 one way system and Programme 2 replaces the one-way system with a two-way arterial and a two-way local road, as shown in Figure 4-1.

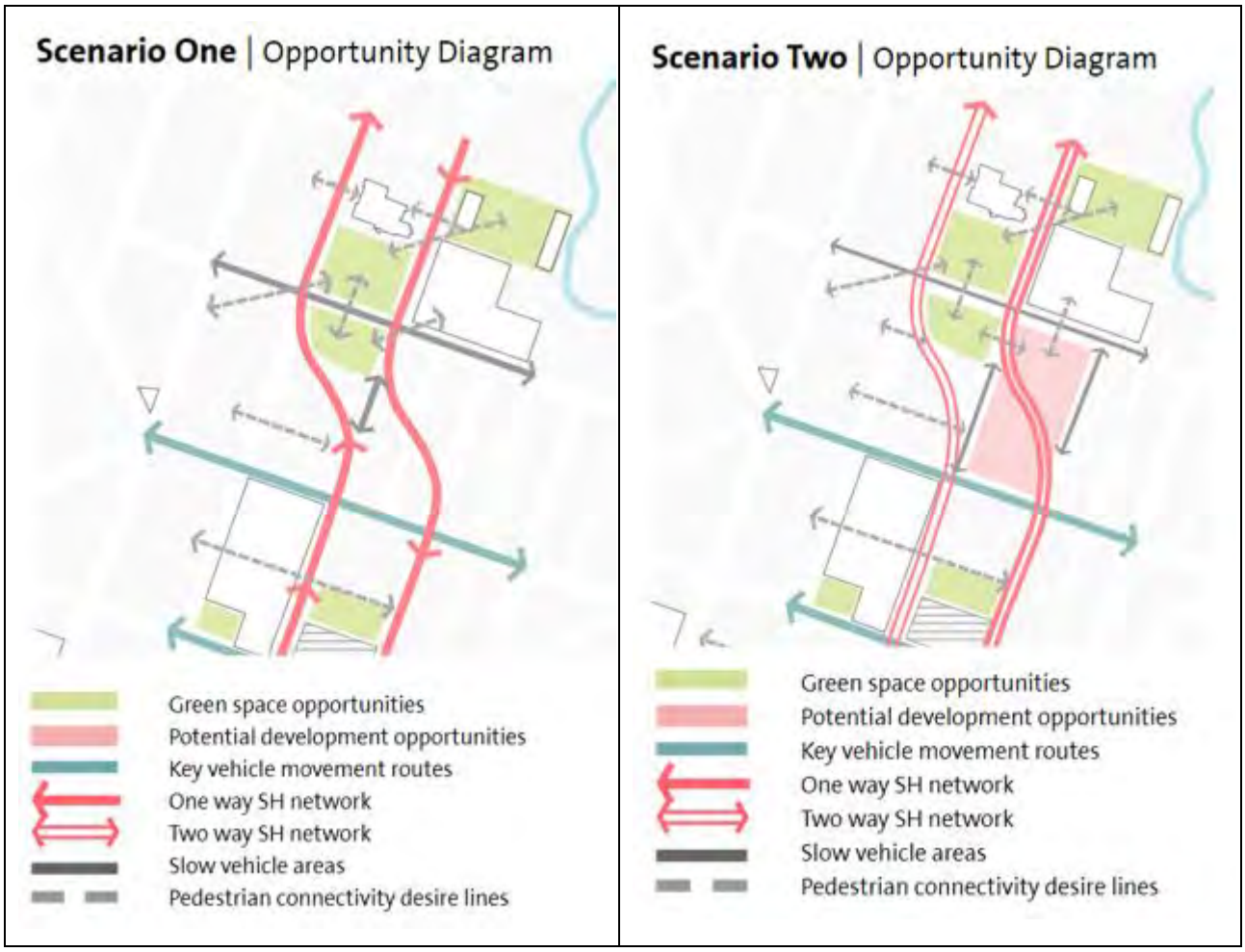


Figure 4-1: Option 1: Shaping Future Dunedin - Programme 1 and Programme 2 – S Bends Schematic Diagrams

As a decision is yet to be made on whether Programme 1 or 2 is preferred, both one way and two-way options have been considered for the S Bends.

4.1.2 Development of Long List

A long list of options was developed by the project team to:

- Address pedestrian connectivity issues and improve the pedestrian environment
- Address land development issues

The long list of options is presented below, along with stakeholder commentary from the workshop.

4.1.3 Excluded Options

The following options were excluded:

- Options which move the arterial function to Cumberland Street south of Frederick Street, as this would put more traffic in front of the New Dunedin Hospital site
- Options that do not address issues of pedestrian connectivity and/or land development
- Grade separation of one or both S Bends, as this would be too expensive
- Roundabouts, as these would not address the issues

4.2 Long List of Options

4.2.1 Stakeholder Workshop

A stakeholder workshop was held in August 2020 to:

- Present the land use and transport context in the vicinity of the S Bends
- Present a summary of previous work that has been undertaken
- Discuss the existing issues at the S Bends and understand organisational priorities
- Discuss the long list of options and see if attendees had further ideas that could be developed into additional options
- Consider each option in turn and discuss advantages, disadvantages, risks and constraints

The workshop was attended by representatives from the University, including those developing the Health Sciences Precinct Masterplan, Dunedin City Council staff and Waka Kotahi staff.

No new options were identified at the workshop. However, University staff highlighted that the land development issues which were part of the driver for previous work and articulated in the University Master plan were no longer a key driver, as the University have developed their ideas about how the land they own in the vicinity of the S Bends is best utilised. There is currently a University Health Sciences Masterplan exercise underway which has furthered this thinking. The Masterplan identifies growth requirements to 2037, and land adjacent to the S bends is no longer required.

A summary of the options and workshop discussion on each is provided below.

4.2.2 Do Minimum

As previously explained, some minor works have already been completed. Further works that could be considered in a Do Minimum would be:

- Slower speeds
- Change Emily Siedeberg Place accesses
- Formalise mid-block crossing of Malcolm Street between Walsh Street and Great King Street
- Barnes Dance at Malcolm/Frederick Street intersection

These possibilities were discussed at the workshop. It was agreed that they would do little to address the fundamental severance and safety issues. These works are captured in Option 1a below. It was agreed that Option 1a is the Do Minimum option.

4.3 Multi-criteria Assessment

Seven options were identified, some of which had one way and two-way variations, and some of which only worked with one way or two-way SH1 configuration. Discussions with University staff allowed identification of what is currently important to the University, namely:

- Land development issues which were important in the past are now less important. The Health Sciences Masterplan can accommodate growth to 2037 without the need to develop land adjacent to the S Bends. In the interim, a parkland is planned in the vicinity of Walsh Street.
- Pedestrian safety and connectivity across the northbound S Bend (Malcolm Street) is still very important, as this is the primary route for staff and students walking between the main campus and the Health Sciences Precinct which is centred on Great King Street.
- Frederick Street and Albany Street have high pedestrian volumes and increases in traffic on these streets would be a concern to the University.
- Great King Street is central to the Health Sciences Precinct, and the University have invested in the buildings and in creating a pedestrian focused, slow street, which has been facilitated by the current 'dead end' arrangement. Any options which reopen the street to general through traffic do not align with the University vision for this street. A partial reopening to buses only could be discussed in future.

4.3.1 Assessment Criteria and Scoring System

Based on the conversations at the workshop the following assessment criteria were identified:

- Connectivity (active modes) - Improve connectivity for pedestrians and cyclists
- Land Development – Create land parcels that provide improved opportunities for land development
- Achievability - Potential achievability (technical, safety and design, consentability, property impacts)
- Affordability – Likely magnitude of cost

A standard seven-point scoring system was used to score each option against the criteria. The scoring system is shown in Figure 4-2.

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernable or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

Figure 4-2: MCA Scoring System

4.3.2 Long List Assessment

Option 1: Shaping Future Dunedin Transport Programme

The Shaping Future Dunedin Transport Programme has identified the following for the S Bends.

Option 1a (Do Minimum):

- Both S Bends will be within the 40km/h slower speed zone
- Barnes Dances would be provided at Malcolm/Frederick Street and Gowland/Frederick Street intersections
- Mid-block crossing would be formalised on Malcolm Street between Walsh Street and Great King Street.

This option slightly improves pedestrian safety and connectivity. However, the speeds are already quite slow, so reducing the speed limit to 40km/h was not expected to make a significant difference to safety. This option does not address land development issues. The University are supportive of implementing the Do Minimum.

Connectivity	Development	Achievability	Affordability	Summary
1	0	3	3	Minimal cost with some positives for pedestrian connectivity and safety through lower speed limit, and Barnes Dances. Cycleway on Albany Street.

Option 1b (SH1 is two way):

Malcolm Street becomes a two-way local road with a 30km/h speed limit

- Malcolm Street has a pedestrian focus and is more permeable for pedestrians with far lower traffic and freight volumes
- Malcolm Street has a two-way separated cycleway

- Mid-block crossing would be formalised on Malcolm Street between Walsh Street and Great King Street.
- Barnes Dances would be provided at Malcolm/Frederick Street and Gowland/Frederick Street intersections
- Gowland Street becomes a two-way arterial route with slightly higher traffic volumes. The new arterial would have one through lane in each direction north of Albany Street. South of Albany Street, two through lanes would be provided southbound, and one through lane northbound. Higher traffic volumes are also seen on the Harbour Arterial and George Street.

Option 1b is the preferred option for the University, with Malcolm Street a slow street and SH1 two way on Gowland Street. The University would prefer to keep Great King Street closed at the north end and retain a pedestrian focus, rather than reopen to buses. However, they are open to further discussion.

The critical intersection for a new Barnes Dance would be Frederick/Malcolm Street, as this has higher pedestrian crossing movements already, and the University are planning a new 1500m2 development on land adjacent to this intersection.

This option offers a significant improvement for pedestrian connectivity and safety, with these issues experienced only on the arterial and to a far lesser extent on the local road. This also aligns better with the park area that the University are planning around Walsh Street, and assists with a more successful outcome for the proposed land development on Frederick Street.

Connectivity	Development	Achievability	Affordability	Summary
3	0	3	-2	Significant benefits for pedestrian connectivity and safety between campus and Health Sciences Precinct through creating a two-way local road on Malcolm Street with a slow speed and pedestrian focus and consolidating arterial traffic on a two-way state highway on Cumberland/Gowland Street. Cycleway on Albany Street.

Option 2: Grade Separation for Pedestrians

These options would provide a subway or a bridge over SH1 northbound and/or southbound, primarily to provide for improved access to the University. There are several possible configurations for the location of this infrastructure, and for any connections. Figure 4-3 below shows the key desire line, from the University library to the Health Sciences precinct on Great King Street, with possible side connections to the Museum and residential areas. For the two-way road configuration any grade separation would only need to extend across the Cumberland Street/Albany Street intersection.

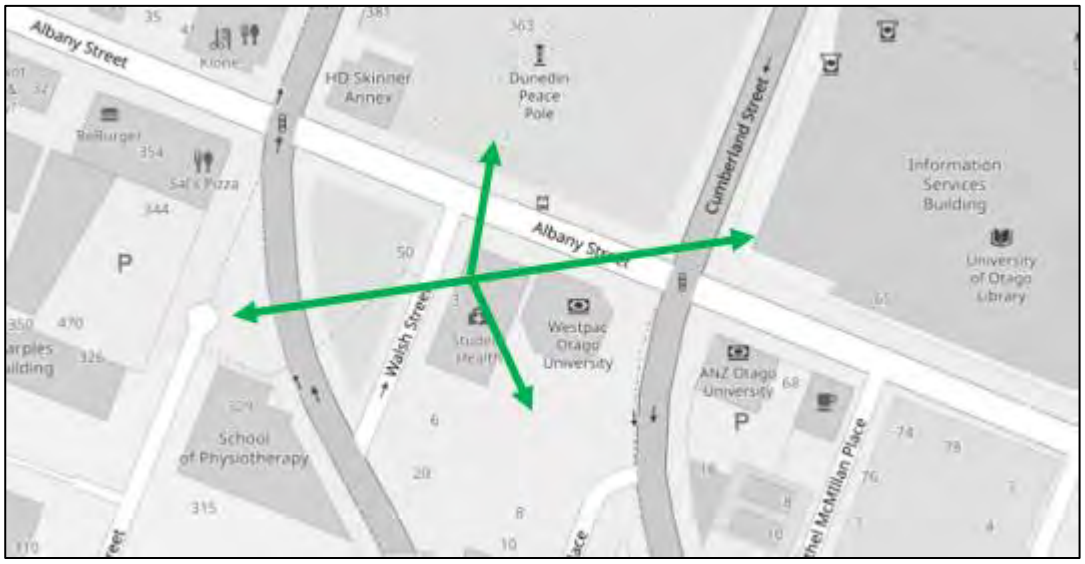


Figure 4-3: Option 2: Indicative location of grade separated pedestrian link for one-way option (subway or bridge)

The footbridge was preferred to a subway due concerns about security. A footbridge that connected two buildings was preferred, as it was felt this would be more attractive than needing to gain elevation from street level. Stakeholders thought grade separation would provide a lower level of service for pedestrians compared to an at-grade crossing, and that people will still cross at grade, even if a bridge or subway is provided. Any footbridge would need to provide weather protection but allow users to be visible and the bridge itself would need to look appealing, as it would dominate the streetscape. Covered walkways at grade would also be desirable. The University noted they could explore the pedestrian bridge option further.

The major downside of these options is the cost, which is expected to be significant, particularly for the one-way street configuration, where the bridge/subway would need to cross both routes, rather than just the arterial route, with the two-way road configuration. There were also concerns that the sporadic flow, e.g. large groups of pedestrians at the end of lectures would result in uneven pedestrian flows, which might make stairs or constrained width solutions difficult. A further concern was that pedestrians at-grade add vibrancy to the street environment which is desirable whereas if pedestrians are grade-separated that vibrancy and interest is lost.

Connectivity	Development	Achievability	Affordability	Summary
2	0	-1	-2	Some benefits to providing grade separation for pedestrians via a bridge or underpass over one or both arterial routes, to better connect the campus and Health Sciences Precinct, as well as Otago Museum. Would improve pedestrian safety and connectivity (noting issues would still remain at grade) but would reduce street vitality and amenity and is likely to be cost prohibitive.

Option 3: Raised Development

Raised development refers to development that extends over the street, leaving the road to pass underneath, as shown in Figure 4-4. In the context of the S Bends, this option would be particularly relevant in addressing land development issues. Raised development could span one S Bend or both, and pedestrians could be provided for at grade as well as via a plaza walkway above the road, within the raised development.

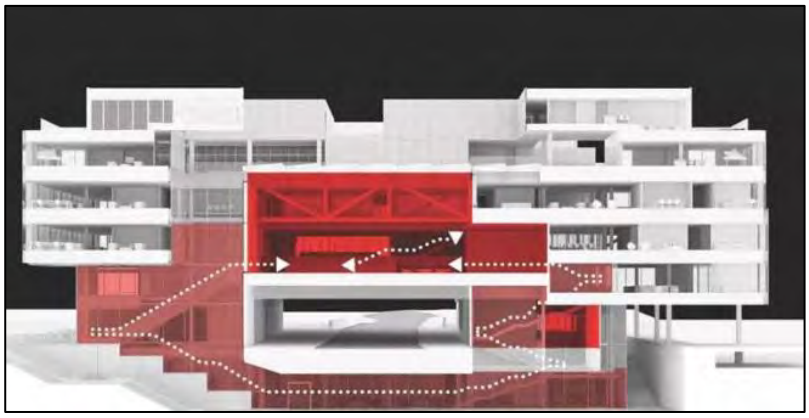


Figure 4-4: Option 3: Example of Raised Development

This option will not remove people crossing at grade, who will still need to be provided for, and height clearance would need to be agreed with Waka Kotahi.

University staff noted it was highly unlikely that the University would invest in a building over any road. Such a building would not align with current needs defined in the Health Sciences Masterplan. Any building would need to cater for increased internal circulation to provide for movement across campus, which would make the option cost prohibitive. Other downsides were that it would negatively affect the view shaft along SH1, and the height restrictions may make it unfeasible.

Connectivity	Development	Achievability	Affordability	Summary
1	2	-2	-3	Raised development over one or both SH1 arterial routes is likely to be cost prohibitive. In addition, the University can accommodate planned growth until 2037, so there is little benefit for this option. It would have a negative effect on the view shaft, and there are likely to be technical challenges and risk which will outweigh any positives relating to land development or pedestrian connectivity.

Option 4 (One Way)

This option would involve removing one or both S Bends and returning to a grid system, using Emily Siedeberg Place or another route, as illustrated in Figure 4-5. The one-way system is retained, with northbound route options shown in blue and southbound route options shown in orange. There are many alternatives in creating a grid system, as shown on the map and in Table 4-1.

Table 4-1: Different grid system route options

		Northbound	Southbound
a	Remove both S Bends	Emily Siedeberg Place – Albany Street	Emily Siedeberg Place – Frederick Street
		Emily Siedeberg Place – Albany Street	Albany Street – Ethel Benjamin Place
		Frederick Street – Great King Street	Albany Street – Ethel Benjamin Place
		Frederick Street – Great King Street	Emily Siedeberg Place – Frederick Street
b	Remove Malcolm Street (NB)	Frederick Street – Great King Street	
		Emily Siedeberg Place – Albany Street	
c	Remove Gowland Street		Albany Street – Ethel Benjamin Place
			Emily Siedeberg Place – Frederick Street

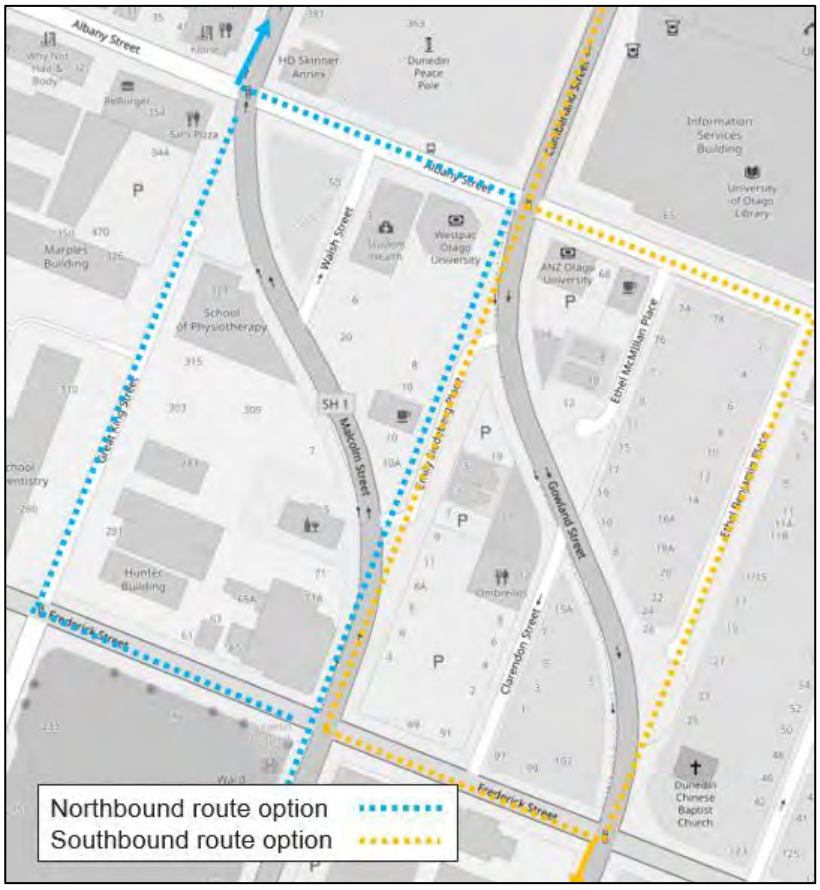


Figure 4-5: Option 4 (retains one-way SH1) - schematic diagram illustrating multiple route options

The primary benefit of these options is to increase land development opportunities for landowners. The landowner is primarily the University. The University agreed that this type of rearrangement of the road network would provide better land development parcels. However, the University confirmed that future development to 2037 is provided for in the University Health Sciences Masterplan, and as such there is no driver to release the land adjacent to the S Bends. As such, the University do not see these options as in any way desirable as they move additional state highway traffic on to Albany Street. The pedestrian focus on Great King Street would preclude options that use that particular street.

There would also be negative impacts on the streets that could be utilised for arterial routes e.g. Emily Siedeberg Place and Ethel Benjamin Place which are currently primarily residential streets.

Connectivity	Development	Achievability	Affordability	Summary
2	3	-3	-3	These options would increase traffic volumes on Frederick and Albany Street, which is an undesirable outcome due to the importance of these roads for campus connectivity. The options would provide better parcels for land development, but this is not currently a benefit as the University can accommodate growth to 2037.

Option 5 (Two Way) Partial Grid

This option introduces a two-way system, with arterial traffic on the current southbound route, and a low volume of local traffic on the two-way local road (currently the northbound route). The option removes the northbound S Bend and utilises an alternative route for the local traffic. The alternative route uses Frederick Street and then either or both of George and Great King Streets, as shown in Figure 4-6.

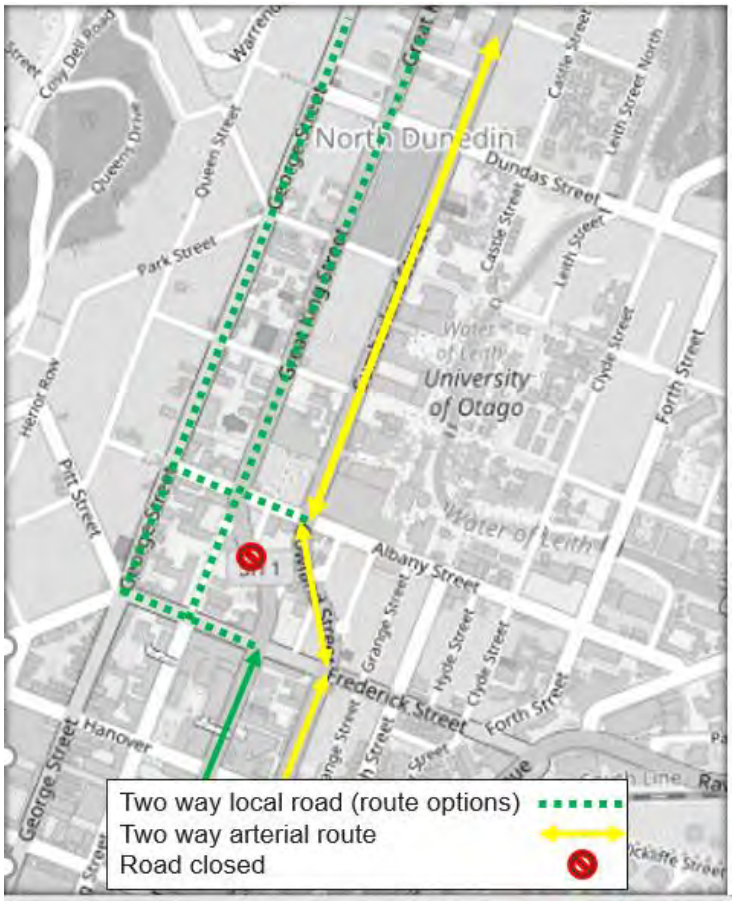


Figure 4-6: Option 5: Alternative route options for northbound local traffic

Note that in Figure 4-5 the Cumberland Street/Dowling Street/Castle Street link (current southbound one way) carries the two-way arterial traffic

The removal of the northbound S Bend no longer provides a development advantage to the University, but it does mean there is one less road to cross between the main campus and the Health Sciences Precinct. Increased traffic on Frederick Street, Albany Street and Great King Street would be undesirable due to the high numbers of pedestrians, which means that George Street would be the most desirable route from the University perspective.

This is potentially of interest to the University because it would allow better connectivity between the planned parkland area around Walsh Street, and the Health Sciences Precinct – they would no longer be separated by a road. The University staff would like to better understand the impact on surrounding streets regarding increased traffic, if this option is taken forward, through traffic modelling.

Connectivity	Development	Achievability	Affordability	Summary
2	2	-2	-2	This offers benefits to Health Sciences Precinct connectivity; however, potential traffic volume increases on Frederick and Albany Streets need to be understood.

Option 6: Two way to North, One way to South

Option 6 is shown in Figure 4-7. Option 6 removes the northbound S Bend. Northbound traffic uses either Emily Siedeberg Place or Great King Street. South of Albany Street, both SH1 routes remain one way, but north of Albany Street they are two way. Major changes would be required at the Albany Street/Gowland Street intersection to provide for the transition.

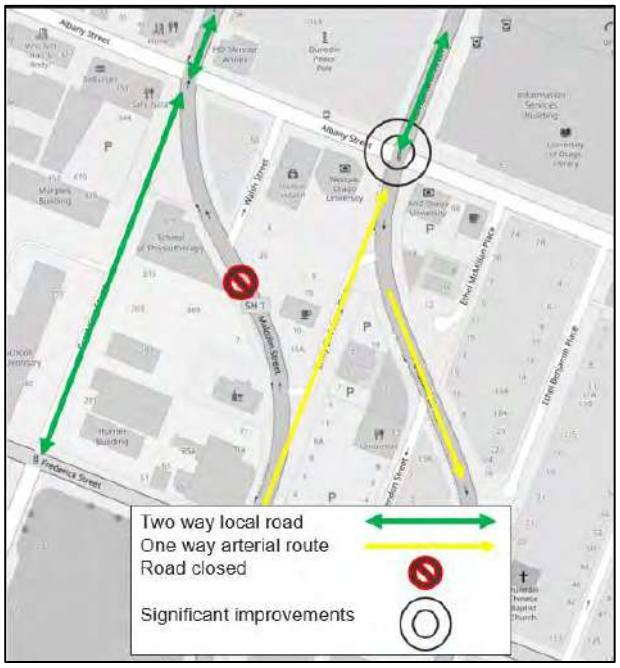


Figure 4-7: Option 6

The map shows northbound state highway traffic using either Emily Siedeberg Place or Great King Street. The University are clear that using Great King Street is not an option due to the high pedestrian numbers and pedestrian focus on that street, which is one of the core streets of the Health Sciences Precinct. Emily Siedeberg Place would therefore be preferred. Using this street would result in negative effects to pedestrians, residents and amenity. It is currently a residential street.

Removing the northbound S Bend would be a very positive outcome for the University and would allow tighter integration of the campus with the Health Sciences Precinct. People moving between the two parts of the campus would only have one road to cross (the Albany Street/Gowland Street intersection).

This option would affect the Pine Hill intersection, which would need to be reconfigured to provide for two, two-way streets to the south of the intersection. The one-way system would start at Albany Street, rather than Pine Hill intersection. The Albany Street/Gowland Street intersection would need to be designed carefully as the street intersection angles would be unusual.

The University view is that provided Great King Street remained shut, this option could work and would provide an advantage to the University in only having one crossing at Albany Street (as for Option 5). However, the impact on the other streets would need to be understood as it would be undesirable to increase traffic volumes on Frederick Street. If traffic increases further on Frederick Street this would rule out this option from a University perspective.

Connectivity	Development	Achievability	Affordability	Summary
2	2	-2	-2	This offers benefits to Health Sciences Precinct connectivity; however, potential traffic volume increases on Frederick and Albany Streets need to be understood.

Option 7: Two way with Arterial Transition

Option 7 is shown in Figure 4-8. The option only works with a two-way system. Local traffic (green arrow on diagram) uses Emily Siedeberg Place. Cumberland Street in front of the University becomes a two-way local road with lower speeds and traffic volumes. The arterial traffic transitions from the Frederick Street/Gowland Street intersection to the Albany/Great King Street intersection, either at grade or via a tunnel.

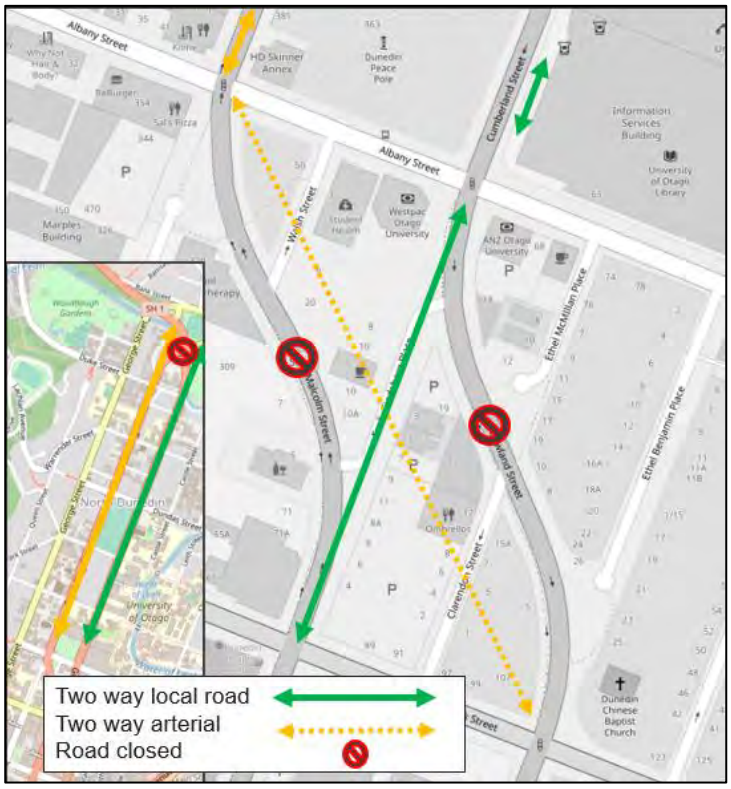


Figure 4-8: Option 7

The benefits of this option are that there would be less traffic on Cumberland Street in front of the University, and both S Bends would be removed allowing better land use integration and pedestrian connectivity on these blocks.

However, the option interrupts provision of a continuous active mode/public transport route and connecting the arterial transition route to the existing network would be challenging. Both the tunnel and an at grade option would be high-cost solutions, the latter as many properties would need to be purchased. Reconfiguring the Pine Hill Road intersection would also add to the cost.

University staff saw some merit in the arterial transition, but the cost, construction risk and impact on adjacent blocks is significant, and out of proportion for the benefits, which are similar to what can be delivered through other, less intrusive options eg Option 6. The impact on the surrounding streets would need to be understood and may make the option unattractive. There is some benefit to closing the northbound S Bend, but less so the southbound one.

Connectivity	Development	Achievability	Affordability	Summary
3	3	-3	-3	This offers benefits to connectivity and for future land development, however it is likely to be cost prohibitive. Similar benefits can be achieved with less cost/risk through Options 5 and 6.

4.3.3 Summary of MCA Assessment

Table 4-2 shows the scores given for each option when considered against each criteria. The scores were based on discussion at the workshop. The table also provides a summary of the primary reasons for the MCA scores and a recommendation as to whether the option should be progressed.

Table 4-2: Multi-criteria analysis and recommendation

	Description	Connectivity	Development	Achievability	Affordability	Summary	Progress?
1a	Do Minimum: Shaping Future Dunedin PBC Programme 1	1	0	3	3	Minimal cost with some positives for pedestrian connectivity and safety through lower speed limit, and Barnes Dances. Cycleway on Albany Street.	Preferred – short term
1b	Shaping Future Dunedin PBC Programme 2v3 (2 way)	3	0	3	-2	Significant benefits for pedestrian connectivity and safety between campus and Health Sciences Precinct through creating a two-way local road on Malcolm Street with a slow speed and pedestrian focus and consolidating arterial traffic on a two-way state highway on Cumberland Street/Gowland Street. Cycleway on Albany Street.	Preferred – medium term
2	Pedestrian bridge or underpass.	2	0	-1	-2	Some benefits to providing grade separation for pedestrians via a bridge or underpass over one or both arterial routes, to better connect the campus and Health Sciences Precinct, as well as Otago Museum. Would improve pedestrian safety and connectivity (noting issues would still remain at grade) but would reduce street vitality and amenity and is likely to be cost prohibitive.	Possible further work
3	Raised development	1	2	-2	-3	Raised development over one or both SH1 arterial routes is likely to be cost prohibitive. In addition, the University can accommodate planned growth until 2037, so there is little benefit for this option. It would have a negative effect on the view shaft, and there are likely to be technical challenges and risk which will outweigh any positives relating to land development or pedestrian connectivity.	No
4	One way grid (multiple route options)	2	3	-3	-3	These options would increase traffic volumes on Frederick Street and Albany Street, which is an undesirable outcome due to the importance of these roads for campus connectivity. The options would provide better parcels for land development, but this is not currently a benefit as the University can accommodate growth to 2037.	No

	Description	Connectivity	Development	Achievability	Affordability	Summary	Progress?
5	Two-way partial grid	2	2	-2	-2	This offers benefits to Health Sciences Precinct connectivity; however, potential traffic volume increases on Frederick and Albany Streets need to be understood.	Possible further work
6	Two-way partial grid to south	2	2	-2	-2	This offers benefits to Health Sciences Precinct connectivity; however, potential traffic volume increases on Frederick and Albany Streets need to be understood.	Possible further work
7	Two way with arterial transition	3	3	-3	-3	This offers benefits to connectivity and for future land development, however it is likely to be cost prohibitive. Similar benefits can be achieved with less cost/risk through Options 5 and 6.	No

5. Recommendations

The recommendations from the workshop and MCA analysis are:

- Short term: Implement Option 1a (Do Minimum):
  - Slower speeds on both SH1 routes
  - Barnes Dances at Malcolm Street/Frederick Street and Gowland Street/Frederick Street signalised intersections
  - Cycleway on Albany Street
- Medium term: Further Investigation to understand traffic implications and costs for:
  - Option 1b: (Shaping Future Dunedin Transport Programme Business Case Programme 2v3) - creates a two-way local road with slow speeds and pedestrian focus on the existing northbound SH1 and consolidates arterial traffic on a two-way state highway on the existing southbound SH1.
  - Option 2: Pedestrian bridge or underpass
  - Option 5: Two-way partial grid
  - Option 6: Two-way partial grid to south

The University of Otago's preferred option is Option 1b, as it will significantly reduce severance between the main campus and the Health Sciences Precinct. However, the progress of this option is subject to wider SFDT outcomes and decision making.

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Appendix D Travel Demand Management Programme

File:	Shaping Future Dunedin Transport – Programme Business Case Travel Demand and Mode Shift Interventions: Technical Note	Date:	June 23, 2020
To:	Client Team	From:	Darren Davis (Stantec)

1. Introduction

1.1. Purpose

The purpose of this technical note is to further develop and assess the mode shift interventions that were short listed through the standard long list to short list process. For details and the full long list refer to Technical Note 2: Long List to Short List. For clarity, the Do Minimum Mode Shift Programme (projects which are planned and committed) is also identified.

The shortlisted mode shift interventions have been pulled together to form a Mode Shift 'sub' Programme. This 'sub' Programme is common and essential to both Programmes being considered through the SFDT PBC, to better balance place and movement through central Dunedin. Guidance has been sought from the client team on the approach for assessing the impact of the Mode Shift Programme, noting that a combination of approaches may deliver the best outcome. The pedestrian improvements and other measures in the two SFTD Programmes are designed to reduce the severance effect of the one-way system in its current form. They are a necessary complement to the Mode Shift Programme but insufficient on their own to achieve the required mode shift that will enable the city to continue to function well for the different modes of travel into the future.

1.2. SFDT Project Outcomes and Investment Objectives

The Project Outcomes and Investment Objectives are:

Project Outcome	Investment Objective
Improve safety	Moving towards vision zero in the central city
Improve multi-modal access to and within central city	Increase use of active and public transport
Enhance connectivity between key central city destinations for active modes	Reduce traffic speed and volumes and increase pedestrian level of service on City Streets
Improve place quality and walking environment in central city	Improve PERS score at key locations
Improve attractiveness of city as place to invest, live, work and play	Make Dunedin a more liveable city, increasing the RIT score
	Maintain consistent reliable journey times on key routes
Improve environmental outcomes moving to zero carbon by 2030	Reduce carbon emissions from transport in the study area

The Mode Shift Programme will contribute to achieving all the project outcomes and investment objectives.

1.3. Definition

Mode shift is defined as a shift away from the private car to more sustainable transport modes, whether passenger transport, walking or cycling. This shift generally reduces the stress on the strategic/arterial road network and parking, to enable those resources to work better for those who need it. Mode shift focuses on making best use of the existing transport system in advance of or instead of new infrastructure investment, where possible.

1.4. Dunedin Current Mode Share

The most widely available travel information is collected by the census 'Journey to Work' question. The table below shows non-car mode splits for 2018:

Mode (non-car)	Percentage Share
Work from home	10.2%
Walking	9.9%
Cycling	2.1%
Public Transport	3.4%

This shows that over 80% of people commuting travel to work by motor vehicle. This choice of mode is linked to the supply of parking in the city, which is reasonably easily available and relatively cheap. Free parking also exists on the edges of the city, an easy walk away. The busiest times of day on the transport network in Dunedin are the morning and evening peak when people make the trip to or from work or study. The Mode Shift Programme focuses on reducing this peak flow through measures that will primarily support commuters and students to change mode. However, the improvements will be available for all regardless of the end destination. In addition, research shows that people who travel to work or study by bus, bike or on foot are more likely to use these modes for other, non-work/study trips such as shopping, recreation, visiting friends and other activities.

1.5. New Dunedin Hospital

The predominantly north-south focus of largely vehicular movement on the State Highway 1/one-way system through central Dunedin has always come into conflict with east west pedestrian and traffic flows. Additional impetus to addressing these long-standing issues is given by the plan to build a new Dunedin Hospital between the two sides of the State Highway 1/one-way pair, as well as plans to better connect the city centre to the waterfront. This will exacerbate existing severance and may create new severance issues, which work against the desire to better stitch areas to the city centre together and improve liveability.

Demolition and construction phases will cause significant disruption to motor vehicle travel in central Dunedin as temporary traffic management will be required to enable those activities to take place. This started in early 2020, is expected to peak in 2023-24, and continue to 2029. One or more lanes will be closed for long periods on Cumberland Street, Castle Street and St Andrews Street. Aligning the mode shift programme with this period will offer benefits as people are likely to be frustrated with delays in driving and more open to consider another mode, particularly if there are incentives to make that change.

The new Dunedin Hospital development is both a trigger and impetus for mode shift in Dunedin. It will be the biggest single capital project ever delivered in the city. The new hospital's lengthy construction period will create significant disruption to existing, largely car-based travel patterns. Its location within 100 metres of the central city bus hub and less than 5 minutes' walk to the George Street retail core, and its direct connection to the protected cycleway network, means that the hospital can become a part of the city, not apart from the city. The lengthy construction period also provides the opportunity for central Dunedin's transport network to be managed in a way that creates new travel patterns and habits. The Mode Shift Programme is a key aspect of this active management.

With change comes not only disruption but opportunity to rethink how Dunedinites move to, through and around the city. The location of the new hospital means that public transport, walking and cycling will become more realistic options for getting to and from work for many more people. This sets the scene for a mode shift programme to deliver on this opportunity for Dunedin; to reimagine the way people move around the city while simultaneously helping to manage the disruption caused by the hospital redevelopment. The end result would be a more sustainable, inclusive, climate-friendly city.

1.6. Do Minimum Programme

The Do Minimum Programme consists of all the work that is currently planned and committed by the partners. This is important to define as it is work that would happen anyway, and therefore should be excluded from the SFDT Mode Shift Sub-Programme, which presents new projects only. To clearly define the Do Minimum, this technical note has been developed through interviews with the members of the project team who respectively represent Dunedin's transport partners.

All the partner organisations have existing Mode Shift work programmes. The projects that make up these programmes are developed to varying degrees of planning and design, and some are ready for implementation subject to funding. Local and central government changes in funding availability change relatively frequently which impacts implementation. Table below shows the Do Minimum programme (only committed projects shown).

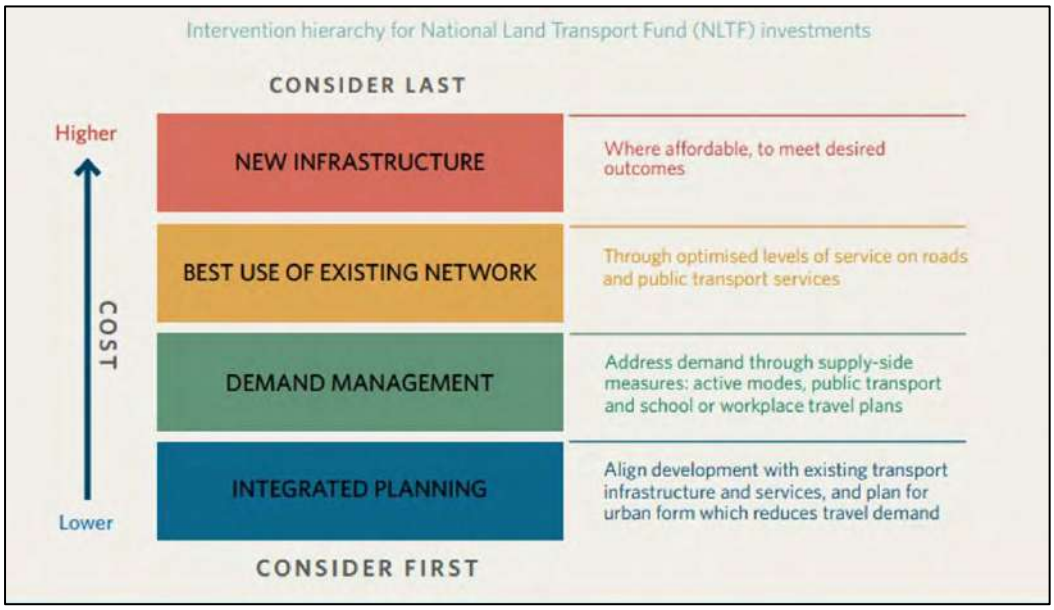
Partner Organisation	Description
Dunedin City Council	Mode shift promotion initiatives to help support change, such as a work travel plan programme, school travel plan programme, and events to promote behaviour change
Dunedin City Council	Project to convert existing on-road painted cycle lanes on North Road to a higher level of service
Dunedin City Council	Project to provide a walk/ cycleway in the rail corridor between Wingatui and Caversham – including through the disused Chain Hills and Caversham tunnels connecting from Caversham to the existing shared path alongside the Caversham Bypass on to the city centre
Otago Regional Council/Dunedin City Council	Investigation of new bus stop locations to close central city gaps, particularly between the Exchange and the Bus Hub
Otago Regional Council	Upgrade or installation of super stops at Green Island, Gardens, University and Cargills Corner.
Otago Regional Council	Provision of at stop real time information at the bus hub

Both Waka Kotahi NZ Transport Agency (Waka Kotahi) and Dunedin City Council (DCC) have Low-Cost Low Risk (LCLR) programmes which are ongoing. The projects included in the LCLR programmes fluctuates and until projects are ready for implementation, it is difficult to confirm the content of the LCLR programmes. However, it is noted that this will be a possible source of funding for some elements of the SFDT Preferred Programme. This will be explored more in Part C of the PBC.

2. Travel Demand and Mode Shift Interventions

2.1. Overview

The short-listed interventions which form the Mode Shift Programme were identified using the Waka Kotahi intervention hierarchy (below).



Land use interventions are considered first. It is worth noting that these tend to take the longest to achieve significant change in mode but have the most enduring effect on mode change. Therefore,

progressing these elements should be a matter of urgency. This is already happening as the Dunedin 2GP contains some effective policies to ensure residential development is located near to local services and public transport links, and to increase residential density in/near the city centre and some local centres.

Travel Demand management is a fundamental building block of the Mode Shift Programme. Put simply, the Mode Shift Programme would be muted in its impact given the current absence of strong reasons to change mode. Much of Dunedin's daily commuter parking is available for free in the harbourside industrial area and streets around the town belt. All day on and off-street alternatives are available for approximately $6 per day, and commuters leased parking space rates range from $5 to $8 per day.

The short-listed interventions aim to make the best use of existing networks. For example, there is spare capacity within the bus system, with the exception of a few pressure points, particularly in Mosgiel, and on the current protected cycleway network. The interventions also aim to build on one another. Examples of these are gap closures in the protected cycleway network and targeted improvements to bus services.

In this way, the Mode Shift Programme is combination of hard and soft measures to make best use of and build on existing networks, both of which are needed to work together for maximum impact. In the Dunedin context, a progressive implementation approach is recommended that targets road space reallocation to sustainable modes in a way that ensures the system keeps moving, with enough pressure that people start to see it as advantageous to shift to other modes of travel for certain trips.

2.2. Integrated Planning

Dunedin has recently begun growing again after a lengthy period of relatively stable population and is now considered a medium-growth city. This resumption of growth has been accompanied by strong growth in house prices and limited land on which to develop housing. The majority of new housing is on the Taieri Plain in Mosgiel and Outram, while the majority of jobs are in the city centre and Tertiary Precinct in the northern part of the city centre. This land use pattern means there is likely to be a greater number of trips, largely by car, on the state highway and arterial road network between the Taieri and the city centre.

At the same time, the city centre's residential population is relatively modest. There is a clear opportunity to connect the new Dunedin Hospital with a greater role for inner city residential accommodation. The current heritage grants scheme has been successful in supporting the regeneration of the Warehouse Precinct but is not aimed at, or sufficiently large at present to be able to support, large-scale conversion of under-utilised heritage buildings to residential accommodation.

The Second-Generation District Plan provides for a Residential Transition Overlay Zone (RTZ). Significant parts of the city centre have this zoning which enables conversion to residential subject to suitable infrastructure being in place. This should be advanced as a matter of urgency, once any infrastructure constraints (e.g. three waters) have been addressed. Support for inner city living and medium density housing around public transport will minimised or reduce the need for car trips for more people.

2.3. Travel Demand Management (TDM)

Travel demand management is "…the flip side of infrastructure. It focuses on understanding how people make their transportation decisions and helping people use the infrastructure in place for transit, ridesharing, walking, biking and telework" [Mobility Lab 2019]. It focuses on reducing travel demand by car in advance of or instead of new investment.

The below table sets out examples of travel demand management measures.

Travel demand measures	
• Parking management • Addressing barriers to walking, cycling and public transport use e.g. improving the infrastructure for these modes • Employer based travel plans* • Neighbourhood based travel plans • Transportation Management Assn*	• Working from home* • Improved travel planning tools* • Flexible work hours and arrangements* • Guaranteed ride home for emergencies* • Carpooling and ridesharing*

* NOTE those marked with an asterisk can be readily focused on by key employers in the city centre to spread (or reduce) the demand to travel at peak periods. The early adoption of these can result in quick wins. Large employer-led approaches to encouraging better management of staff travel and encouraging and incentivising staff to travel by sustainable modes will be key for Dunedin. Similar programmes in other cities have achieved significant mode shift, even without broader network interventions.

A key element to a successful TDM programme is leadership by example. The public sector and other large employers are often best placed to show this leadership. Put simply, it is hard to persuade other people to change their travel behaviour if the organisations promoting travel behaviour change are not leading by example. Dunedin City Council's intention to develop a TDM programme is a good example of leadership in this area.

The core city centre has 36% of the city's entire jobs (viz 13% in Auckland) while the wider city centre from the Gardens to the Oval has an estimated 50% of the entire city's jobs and the vast majority of its tertiary student places. There is an extraordinary concentration of these jobs in very few employers meaning that a TDM programme championed and led by key city centre employers can make a significant positive impact.

3. Mode Shift Programme

This section focuses interventions to better manage parking while nudging car commuters to sustainable transport modes, such as walking, cycling and public transport.

Walking is close to saturation at near 10% (some areas already have 60% walk mode share, the highest in New Zealand). Realistically this could increase to 14% with an increase in inner city living. An 8% growth in cycling – achievable with a critical mass of safe protected infrastructure – could achieve 5% by 2030. Maintaining the current 8% per annum public transport growth rate, would achieve 8% by 2030, abetted by cheaper fares, better service and bus priority. Added to this could be a 13% work from home share, up from 7% at the 2013 Census.

Interventions relating to parking management and sustainable modes (walking, cycling, public transport) are below. The accompanying tables provide a high-level summary of interventions, to be considered in more detail during the next stage.

Each intervention has an indication of timing for implementation - S (1-3 years), M (3-10 years) or L (10 years +).

3.1. Active Modes

Walking

Virtually every journey involves walking for access at either end or as part of the trip. As such, walking has the highest mode share of any mode of transport. Improvements for walking benefit all modes of transport, including people in cars.

Dunedin has made some notable improvements in walking in recent times, most notably the conversion of 12 inner city intersections from parallel pedestrian crossing to barnes dances. Dunedin City Council has an ongoing LCLR programme to improve Dunedin's strategic walking network, for example by ensuring drop kerbs for all desire lines.

A base principle of this part of the programme is universal access and design, noting that 14.9% of the city's population is over 65. This is above the New Zealand average, in spite of an overall younger than average median age due to the large number of tertiary students in the city. In addition, a significant proportion of the population suffers from visual, auditory, cognitive or intellectual disability as well as the impacts of temporary injuries. Children are particularly vulnerable, exacerbated by the large increase in SUVs in the New Zealand vehicle fleet, whose centre of gravity strikes vital body organs in a crash whereas sedans strike legs.

Hence, we recommend that, in addition to universal access and design as a baseline, measures are introduced such as the use of raised tables at side road crossings, preferably in conjunction with zebra crossings.

The collective impact of these measures positively impacts all road users, including car drivers and passengers. The positive reception to Barnes Dance intersections highlighted in the People's Panel

survey[1] reflects the fact that they eliminate conflict between pedestrians and people in cars. They also assist buses in the left lane, which are no longer held up behind left turning vehicles waiting for pedestrians to clear a parallel crossing phase.

The mode shift programme includes further Barnes Dance implementation, split into two stages – the first stage extending barnes dances to the Exchange and Frederick Street, with a subsequent further extension.

Cycling

Dunedin has made substantial investments in protected cycleways and off-road shared paths. The State Highway 1 protected cycle lanes are the first instance of such a facility on a major urban on-street State Highway. The final stage of the Port Chalmers shared path from St Leonards is under construction and work is progressing in stages on the Peninsula Link to Portobello. However, each of these projects suffer from weakest link issues in their connections to the city centre. Both side of the Harbour Link – Port Chalmers and Portobello – lack safe all ages and abilities connections to the core city centre, and the State Highway 1 protected cycleway network ends at Queens Gardens with a much lower quality of service from there to the Caversham Bypass.

There are significant positive effects from linking individual protected cycleway components into a connective network. The mode shift programme calls for these links to be completed as a matter of urgency. Evidence from other cities is that filling gaps in protected cycleway networks benefits the entire network and creates an all ages and abilities network.

Active Mode Interventions

Type	Description	Impact/Observations
East-west links between Harbour Circuit and city centre	Provides key missing links in the protected cycleway network to link the Harbour Circuit to the city centre and State Highway 1 protected cycleway network, e.g. Albany Street (S – M)	Creates a critical mass network effect of a much larger connected all ages/abilities cycleway network.
North-south protected cycleway	Investigate extending existing north-south protected cycleway from Queens Garden to the Caversham Bypass (S-M) and north into North East Valley (S-M)	Continuous level of service for cyclists from northern and southern suburbs into and through city centre. Provides key missing links between the end of the protected cycleway network at north and south communities
Central bike hub(s)	Bike hubs providing bike parking, bike repair and ancillary facilities e.g. charging. Could be co-located with the bus hub and/or conveniently located elsewhere within the city centre, North Dunedin/Tertiary and South Dunedin (S)	Key role is to act as a hub and focal point and as a signal of strong public commitment to supporting cycling as a sustainable transport mode.
Dedicated bike and scooter parking	Providing sufficient safe and secure bike and scooter parking close to key destinations within the city centre, North Dunedin/Tertiary and South Dunedin. (S)	Providing sufficient visible and accessible parking for bikes and scooters is important for the same reason as convenient parking – it overcomes anxiety about the availability of parking at the trip destination. Scooter parking addresses the issue of scooters being left on the footpath where they can be an obstruction to pedestrians.
Pedestrian priority	Investigate opportunities to increase	Expands the extent of Barnes

[1] A Peoples Panel survey was undertaken for SFDT in [Monday 25 November to Saturday 7 December], which asked panellists a variety of questions about their experience of the Dunedin transport system.

Type	Description	Impact/Observations
measures	provision of Barnes Dances, signalled crossings and introduce raised crossings with zebra to support strategic pedestrian and cycle network and identified desire lines (S-M)	Dance intersections to the broader city centre. It helps addresses the barrier effect of the one-way system by providing safe pedestrian crossings. The Vogel Street signals would provide a safe link for people on foot between the Warehouse Precinct and Queens Gardens There are currently no formal pedestrian crossing opportunities on Princes Street south of Five Ways which encourages an overspeed traffic environment and discourages public and active transport use. Raised tables encourage slower traffic speeds and with a zebra crossing provide pedestrian priority

3.2. Public Transport

This section concentrates on public transport but needs to be read in conjunction with the parking management section (below) as the two are intricately interrelated. Put simply, best predictor and driver of mode shift is the cost and availability of parking near the workplace. In Dunedin, the daily cost of parking is often free, or if paid it is cheaper than the return bus fare from even relatively inner suburban communities. For Dunedin, this needs to change to achieve significant mode shift away from private cars.

There have been significant improvements to Dunedin's bus network over the past few years with a simpler, more legible network generally running at consistent frequencies, including frequent service on weekdays on route 8 St Clair to Normanby; route 63 Balaclava to Logan Park; route 44 and 55 to St Clair as well as between Cargills Corner and the bus hub as well as up George Street to The Gardens and up Stuart Street to Highgate. This network has solid bones and provides a good platform for future service enhancements.

In the short to medium term, an enhanced existing bus network is likely to be able to meet the increased demand for public transport. Longer term, the option of the return of commuter rail should not be ruled out given that for Mosgiel, in particular, it connects a major growth area to a city centre with a high proportion of employment, a railway station in its centre and close to the new Dunedin Hospital. In the short-term, measures that might preclude a return of commuter rail should be avoided.

Public Transport Interventions

Type	Description	Impact/Observations
Bus priority measures	Investigate opportunities to prioritise the movement of buses ahead of private motor vehicles and maintain reliable bus operation, particularly at intersections and on main route from south for example by reviewing traffic light phasing, converting left hand lanes at signals for left turners and straight ahead buses only, introduction of Bus Only lanes and greater use of clearways (S-M-L)	These measures could be used to significantly prioritise buses, particularly coming from the south which generates nearly 70% of peak period trips to the study area, 65% of which from the south are terminating in the city centre. For example, new measures at King Edward Street could give buses a head start over traffic at signalised intersections but would have a negative impact on general traffic on Hillside and Macandrew roads.

Type	Description	Impact/Observations
		A southbound clearway on Princes Street would assist with bus movement southbound in PM peak in conjunction with Barnes Dance at the Exchange.
Improve frequency, efficiency and directness from south	Investigate increasing peak frequency of services and introduction of direct/non-stop services from Mosgiel, as well as some southern suburbs, for example to every 15 minutes and/or via Southern Motorway (S)	The biggest increase in housing is around Mosgiel where the existing bus network is under pressure in the peak. This combined with 65% of journeys from the south terminating in the city centre, means that focusing on these areas has the biggest opportunity to achieve mode shift and convert longer distance car journeys to public transport. These interventions have significant opex implications as they increase the size of the peak bus fleet but also significant benefits.
Frequencies and operating hours	Investigate frequency and operating hours to ensure that they are simple, legible and meet customer requirements as best as possible within available funding. (S-M)	While the span of service is largely OK, there are some gaps such as some first services not reaching the city centre in time for 7am work starts (particularly at Dunedin Hospital). Other routes such as the 77 Mosgiel have very limited late evening service with up to 3-hour gaps between trips, while some other service have uneven 20/40-minute frequencies.
Park and Ride (Mosgiel and southern suburbs)	Seek low-cost sites where existing parking or land could be purchased and used for park and ride. Locate where commuters can take advantage of frequent services. For example, church parking areas are only heavily used on Sunday mornings, making them ideal weekday park and rides. (S-M) Incorporate into opportunity for Ride Share/Travel Smart travel planning.	Low-cost interventions (assuming suitable sites are available) to recruit new customers to public transport, especially from areas such as Outram where there is growth but no current bus service.
Bus stop upgrades	Especially where multiple services converge **(currently "superstops")** Upgrade bus hub to provide continuous canopy cover and improve customer amenity. (S) Investigate bus hub capacity for growth and possible extension to north of St Andrew Street intersection for the Palmerston service (when required to optimise bus hub capacity) Provide peak (in 7-9am; out4-6pm) bus stop extensions as needed on Princes Street from Moray Place to Five Ways. (S) Extend green time for buses turning between Moray Place and Princes Street	Walk distance sensitivity at destination is much greater than at trip origin with 50th percentile around 400 metres. People Panel feedback revealed the lack of bus stops near the Octagon as a significant issue for older adults. The bus hub needs a significant upgrade to improve customer comfort in order to attract significant mode share. Provide upgraded bus stops at key connection points on the bus network Provide enough bus stop capacity

Type	Description	Impact/Observations
	to prioritise buses on route to and from the bus hub. (S) With the implementation of Trackabus to Dunedin, provide at stop real time information at super stops, key city centre bus stops and key inbound bus stops. (S-M) Incorporate with use of real time information app.	in the peak so that buses can get into bus stops without blocking other buses or general traffic. On road real-time information overcomes a key customer pain point – not knowing how many minutes away a bus is.
Fare products	Investigate fare and zone restructure options, including simplifying current fare structure, weekly or monthly ticketing options, and low flat fare on Bee Card within the urban area (to Mosgiel, Portobello and Brighton (supported by alternative revenue) (S)	This proposal would bring Dunedin in line with Queenstown and Invercargill, which both have flat fares ($2) for urban bus journeys. The introduction of $2 fares in Queenstown has contributed to a 192% increase in patronage in two years. While the effect will probably not be so significant in Dunedin, particularly without corresponding parking changes, it will mean that buses will be cheaper than paying for all-day parking. Current Go Card fares vary between $1.92 and $11.41 (compared to Auckland AT Hop card fares of $2 to $7.60). For most journeys, all-day parking is cheaper than a return bus fare. For long journeys, $5 fare to Waikouaiti and Harrington Point and $7.50 to Palmerston.
Zone restructure	Review to include replacing the existing city zone with a free fare zone (Gardens to Oval), supported by other revenue. The proposal to move commuter parking further away from the core city centre is supported by this measure to provide impacted commuters with a free last mile connection to their destination (but much easier for them just to get on the bus at their point of origin). (S – could be a staging to low flat fare fares by reducing all fares commensurately)	Note that this intervention, supported by better mapping of the existing frequent transit network, could obviate the need for a dedicated central city shuttle service by making best use of existing frequent services in the core.
Revenue sources to support buses	Investigate new funding sources to change the current revenue structure. Consider central/local government options across partners, e.g. modest increase in parking charges and expansion of paid parking area (or alternative revenue source) to support free bus service in the city centre and discounted bus fares from elsewhere. This will also reduce the amount of free commuter parking close to the city. (S-M)	A staged move towards demand-based pricing would provide this additional revenue but it would need to be transparent that this revenue is hypothecated to supporting improved bus service as a viable alternative to driving.
Cluster or loop services	Investigate small additional services to discrete part of the city from the hub or bus stops servicing multiple routes. For	The withdrawal of dedicated school buses has led to some increase in parents driving their

Type	Description	Impact/Observations
	example, a loop between the city and Town Belt or inner blocks of South Dunedin could service school clusters (S)	children to school. All buses serve the bus hub and some stops service multiple routes (super stops). A pragmatic lower-cost solution could be to run short loop services to and from the hub/main stops at school start and finish times.

3.3. Parking Management

The parking management approaches focus on better balancing supply and demand through demand-based pricing, while ensuring that parking is still freely available for those who really need it, such as people with disabilities and older adults. Commuter and hospital parking are still provided for, but some commuters may need to walk further or catch a free frequent bus to get to their destination.

Many of the interventions identified below will form part of a new Dunedin Parking Policy. The relevant interventions are marked '*(pp)*'.

Parking Management Interventions

Type	Description	Impact/Observations
Prioritise parking by need *(pp)*	Focus parking provision on hierarchy of need, located where it is most needed, for example disability parking, taxis, short-stay, motorcycle, bike/micro mobility parking, car share, e- charging (S-M-L) Enforcement grace period in all zones to enable goods service deliveries; drop offs and pick-ups and quick in-and-out errands. Additional loading zones as required to service businesses.	People who need parking the most will have better access to parking.
Price parking for 85% occupancy *(pp)*	A demand management approach prices parking so that one in seven spaces is free at any given time. This largely eliminates congestion caused by cruising for parking but comes at a literal price. Where parking demand is low, the price is commensurately low, rewarding those who are able and willing to walk a bit further. (S-M)	Better parking availability but at a price. Potential equity implications unless the alternatives are both good and affordable (which the Mode Shift Programme aims to achieve).
Review Parking Zones *(pp)*	Concentrate Central City parking for shoppers and provide for commuter/long stay further out, connected to the core by frequent bus service. Extend paid parking area	Managing parking demand and prioritising it for those who need it most while still providing some commuter and new hospital parking
Divest some existing parking *(pp)*	Investigate use of current parking locations for alternative use, particularly if feasible development opportunities with parking relocated. DCC has already considered Filleul Street, and the hospital relocation may create development opportunities for Frederick street Incorporate with management and review of leased/commuter parking structure to gradually reduced in favour of alternative uses such as parking for short stay/shoppers (while grand-	Opportunity to get higher value uses out of some current parking sites – noting proposals to provide commuter parking where it minimises impact on the hospital build and supports use of the Harbour Arterial. Moving away from leased parking will support mode shift.

Type	Description	Impact/Observations
	parenting existing lease parking) (S-M)	
Parking Guidance System *(pp)*	Electronic guidance system using parking occupancy detection to direct drivers to available parking spaces. (S-M)	Makes it much easier to find available parking, significantly reducing the amount of time spend searching for parking.
Commuter parking (south)	Review parking configurations on Crawford Street near Police Street. (S-M)	Still provides for commuter parking, albeit a bit further from main destinations. PT zone restructure and potential free bus travel to the final destination and very frequent services on Princes Street.
Harbour Arterial parking	Investigate opportunities alongside new hospital and city centre redevelopment. Consider new 750 space parking building at 10 –30 Thomas Burns Street, use of multiparty funding agreements. (S-M)	Within easy walking distance of city centre and the new hospital but care needed to avoid negative visual impacts on Dunedin Railway Station.

3.4. Promotion

Promotion approaches focus on encouraging behaviour change, introducing and promoting new ideas and initiatives, so Dunedinites start to move around the city differently. A large portion of Dunedin's workforce have experience of working from home, and this may be an ongoing option that many people have available to them. By contrast, less people may have experience of flexible working hours. The peak periods are intense but relatively short. Simple measures such as flexible working hours, to move away from these intense peaks focused on 8:30am start and 5:00pm finish times, or staggered work from home days, can have a positive impact.

A change in culture and attitude around mode choice and flexible working could go a long way to alleviating pressure on the network.

Promotion Interventions

Type	Description	Impact/Observations
Demand management (during hospital build)	To be undertaken during the period of the Hospital build, as a combined effort between the three partner organisations (M)	Dunedin's transport network will need to be actively managed during the hospital build period. Active management, targeting people at moments of change in their life and align action to that, will create new patterns of travel. This will require deep engagement with SDHB and other large employer staff to motivate and incentivise more sustainable commuting patterns for their staff.
Sustainable Transport Programme	This acknowledges the work that DCC currently has in planning, but calls for significantly more funding to increase momentum with major employers, schools, targeted communities (M)	While existing measures are a good start, they need to be scaled up in order to have a significant positive impact on travel choices.

4. Intervention Tables

The draft Mode Shift Programme is summarised below in a series of intervention tables. These cover type of intervention by mode, and provide an indication of timing for implementation, high level indicative cost and potential impact. The key below shows how to interpret the abbreviations in the tables –

noting that these are high-level assessments which will be refined as costs are better known and modelling outputs are available.

- S - Short Term; M - Medium Term; L - Long Term
- $ lower cost; $$ medium cost; $$$ higher cost
- + lower impact; ++ medium impact; +++ higher impact

Cycling and Walking	SML	$	Impact
East-west links between Harbour Circuit and city centre	M	$$	++
North-south protected cycleway	M	$$	+
Central bike hub(s)	SM	$$	+
Dedicated bike and scooter parking	S	$	+
Pedestrian priority measures	SM	$	+

Public Transport	SML	$	Impact
Bus priority measures	SML	$$	++
Improve frequency, efficiency and directness from south	S	$$	++
Frequency and operating hours	SM	$	++
Park and Ride (Mosgiel and southern suburbs)	S	$$	++
Bus stop upgrades	S	$$	+
Fare products	S	$$	+++
Zone structure review	S	$$	+
Cluster or loop services	S	$$	++

Parking	SML	$	Impact
Prioritise parking by need *(pp)*	SML	$	++
Price parking for 85% occupancy *(pp)*	SM	$	++
Review parking zones *(pp)*	SM	$	++
Revenue sources to support buses	SM	$	++
Divest some existing parking	S	=	+++
Parking Guidance System	M	$$	++

Parking	SML	$	Impact
Commuter parking (south)	SM	$	++
Harbour Arterial parking	M	$$$	++

Promotion	SML	$	Impact
Demand management	M	$	++
Sustainable Transport Programme	M	$	++

5. How the combined programme works together

Each of the programme elements works with and builds on the others to provide a much broader range of non-car transport choices to the citizens of Dunedin. There are numerous examples within the programme of how elements integrate with each other. For example, the combination of Barnes Dances, new signalised intersections and bus lanes work together to provide significant and clearly visible priority to buses. They do this while improving conditions for pedestrians with additional crossing points to get to and from buses, noting that Barnes Dance intersections eliminate the conflict between turning buses (and other vehicles) and parallel crossing pedestrians. Equally, significant bus priority on the main route from the south, supported by low, flat fares and targeted service and infrastructure improvement would make public transport from the southern suburbs considerably more attractive.

6. Suggested Evaluation Approaches

The tables above present an initial evaluation of each intervention. There are a number of approaches that could be used to evaluate the impact of the combined Mode Shift Programme. These are described below.

Existing modelling tools - this has the benefit of using established tools to measure the impacts of interventions but doesn't always pick up on human factors that drive mode shift. For example, this meant that the models significantly underpredicted the patronage impact of the new bus network in Queenstown and the electrification of the Auckland rail network.

Standard elasticities - for responses to the improvements proposed. This works well where single isolated measures such as a bus frequency improvement are being considered. It is difficult where a programme is made up of various modal elements and interventions, due to cross- and counter-elasticities.

Back-casting from strategic goal - Dunedin's goal is to move from 20% of 40% sustainable mode share for commuting to work and to be carbon neutral by 2030. Achieving these goals will require very significant mode shift to be achieve, given that most achievable carbon reduction gains are in transport. Back casting takes place by assuming a desired mode shift and then seeing how the network would perform if that mode shift were achieved in practice. This approach is useful to know the impact of a "what if" scenario. This approach has been used in Queenstown simply because the current network is close to or at capacity.

Achievable Stretch Mode Shift Goal - This approach looks at comparator cities which have implemented aggressive mode shift measures to see what the effect was. For example, Auckland has tripled public transport patronage in the past 25 years. For Dunedin, 40% non-car mode share, including working from home, is a stretch target, but achievable with a range of supportive policies, such as improved parking management and travel demand management programmes.

6.1. Recommendation

Develop achievable stretch mode shift goal by looking at comparator cities. Use existing modelling tools to measure the impact of the Mode Shift Programme as part of the network options being evaluated but do a sensitivity test of a "what if" scenario. This back-casts from an assumed 40%

sustainable mode share for commuting to work based on the "Achievable Stretch Mode Shift Goal" above.

7. Estimated Impact of Mode Shift Programme

By using standard elasticity responses to the types of interventions proposed in the mode shift programme, estimates have been derived of their potential impact in achieving mode shift. The work from home share reflects an increased propensity for this in the wake of the Covid-19 pandemic.

By using an achievable stretch mode shift approach, we looked at comparator cities which have implemented aggressive mode shift measures to see what their effect is. For example, Auckland has tripled public transport patronage in the past 25 years. As at 2013 Census, the Dunedin urban area achieved a 11% walk: 3% bike and 4% bus (=20% non-car) mode share. Walking is close to saturation (some areas already have 60% walk mode share, the highest in New Zealand). Realistically this could increase to 14% with an increase in inner city living. An 8% compound annual growth rate in cycling – achievable with a critical mass of safe protected infrastructure – would achieve 5% by 2030. Maintaining the current 8% per annum public transport growth rate, would achieve 8% by 2030, abetted by cheaper fares, better service and bus priority. Added to this is a 13% work from home share, up from 7% at the 2013 Census. Therefore, 40% non-car mode share, including working from home, is a stretch target, but achievable with a range of supportive policies, such as improved parking management and travel demand management programmes.

The following table shows the estimated combined impact of the Do Minimum + Mode Shift Programme:

Mode (non-car)	2013	2018	2030
Worked at home	7%	10.2%	13%
Bus	3%	3.4%	8%
Bicycle	3%	2.1%	5%
Walk or Jog	11%	9.9%	14%
TOTAL % Active/PT/WFH (excluding 'other' and 'did not work')	24%	25.6%	40%

This will be used in the Paramics modelling to understand the impact that the Mode Shift Programme will have on traffic volumes and congestion.

8. Conclusion

For Dunedin to leverage the opportunity and challenge presented by the new Dunedin Hospital and its lengthy construction period, significant mode shift is required in order that Dunedin keeps on moving and access to the city is maintained. The short list has been further developed to form a Mode Shift programme, and the likely impact of this programme assessed. Each programme element works with and builds on the others to provide a much broader range of non-car transport choices to the citizens of Dunedin.

The Mode Shift Programme recognises that the current levers to encourage mode shift are weak and aims to push the dial sufficiently to provide gentle but potent nudges to mode shift through better pedestrian facilities; a more connective all ages and abilities cycleway network; targeted improvements to bus services, priority and price point; as well as a more targeted approach to demand management for parking to ensure that parking is available and easy to find for those who need it, while nudging commuters to consider more sustainable options.

9. Next Steps

The work completed as part of the SFDT PBC has allowed development of a preferred Mode Shift Sub-Programme. The next steps to develop this work are:

Within the PBC:

- Understand the impact of the Mode Shift Programme on traffic volumes through modelling
- Once the Preferred Programme is confirmed through consultation, present the Mode Shift Programme in a simplified table that provides an overview of the interventions, timing, and costs and likely impact. This will help show the highest priority elements.
- Develop a programme which clearly identifies the timing of key elements of the Mode Shift Programme and those that are needed in the short term to assist with access during hospital construction period. The Programme will also clarify those that require more time to implement and which will be scheduled later in the ten-year period.
- Identify a way forward for implementation for each element. Some will be progressed under LCLR programmes, whereas others will require an SSBC and/or LTP/TAIP funding commitment.

Within Future Stages:

- Further consider and assess available evidence and justification to confirm the proposed works.
- Further modelling to understand the impact of specific activities.
- Further develop mode shift programme in discussion with clients and stakeholders.

Appendix E Programme Long List

PROGRAMME LONG LIST									
Strategic Response		Option	Programmes						Comments
			Do min	1a	1b	2a	2b	2c	
				1		2		3	
SH1 Configuration	1	1 way retained	X	X	X				Option B2 from previous PBC
	2	2 way system reintroduced				X	X		Option C2 from previous PBC
	3	2 way system reintroduced with Harbour Arterial upgraded and prioritised						X	Harbour Arterial becomes SH88 and/or SH1 (similar to Option E from previous PBC)
TDM	4	TDM sub-programme	X	X	a	b	b	a	Sub-prog (a) used where road capacity not much altered. Sub-prog (b) used where need more mode shift to achieve levels of service because a) no harbour arterial upgrade b) extent of 2 waying more signficant and likely to lead to congestion. PT and parking sub-programmes compliment each other so that PT viability is not undermined by free/cheap parking, and for potential revenue hypothecation.
Public Realm Improvements	5	Targetted improvements 1	X	X	X	X	X	X	Mid block crossings and urban design on Cumberland and St Andrew hospital frontages, slow speeds as per B2 and C2
	6	Targetted improvements 2		X	X	X	X	X	Mid block crossings and urban design at additional key locations eg Queens Gardens, University, Pine Hill, Railway Station, current SB SH1 plus slow speeds as per B2 and C2
	7	High quality corridor enhancements (1) for full length current NB SH1 and St Andrew Street				X			Kerbs are moved to create high quality active and PT mode/place spine (Anzac-George)
	8	Corridor enhancements (2) full length current NB SH1 and St Andrew Street						X	Kerbs remain the same but improvements create quality active and PT mode/place spine (Anzac-George)
Harbour Arterial	9	Sign route and minor improvements		X	X	X	X	X	Real time route display signs promoting route to through traffic. Minor improvements to widths and markings
	10	Improve surface, some intersection upgrades					X	X	
	11	Take SH1 out of city altogether and upgrade Harbour Arterial to become SH1						X	
Frederick Street	12	Assume becomes SH88	X	X	X	X	X	X	Implications for NZTA and DCC in terms of ownership
St Andrew Street	13	Assume Slow Street as per previous PBC and hospital request	X	X	X	X	X	X	Pedestrian priority, low speed, low movement - access + drop off

Appendix F Harbour Arterial Long List

Alternative	Option
Management	Sign as through route and freight route
	Real time traffic information promoting route when SH1 congested
	Bylaw to force HCVs to use rather than SH1
	Upgrade surface and remark
	Consolidate/reduce existing private accesses where possible
	Harbour Arterial becomes state highway owned by Transport Agency
Land Use	Designate corridor for future roading and limit new developments, protect land for roading purposes
	Control and limit new accesses through 2GP
Intersection changes	SH1/Andersons Bay Road - add signalised roundabout Andy Bay/SH1. Issue with stacking for R turn blocking L turn on SH1. [TEST]
	Andersons Bay Road/Strathallan - close PacNSave/Warehouse leg and put signals at Hillside access instead.
	Strathallan/Portsmouth Drive- two L lanes out of Strathallan (no R), priority to Strathallan/Thomas Burns movement over Portsmouth Drive and redesign intersection
	Signalise Wharf/Kitchener Street for industrial area access.
	Remove on/off ramp between Jetty Street overbridge and Thomas Burns Street [TEST]
	Thomas Burns/Ward Roundabout - Upgrade to two lane roundabout. Remove free turn to St Andrew St. St Andrew Street City Street. Two lane entry and exit to roundabout on Thomas Burns/Ward (main route).
	Ward/Frederick/Anzac - close Anzac Ave or out only, adjust rest to suit. Two lanes each approach. Make turns easier for trucks.
Corridor	Upgrade Ward Street to provide through route to Ward Street bridge (instead of on Anzac). Remove some parking to provide short RTBs for Devon and Bauchop Streets. Close Ward Street north of intersection by Halsey/bridge. Leave access to Halsey. Close car park access.
	Ward Street bridge - review and upgrade layout of Ward Street bridge, but largely retain structure as is. Priority to through route. Close Hanover ramp and make Wickliffe ramp L in only. May need some widening on deck achieved through retaining walls to replace grassy slopes and/or option to amend footpath.
Access changes	Close Fryatt (part of masterplanning for area)
	Willis - Left in only to address known safety issues
	Birch, Kitchener, Creswell and Bombay Streets - Left in Left out only to address known safety issues
	Roberts - Left in but not from bridge, Right in to address known safety issues
Pedestrians	Extend Railway ped bridge to cross Thomas Burns Street and remove pedestrian signals on Thomas Burns Street.
	Construct new pedestrian and cycle bridge between Queens Gardens and Waterfront (part of Do Minimum)
Parking	Create new car park 10-30 Thomas Burns Street, multi level 750 spaces for CC, NDH and Waterfront. Left in left out only. Right in if space for RTB.

Appendix G Pedestrian Packages

File:	**Shaping Future Dunedin Transport: Pedestrians: Technical Note**	**Date:**	**March 20, 2020**
To:	**Client Team**	**From:**	**Sarah Connolly (Stantec)**

Technical Note 5: Developing Pedestrian Packages

1. Introduction

The purpose of this technical note is to explain how the package of pedestrian improvements for the scenarios were developed. The following method was used:

1. Identify and map the existing and future origins and destinations for pedestrians within the study area, pedestrian desire lines and the ONRC network to understand locations where severance is an issue and where improving place value would offer benefits.
2. For those locations and for each short-listed scenario, identify the existing provision and a package of street amenity and pedestrian improvements that respond to the project drivers. Use available pedestrian data to understand demands at key locations.

The information in this Technical Note can be used to explain the detail of the scenarios, inform public engagement messages and will form part of the Programme Business Case Part B.

2. Pedestrian Analysis

2.1 Land Use – Existing and Planned

Central City Plan

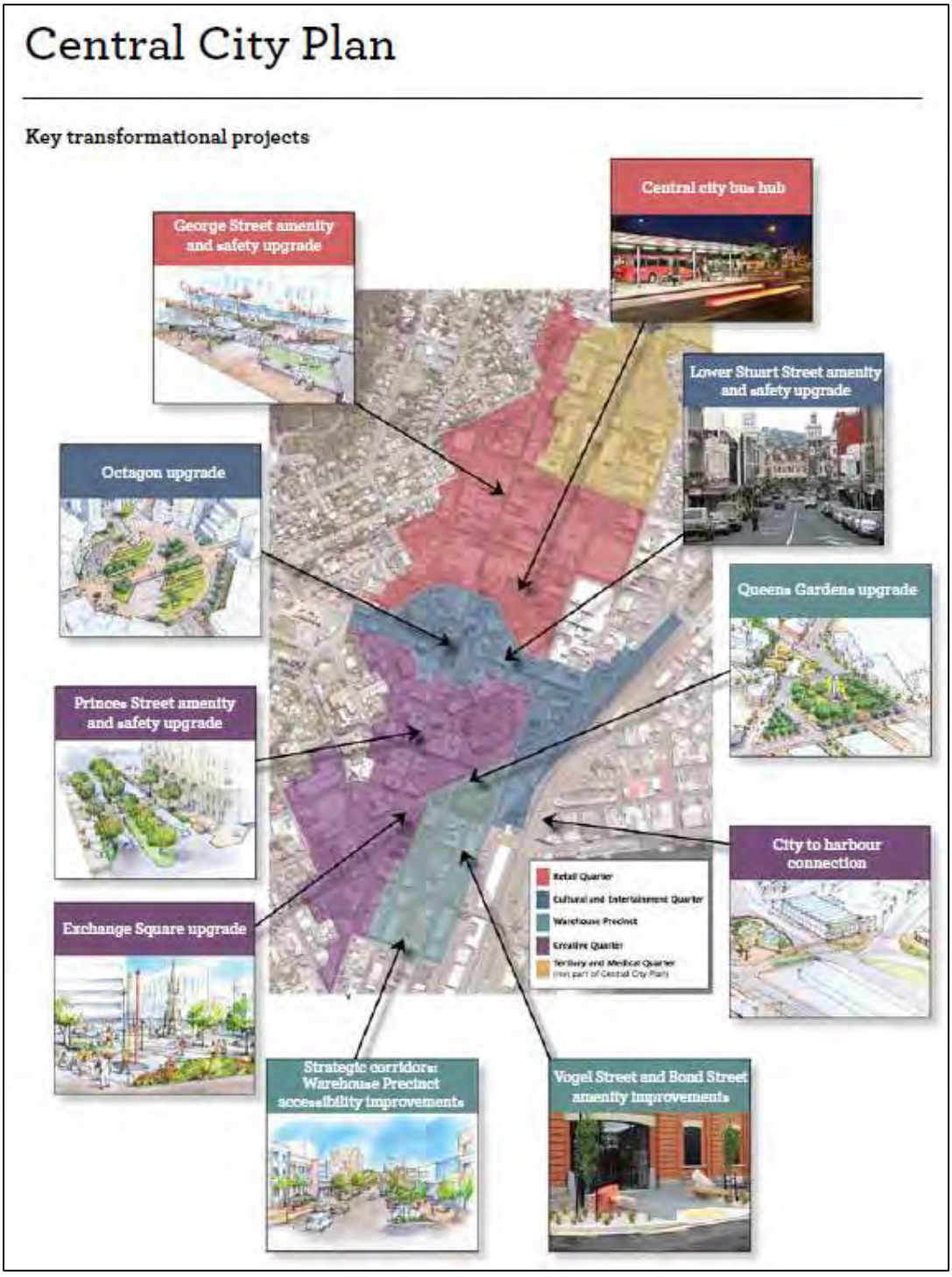
The Council's Central City Plan identifies five precincts. Each precinct has its own character, and the plan aims for the precincts to be well connected for people on foot so that they are easy to access and walk between. The five precincts are shown on the map below. Also shown are the ten transformational projects which will contribute to achieving the Council's goal of Dunedin as 'one of the world's great small cities'. Progress with these projects is as follows (**bold** indicates strong link to the SFDT):

- Central city bus hub – opened in 2019 on Great King Street
- Vogel Street and Bond Street improvements – completed during 2015-2019
- **City to Harbour connection** – planning for pedestrian/cycle bridge underway, budget in LTP
- **Strategic corridors: Warehouse Precinct accessibility improvements** – a project to consider options that reduce severance caused by the one-way pair, including rationalising SH1 on Cumberland Street
- George Street amenity and safety upgrade – planning underway, budget in LTP
- Exchange Square upgrade – some planning and designs completed, budget in LTP
- Octagon upgrade – trials underway, budget in LTP
- Lower Stuart Street amenity and safety upgrade – budget in LTP
- Princes Street amenity and safety upgrade – budget in LTP
- Queens Gardens upgrade – no progress

The Plan identifies the following challenges to achieving the vision (**bold** indicates strong links to SFDT):

- Aging infrastructure and public realm improvements
- The challenges of a low growth environment
- An unbalanced central city (economic activity drifted north leaving south less vibrant)
- **A car-dominated environment**
- **Severance caused by the one-way system**
- Insufficient quality public open space
- Insufficient visitor infrastructure
- Areas of negative experiences (e.g. around city's main hotels)
- Changing retail patterns

- A lack of visibility of Ngai Tahu cultural heritage
- Poor connections to the waterfront
- Resistance to change (retailers in particular)



Second Generation District Plan (2GP)

The 2GP zones and overlays identify key origins/destinations for pedestrians, and also indicate the Council's aspirations for different zones. The zones and overlays have their foundation in the Central City Plan, and aim to contribute to the Plan's outcomes through land use planning rules and regulations.

SFDT could also contribute to achieving these outcomes through pedestrian and streetscape improvements in certain locations. The table below shows the relevant zones and overlays for this project and explains the benefits of investment in street amenity and pedestrian permeability/connectivity.

Zone or Overlay	Description	Benefits of investment in street amenity and permeability
Campus Zone	Where the tertiary education providers (the University of Otago and Otago Polytechnic) are located. Provides for a range of land use activities that include teaching, training, learning and research and any ancillary activities.	Accessibility and amenity of the campus environment is vital to attracting staff and students.
Warehouse Precinct Zone	Mixed-use zone providing for inner city living, visitor accommodation, conference meeting and function, entertainment and exhibition, light industrial, restaurant and bulky goods and trade related retail activity. General retail and office activity is provided for if it occurs in scheduled heritage buildings, in order to encourage their restoration.	Improved pedestrian access from the CBD and across Crawford Street along with streetscape amenity improvements on Crawford Street would make this area more attractive for inner city living.
Harbourside Edge Zone and Harbourside Edge Transition Overlay Zone	Provides for the continuation of existing industry while allowing transition toward a mixed-use environment by also providing for conference, meeting and function, entertainment and exhibition, restaurant, training and education, visitor accommodation, residential activities and some office activity. New buildings will be required to be designed and located to provide a high level of amenity. Public pedestrian access is required to and along the coast.	Location of the Council's aspirational 'Waterfront' development. A new bridge is proposed from adjacent to the Chinese Garden. High quality pedestrian links to the bridge from the CBD are essential to the successful regeneration of this area.
Central Business District	The focus for employment, retail, entertainment, leisure, visitor accommodation, and art and culture activities. This includes key destinations for visitors and residents.	Improved pedestrian access between the Octagon, Railway Station/Toitu, New Dunedin Hospital, Otago Museum, Central City Bus Hub, and Queens Gardens would contribute to the liveability of the city for visitors and residents.
Residential Transition Overlay Zone (RTZ)	This overlay identifies preferred areas for transition to residential zoning if and when required. In the study area, the RTZ extends along George and Stuart Streets, north of the Campus Zone, and over the Warehouse Precinct and Harbourside Edge Zones.	In order to support inner city living in these areas, higher levels of pedestrian accessibility and streetscape amenity are desirable.

In addition, development of the New Dunedin Hospital is driving demand for improved streetscape amenity and pedestrian access, particularly on St Andrew Street between the two hospital sites, and Cumberland Street, along the hospital frontage.

Tourist Attractions

As referenced in the Central City Plan, many of the Dunedin's tourist attractions are physically isolated for pedestrians due to severance caused by the one-way pair. The primary tourist attractions in Dunedin are:

1. Otago Museum – located in between the northbound and southbound SH1 routes
2. Toitu Settlers Museum and Dunedin Railway Station – located between the southbound SH1 and the railway, visitors starting in the central city/main hotel areas must cross both SH1 routes to reach these sites
3. Dunedin Art Gallery – located in the Octagon – minimal severance issues

Other Destinations

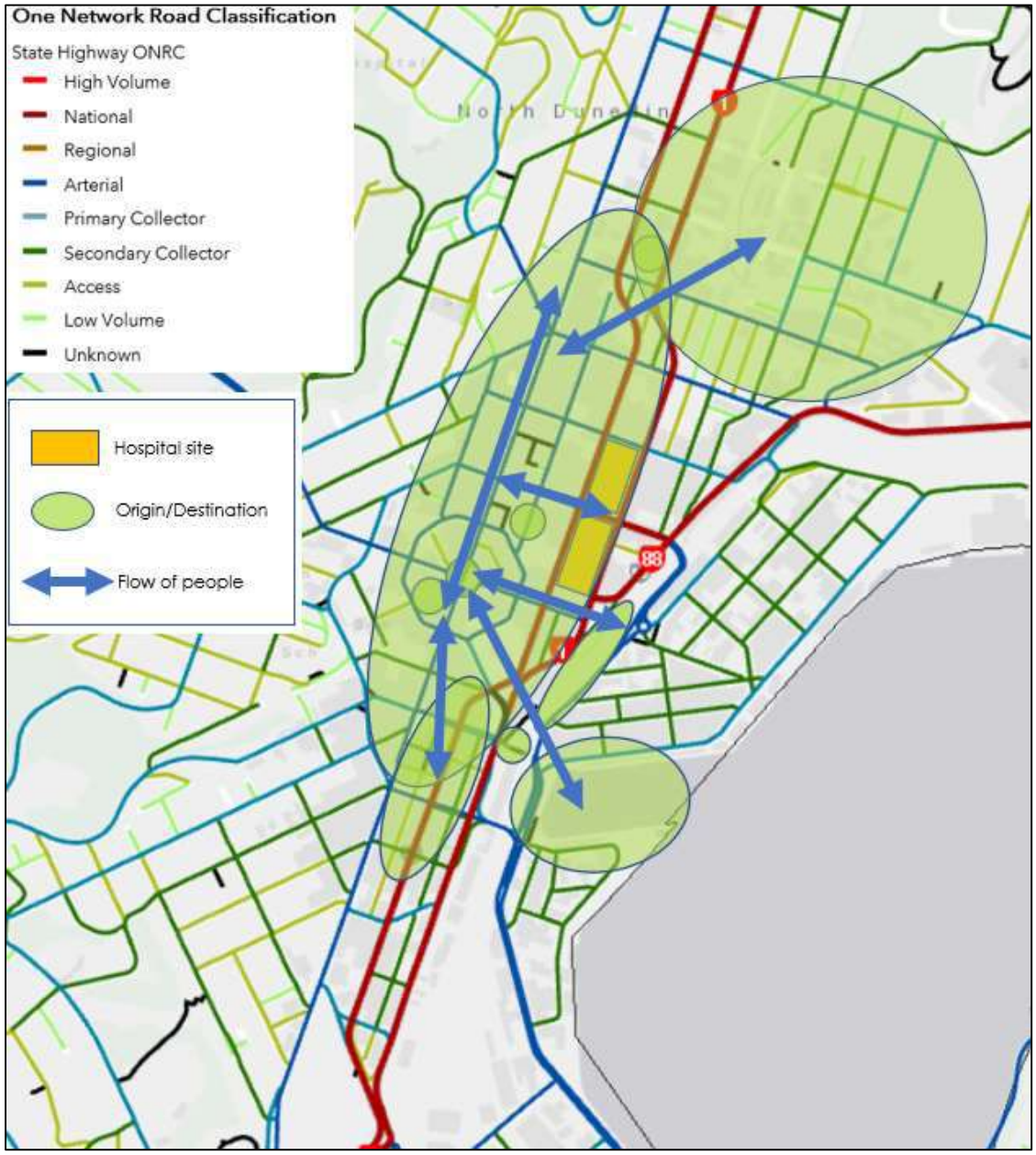
Other key destinations include the Octagon, the bus hub, George Street and wider retail area, and the existing Dunedin hospital which is a major employer and serves patients across the Southern DHB region. The University, as one of the biggest employers on the South Island, is a notable destination for both staff and students. Car parking areas also generate pedestrian traffic. The key areas for parking are around the railway line, Moray Place, Fileul Street, Dowling Street, Frederick Street and Great King Street.

2.2 Pedestrian Desire Lines

The key origins and destinations in the SFDT study are have been mapped (Map 1). This information, along with pedestrian data and an understanding of the size of specific attractors has allowed the main pedestrian desire lines to be identified.

The map underlay is the ONRC network. This allows heavily trafficked routes to be easily identified, and the one-way pair, as national routes, are shown in red. Locations where key pedestrian flows are interrupted by a main arterial route can then be identified.

This information was used to identify three primary locations that would benefit from pedestrian and streetscape amenity improvements (shown on map).



2.3 Primary Locations on SH1 for Pedestrian and Amenity Improvement

The map shows that pedestrian and street amenity improvements would offer the most benefit and best support for future investment in the city three primary locations areas:

- North - Tertiary: along both SH1 routes from Hanover Street to Dundas Street. The University, with around 20,000 students and 3,500 staff, needs safe and convenient pedestrian routes between residential areas, the campus (including the health precinct on Great King Street), the New Dunedin Hospital and the CBD. A benefit of these improvements will be better pedestrian access to Otago Museum for visitors.
- Central: along both SH1 routes from Stuart Street to Hanover Street. The Dunedin hospital employs around 3,000 staff and hundreds of visitors per day and is a significant generator of foot and vehicular traffic within the city centre. In summer, around a thousand additional visitors come to Dunedin on cruise ship days and walk around the city, visiting the retail precinct, railway station, Art Gallery, Museums and the Octagon and require good pedestrian facilities.

- South - Queens Gardens, Warehouse Precinct and Waterfront: along both the northbound SH1 route from Police Street to Burlington Rise, and along the southbound SH1 route from Stuart Street to the Chinese Garden. This will provide for improved access to Queens Gardens and better walking routes between the retail centre and the new pedestrian/cycle bridge to the Waterfront.

3. Programme Development

The above information fed into the development of the network scenarios. Through routes for traffic were identified for each scenario. It is expected that this route will have a high movement function, with lower local access/place function. The two network scenarios are:

Programme 1: A one-way option with two through routes within the central city on the existing SH1 one-way pair.

Programme 2v3: A two-way option where the current northbound route becomes a local road, and the current southbound route becomes an arterial. Cyclists are provided for on the local road.

4. Pedestrian Improvements

4.1 Speed Limits

Both scenarios include a slow speed zone in the core, as shown on the diagram. For Scenario 1 this is expected to be 40km/h on both north and southbound routes. For Scenario 2 this is expected to be 30km/h on the local road. The arterial route will remain at 50km/h to encourage traffic to use this route rather than the new local road, which is pedestrian/cycle focussed. The slow speed zone extends from the Warehouse Precinct in the south to St David Street in the north, encompassing the areas where there are higher numbers of pedestrians.

This slow speed core zone will improve safety and comfort for all road users, particularly pedestrians and cyclists. The slower speeds would be achieved through signage, threshold treatments (plantings and build outs) marking a change in environment for drivers, and side friction introduced through the targeted amenity/pedestrian improvements outlined below.

4.2 Corridor improvements

Corridor improvements are part of Programme 2, which provides more scope for change due to the downgrading of the existing northbound SH1 route to a local road and the creation of a two-way arterial on the existing southbound SH1 route. At this stage the proposed improvements are indicative only and will need to be further developed in the Single Stage/Detailed Business Case.

Local Road:

- Outside the slow speed zone: low level planting and refuges for mid-block crossing, for each block between the edge of the slow speed zone and the edge of the study area. This will encourage use of the active mode spine and provide a better environment for walking and cycling.
- Rapid signal phasing at all signalised intersections giving equal priority to all directions and Barnes Dances for pedestrians. This reflects the nature of the local road which will provide a high degree of accessibility at intersections and minimal wait times. It will also improve safety for pedestrians.

Arterial Route:

- A solid median for the full length of the through route, which will be planted between Jetty Street and St David Street. This solid median is for safety purposes and where planted it will enhance amenity. The planted area reflects the extent of the through route which experiences high visitor numbers and features many of Dunedin's landmarks such as the railway station, Toitu, Queens Gardens, the Chinese Garden and the interface with the Warehouse Precinct. It will also be the gateway to the Waterfront via the planned pedestrian/cycle bridge between Rattray and Fryatt Streets. The median will also be planted between Albany and St David Street to enhance the border of the Tertiary area. In this section, if space permits, it will also be used to provide a refuge for pedestrians crossing from in front of the University.

4.3 Targeted improvements

Targeted pedestrian and streetscape amenity improvements are the best way for the project to achieve value for money and maximise the benefits of investment. Packages have been identified for Programme 1 and 2v3. At this stage the proposed improvements are indicative only and will need to be further developed in the Detailed Business Case.

Within each area, existing conditions have been considered, and improvements identified where these are justified by current conditions or change in land use. For pedestrians, a minimum level of service has been identified for each scenario which would provide improved pedestrian permeability. At busy intersections which are already signal controlled, if it appears justified it is proposed to improve pedestrian levels of service

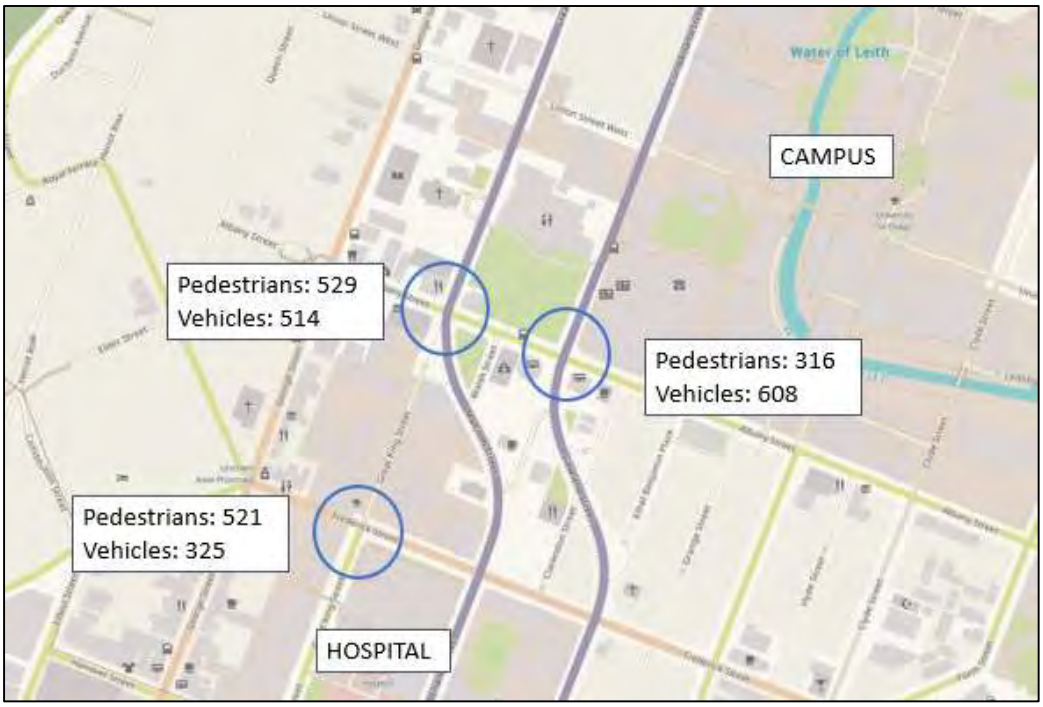
by introducing Barnes Dances, which have been well received by Dunedin residents (30 positive and 2 negative responses to People's Panel survey 2019). The proposed streetscape improvements support improved provision for pedestrians as well as a higher level of amenity by including build outs, plantings, street furniture and indented parking.

The targeted improvements for each of the primary locations are described in more detail below.

4.4 Primary Location 1: North – Tertiary connections

Pedestrians

The campus activities generate some of the most significant pedestrian flows in the city as people walk between the Tertiary area and the rest of the city. The Albany Street intersections recorded the highest peak pedestrian crossing demand (from available data), which occurred around the middle of the day, with 529 crossing movements in a 15-minute period. Data was also available at the Frederick Street intersection which is by the existing Dunedin hospital which recorded 521 crossing movements in 15 minutes in the morning peak. Data is illustrated below.



Intersection	Peak 15 min pedestrian crossing movements	Peak 15 minute traffic movements
Cumberland/Albany/Gowland Streets	316 (12.45pm)	608 (8.45am)
Great King/Albany/Malcolm Streets	529 (11.45am)	514 (5pm)
Great King/Frederick Streets	521 (8.45am)	325 (5pm)

Proposed Pedestrian Packages

Current provision: In 2019, Barnes Dance crossings were introduced at the two Albany Street/SH1 intersections as part of an NZ Transport Agency trial. It has been confirmed by the Transport Agency that these will be retained permanently. They will support access to the NDH. Some other pedestrian improvements have been completed in recent years, including pedestrian only signals across Cumberland Street between the University and the Museum Reserve, more formal build outs on Malcolm Street at the S bends, and closure of Walsh Street access from Malcolm Street. There is no provision for mid-block crossing of Cumberland Street along the University frontage.

Future needs: It is expected that the effect of the hospital relocation will be to generate more pedestrian crossing demand at the SH1 intersections on Frederick Street (and further south – considered in the Central section). Mid-block crossing in front of the University could be provided via the solid median in scenario 2 - this is not proposed for the other sections, but in the north the traffic volumes are lower and this could work well, but needs further consideration in the DBC stage. The informal build outs on Malcolm Street providing a

pedestrian route between Walsh and Great King Streets are popular and more formal provision should be considered.

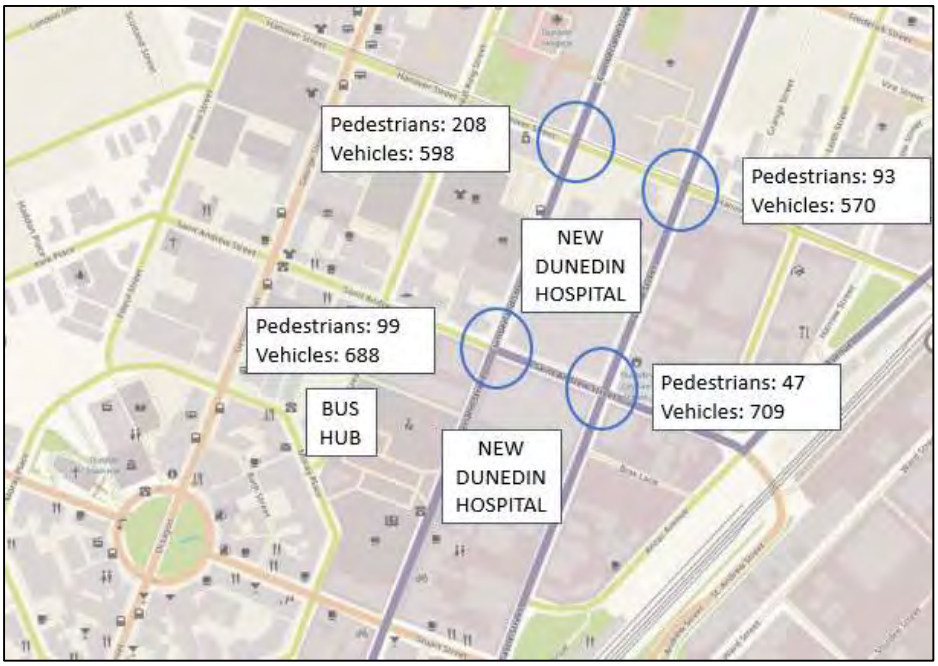
Indicative improvements (high level analysis only)

Indicative Improvement	Existing	Programme 1	Programme 2v3
Crossings	Build outs on Malcolm Street providing for desire line between Walsh and Great King Street	No change	Upgrade to formal pedestrian crossing
	Pedestrian signals on Cumberland Street to Museum Reserve	No change	No change
	Signals at Frederick, Union and St David Street, across both SH1 legs	Barnes Dance at Frederick to provide for route to NDH. Barnes Dances at Union and St David to provide higher level of service for pedestrian movements to/from University.	Barnes Dance at Frederick to provide for route to NDH. Barnes Dances at Union and St David to provide higher level of service for pedestrian movements to/from University.
	Barnes Dances at Albany across both SH1 legs	No change	No change
	Signals on Great King Street between Dundas and Duke	No change	Change to Barnes Dances on the local road.
Street amenity	Just north of St David Street	Threshold treatment for slow speed zone	Threshold treatment for slow speed zone on local road only.
	Corridor	Indented parking, build outs and plantings on Great King and Cumberland Street	Indented parking, build outs and plantings on the local road. Solid planted median on the arterial with some mid-block crossing opportunities.
Speed environment	50km/h	40km/h both SH1 legs	30km/h local road 50km/h through route

4.5 Primary Location 2: Central – New Dunedin Hospital connections

Pedestrians

Pedestrian data was provided which indicated crossing demands of SH1 at Hanover and St Andrew Street intersections. The busiest intersection for crossing movements is currently Hanover/Cumberland Street, but in the future, with the relocation of this hospital, crossing demands will substantially increase at all these intersections as well as those on Stuart Street to the south of the hospital. For this reason, improvements target these locations. The data is illustrated below.



Intersection	Peak 15 minute pedestrian crossing count	Peak 15 minute traffic count
Cumberland/Hanover Streets	208 (5pm)	598 (5.15pm)
Castle/Hanover Streets	93 (11.45am)	570 (5.15pm)
Cumberland/St Andrew Streets	99 (12.15pm)	688 (5pm)
Castle/St Andrew Streets	47 (8.15am)	709 (4.30pm)

Proposed Pedestrian Packages

Current provision: On SH1 in this area pedestrians cross at signalised intersections. There is no provision for mid-block crossing although this does happen informally when there are gaps in traffic.

Future needs: To support the NDH it is proposed that Barnes Dance crossings be introduced at Stuart, St Andrew and Hanover Street intersections with Cumberland Street. Mid-block crossing demands will increase due to the NDH and formal mid-block crossings are provided on the two hospital blocks fronting Cumberland Street. These could be zebra crossings or pedestrian signals.

Indicative improvements (high level analysis only)

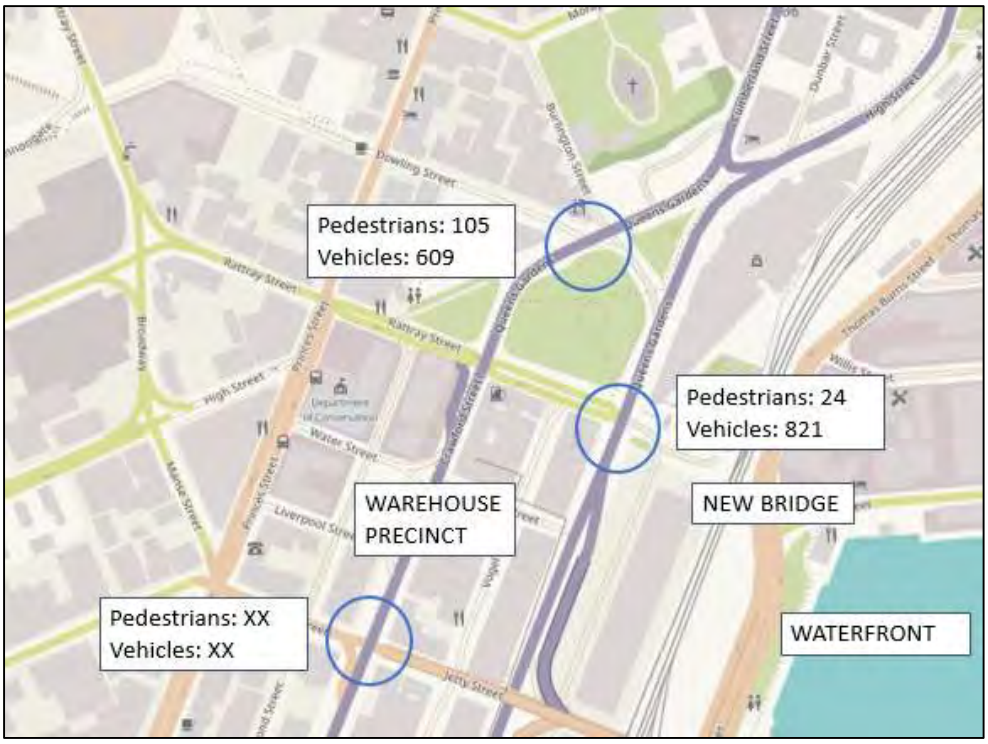
Indicative Improvement	Existing	Programme 1	Programme 2v3
Crossings	Signals at Hanover, St Andrew and Stuart Street, across both SH1 legs	Barnes Dance at Cumberland Street intersections with Hanover, St Andrew and Stuart Street. Barnes Dance at Castle Street intersections with St Andrew and Stuart Streets intersections.	Barnes Dance at Cumberland Street intersections with Hanover, St Andrew and Stuart Street. Barnes Dance at Caste Street intersections with St Andrew and Stuart Street intersections.
	Cumberland between Hanover and Stuart Streets	Mid-block crossings each mid-block and secure a pedestrian route to the bus hub.	Formal pedestrian crossings each mid-block on the local road. None on arterial. Secure a pedestrian route to the bus hub.
	Castle between Hanover and Stuart Streets	No change	No change. Although there will be a planted median, pedestrian crossings mid-block not encouraged due to traffic mix and volumes.

Indicative Improvement	Existing	Programme 1	Programme 2v3
Street amenity		Indented parking, build outs and plantings on Cumberland and Castle Street	Indented parking, build outs and plantings on the local road. Solid planted median on the arterial.
Speed environment	50km/h	30km/h both SH1 legs	30km/h local road 50km/h through route

4.6 Primary Location 3: South - Queens Gardens, Waterfront and Warehouse Precinct

Pedestrians

The Waterfront will be a key destination and a pedestrian/cycle bridge is planned to provide a connection adjacent to the Chinese Garden across the railway line and harbour arterial to Fryatt Street. Better pedestrian connectivity around Queens Gardens and the Warehouse Precinct offers benefits in terms of increased use and enjoyment of public space contributing to improved city liveability. Pedestrian count data is illustrated below. The highest pedestrian crossing count was at the Queens Gardens/Dowling Street intersection, with 105 crossing movements in a 15 minute period at lunchtime.



Intersection	Peak 15 minute pedestrian crossing count	Peak 15 minute traffic count
Queens Gardens/Cumberland Street (Dowling)	105 (12.15pm)	609 (8.30am)
Queens Gardens/Cumberland Street (Chinese Garden)	24 (12.45pm)	821 (5pm)
Crawford/Jetty Street	24 (5pm)	725 (7.45am)

Proposed Pedestrian Packages

Current provision: Pedestrian access around Queens Gardens is relatively good with the ability to cross from the north side of Burlington Street or Cumberland Street to Toitu via two sets of signals – one across Cumberland Street and one across Castle Street. However, there is no wayfinding signage and this route it not obvious. To reach the Gardens itself requires crossing Burlington and then Cumberland Street. Walking to the Warehouse Precinct requires the most awkward combination of crossings, with Burlington Street signals,

Dowling Street signals, and a zebra crossing over the left slip lane into Dowling Street, followed by signals at the Rattray Street intersection.

Future needs: The improvements focus on providing clear routes for pedestrians and pedestrian signage. Where demands are higher Barnes Dances are proposed. The crossing of three roads (Burlington Street, Dowling Street and the Dowling slip lane) is proposed to be rationalised in both options.

Indicative improvements (high level analysis only)

Indicative Improvement	Existing	Programme 1	Programme 2v3
Crossings	Signals at Queens Gardens/Rattray Street	Barnes Dance	Barnes Dance. Remove left slip lane.
	Pedestrian signals at Queens Gardens / Burlington, Queens Gardens / Dowling Street and zebra crossing at Dowling Street slip	Redesign Dowling Street intersection to remove left slip. Restrict movements. Retain signals at both intersections. Provide Barnes Dance.	Redesign Dowling Street intersection to remove left slip. Restrict movements. Provide Barnes Dance on local road.
	All other signals and mid block to Vogel Street	No change	No change
Street amenity		Thresholds for low speed area just south of Jetty Street	Thresholds for low speed area on local road just south of Jetty Street
Corridor		Indented parking, build outs and plantings on Cumberland and Castle Street	Indented parking, build outs and plantings on the local road. Solid planted median on the arterial.
Speed environment	50km/h	40km/h both SH1 legs	30km/h local road 50km/h through route

Appendix H Engagement Report

Shaping Future Dunedin Transport

Summary of Public Engagement

September 2020

WAKA KOTAHI NZ TRANSPORT AGENCY

Otago Regional Council

DUNEDIN CITY COUNCIL | kaunihera a-rohe o Ōtepoti

CONNECTING dunedin

Introduction

Shaping Future Dunedin Transport project - public engagement

In July 2020, as part of the Shaping Future Dunedin Transport business case process, Connecting Dunedin, a partnership of Waka Kotahi NZ Transport Agency, Dunedin City Council and Otago Regional Council, asked people to share their ideas and thoughts about the future of Dunedin's central city transport system.

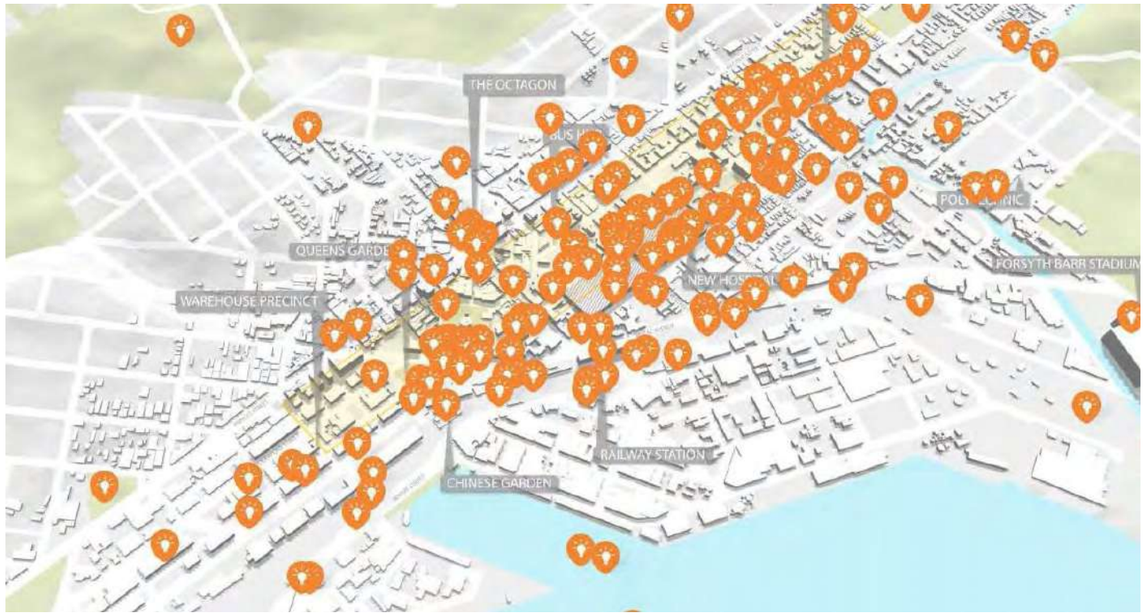
The engagement's purpose was to start a city-wide conversation about the changes the central city transport system may face in the future and how it could be improved to be safer, better connected and offer a range of ways for people to get around the city as the new Dunedin Hospital and other central city developments take shape.

The Shaping Future Dunedin Transport project team sought feedback from the community on a range of ideas through on-line interactive maps.

There were over 22,000 total visits to the maps, with over 5,000 unique visitors, meaning many people repeatedly engaged with the information. As well as the interactive maps, there was a 26-question survey. Nearly 500 comments were left on the interactive maps and 756 people completed the survey.

This engagement report summarises the ideas and comments made on the maps and provides more details of the survey responses. It also summarises feedback received from key stakeholders.

All the comments made on the interactive maps will also remain **online** for people to read in more detail.



On-line interactive maps were used to ask people for their comments and ideas (Social Pinpoint)

About the project

Shaping Future Dunedin Transport

With the new Dunedin Hospital being built in the central city and other developments planned, Dunedin has a unique opportunity to look at ideas to create a transport system that's safer, better connected and offers a range of travel choices.

Connecting Dunedin has been working on the Shaping Future Dunedin Transport project to develop what those ideas might look like. Ideas include:

- suggested ways to make it easier and safer for people to get around on foot and by bike
- improving public transport choice and parking
- providing an alternative route bypassing the city centre
- changing the current road network e.g. whether the one-way system could become two-way.



Indicative image of Cumberland Street, outside the new hospital

Purpose of the engagement

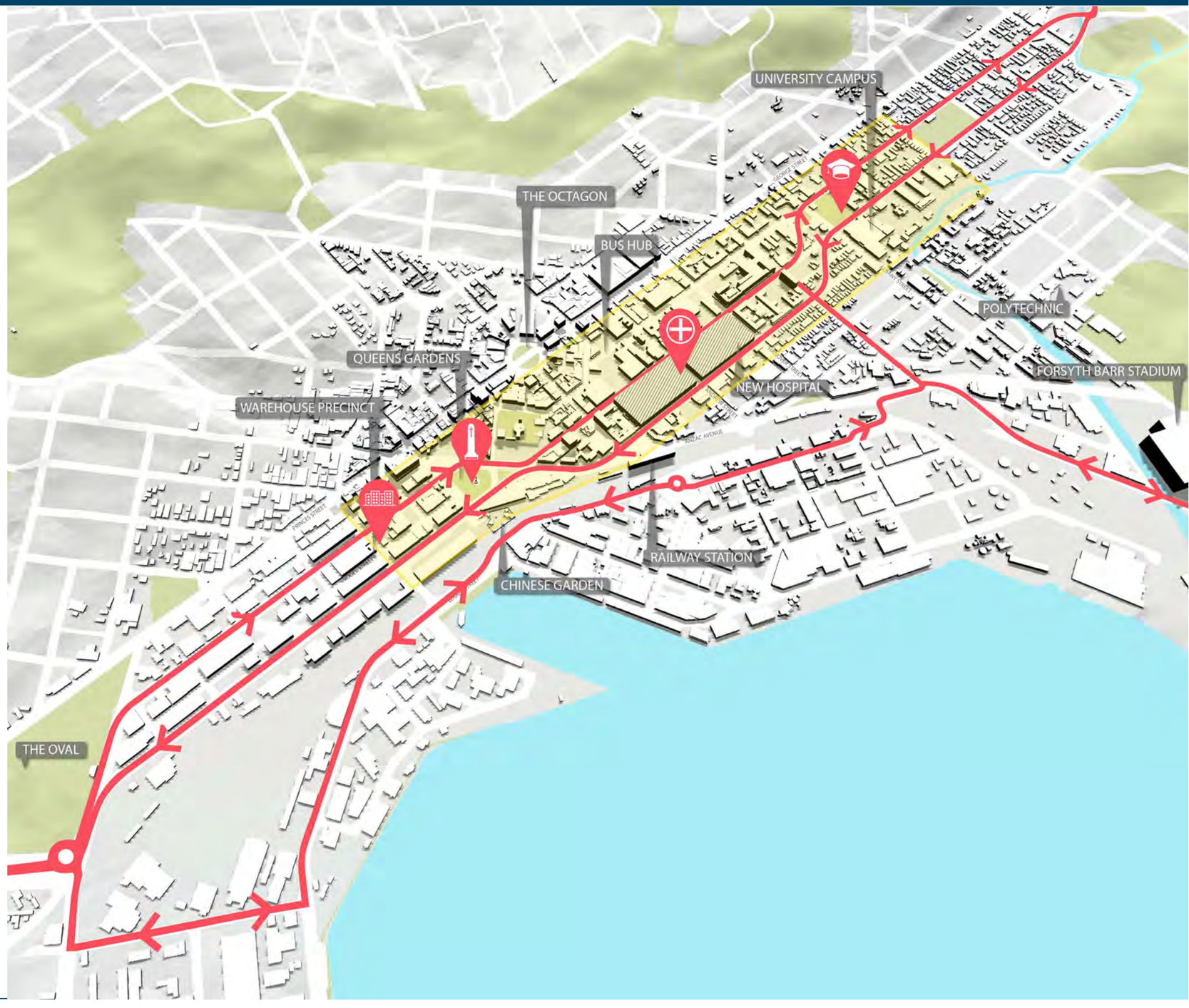
Purpose of the engagement

As part of the Shaping Future Dunedin Transport Business Case process, the Shaping Future Dunedin Transport Project team ran a four and half week online interactive engagement that finished on 16 July 2020. The purpose of the engagement was to start a city-wide conversation about the changes that the central city transport system will face as the new Dunedin Hospital and other central city developments take shape.

Together with a suite of supporting technical and planning studies, the comments and ideas received during the engagement period will be used to inform the business case as it's developed.

Key themes emerging from the public engagement included:

- Provide more all day commuter parking, including park and ride facilities around the edge of the central city and within walking distance of major destinations and places of work.
- Concern that changing the SH1 one-way system to a two-way system would result in congestion and reduce the capacity of the existing network.
- Move the cycleways from SH1 to local roads and provide more connections to the existing cycle network.
- Improve the bus network incuding providing an improved inner-city bus loop.
- Provide more seating and planting to improve the main walking routes so that they are safer and easier for everyone to use, regardless of age and mobility.



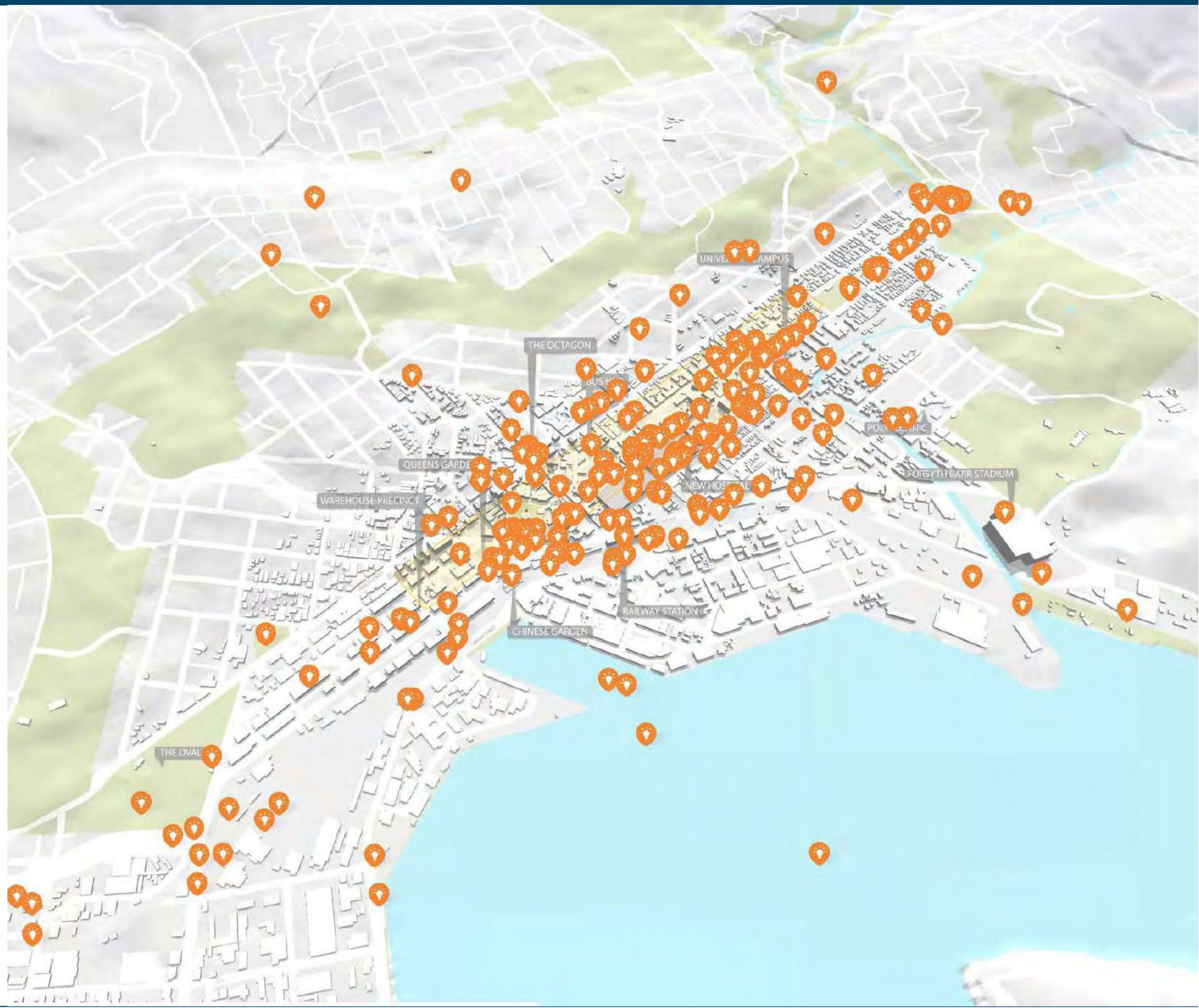
Engagement methods

Online interactive maps

Shaping Future Dunedin Transport set out to engage with the Dunedin community to find out what's important to people as they travel around the city, whether driving, on the bus, cycling or walking. The project team also encouraged many stakeholder organisations to provide their views. The engagement was open to anyone who wished to provide feedback, and they were able to do so anonymously.

The Shaping Future Dunedin Transport project team created a number of online interactive maps using the engagement tool Social Pinpoint. These were hosted on the NZTA website (wwww.nzta.govt.nz/sfdt). The maps allowed people to look at a range of ideas and then leave comments, ask questions and debate the future of transport in central Dunedin.

Other ways to provide feedback included emailing at sfdt@nzta.govt.nz or calling a phone mumber set up to help people provide feedback online.



Promoting the engagement

To encourage participation in the engagement, there was promotion through print and digital advertising, including:

- Newspaper ads and leaflets (Otago Daily News, The Star)
- Radio advertisements and interviews
- Leaflets and posters at Council facilities
- Promotion through NZTA, DCC and ORC websites
- Public dashboard reports throughout the engagement period including the top five comments

Engagement methods - dashboards

Shaping Future Dunedin Transport

Social Pinpoint engagement update
Dashboard report 15 Jun-30 Jun 2020

www.nzta.govt.nz/sfdt

Top 5 Comments:

"A multistory car parking building would be pivotal to the success of the hospital. Dunedin already lacks parking spaces, and either an underground or above-ground car park would be a big help" 55 likes 3 dislikes

"Please create a high frequency free/low cost inner city bus loop that joins the university/ polytech, city centre and warehouse district, with park and rides on the outskirts." 46 likes 5 dislikes

"I'm not convinced about removing the current one way system. Traffic is already congested during peak hours on that system. I would like to see some more details of how the proposed traffic flows on the alternative two single lane roads (one local, one state highway) will cope with current and future anticipated traffic." 44 likes 5 dislikes

"This [Ward Street] road is already very busy and doesn't have the capacity to take the volume of traffic being moved from the one way system." 41 likes 5 dislikes

"Please please please – create a better outcome for the areas around the railway station gardens, Toitu, the old prison building, the Chinese gardens – these are drawcards for local and visitors alike and to be divided as they are now (and continue to be as proposed) is a poor outcome." 35 likes 0 dislikes

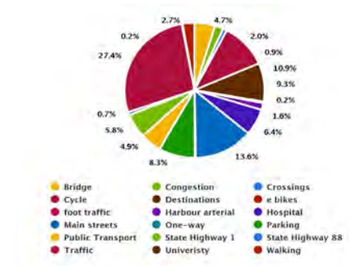
13,317
site visits

3,181
unique users

290
survey responses

222
comments

Tags



18-24	25-34	35-44	45-54	55-64	65+
10%	16%	16%	18%	19%	22%

User age breakdown

CONNECTING dunedin

WAKA KOTAHI NZ TRANSPORT AGENCY | Otago Regional Council | DUNEDIN CITY COUNCIL kaunihera a-rohe o Ōtepoti

Shaping Future Dunedin Transport

Social Pinpoint engagement
Dashboard report 15 Jun- 16 July 2020

www.nzta.govt.nz/sfdt

Top 5 comments:

"A multistory car parking building would be pivotal to the success of the hospital. Dunedin already lacks parking spaces, and either an underground or above-ground car park would be a big help" 76 likes 3 dislikes

"Please create a high frequency free/low cost inner city bus loop that joins the university/ polytech, city centre and warehouse district, with park and rides on the outskirts." 73 likes 5 dislikes

"I'm not convinced about removing the current one way system. Traffic is already congested during peak hours on that system. I would like to see some more details of how the proposed traffic flows on the alternative two single lane roads (one local, one state highway) will cope with current and future anticipated traffic " 65 likes 5 dislikes

"This [Ward Street] road is already very busy and doesn't have the capacity to take the volume of traffic being moved from the one way system." 48 likes 6 dislikes

"The proposed changes appear to halve the capacity of Highway one, and it therefore appears transit times will rise sharply when the system reaches capacity. What is the proposed system's capacity in relation to 2019 volumes? What is the economic impact of the greater delays to the non-local traffic that has to pass thought Dunedin on the way North or South? " 45 likes 1 dislikes

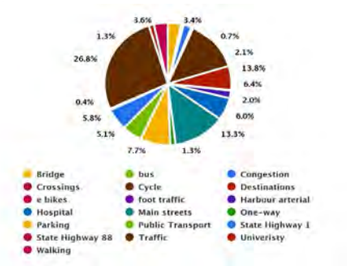
22,057
Total Visits

5,368
Unique users

756
survey responses

459
comments

Tags



18-24	25-34	35-44	45-54	55-64	65+
10%	16%	16%	18%	19%	22%

User age breakdown

CONNECTING dunedin

WAKA KOTAHI NZ TRANSPORT AGENCY | Otago Regional Council | DUNEDIN CITY COUNCIL kaunihera a-rohe o Ōtepoti

Feedback Themes

What you told us

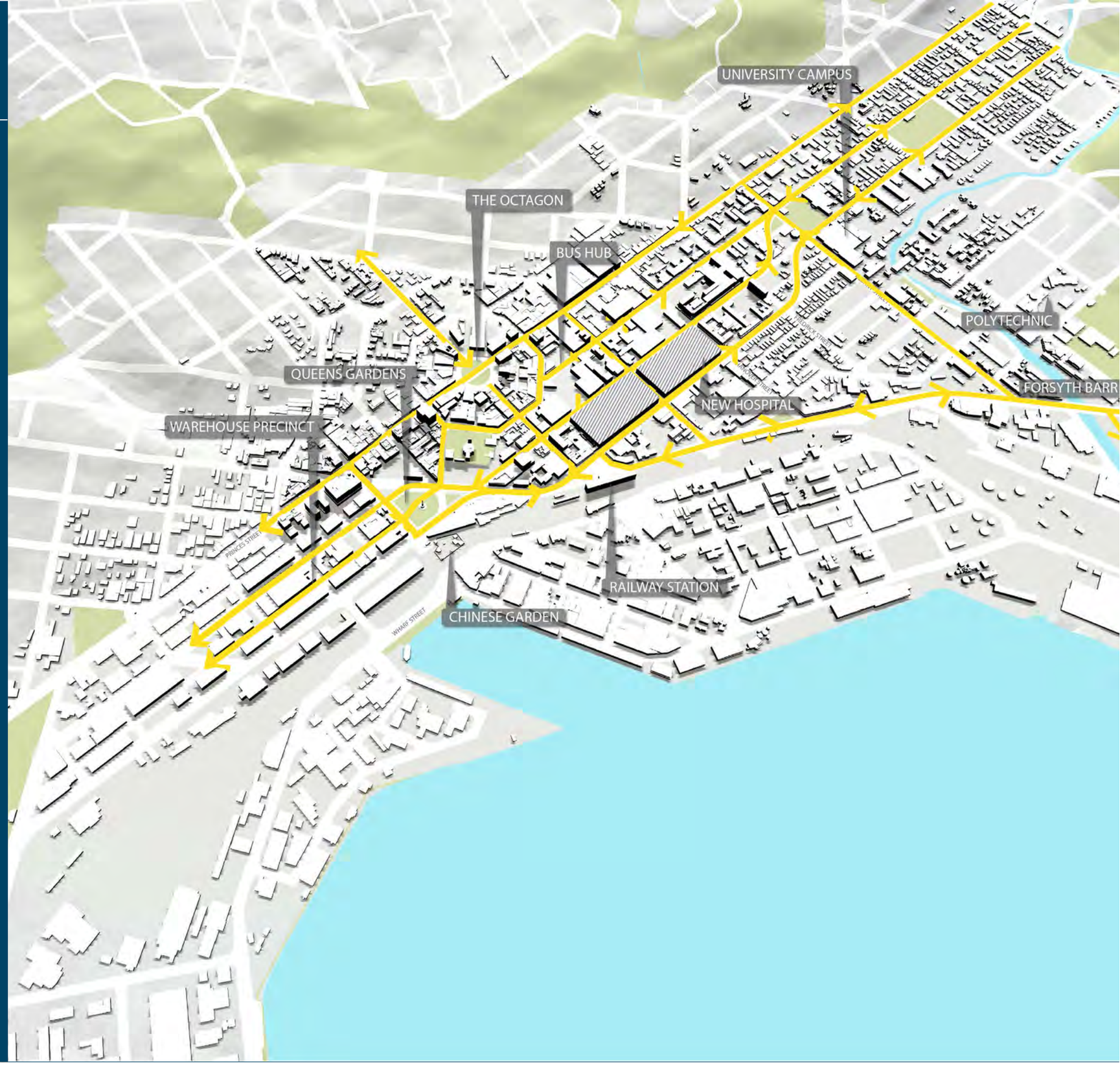


Walking

One of the project goals is to make it easier and safer for everyone to get around the central city on foot.

This is particularly important around the new hospital building and between popular destinations such as the Octagon and George Street, the University, the Railway Station, Toitū, the Chinese Gardens, Queens Gardens and the Warehouse Precinct. Ideas for how we could do this include:

- Improving the quality of the footpaths on the main walking routes so they are safe for everyone to use, regardless of age and mobility.
- Adding more seating and planting to improve people's walking experience. This is particularly important around the new hospital building and between popular destinations.
- Providing more Barnes Dances at key intersections, more mid-block crossing points and moving e-scooter parking off footpaths.
- Extending the current central city 30-40km/hr slow speed zone



Walking - key feedback themes

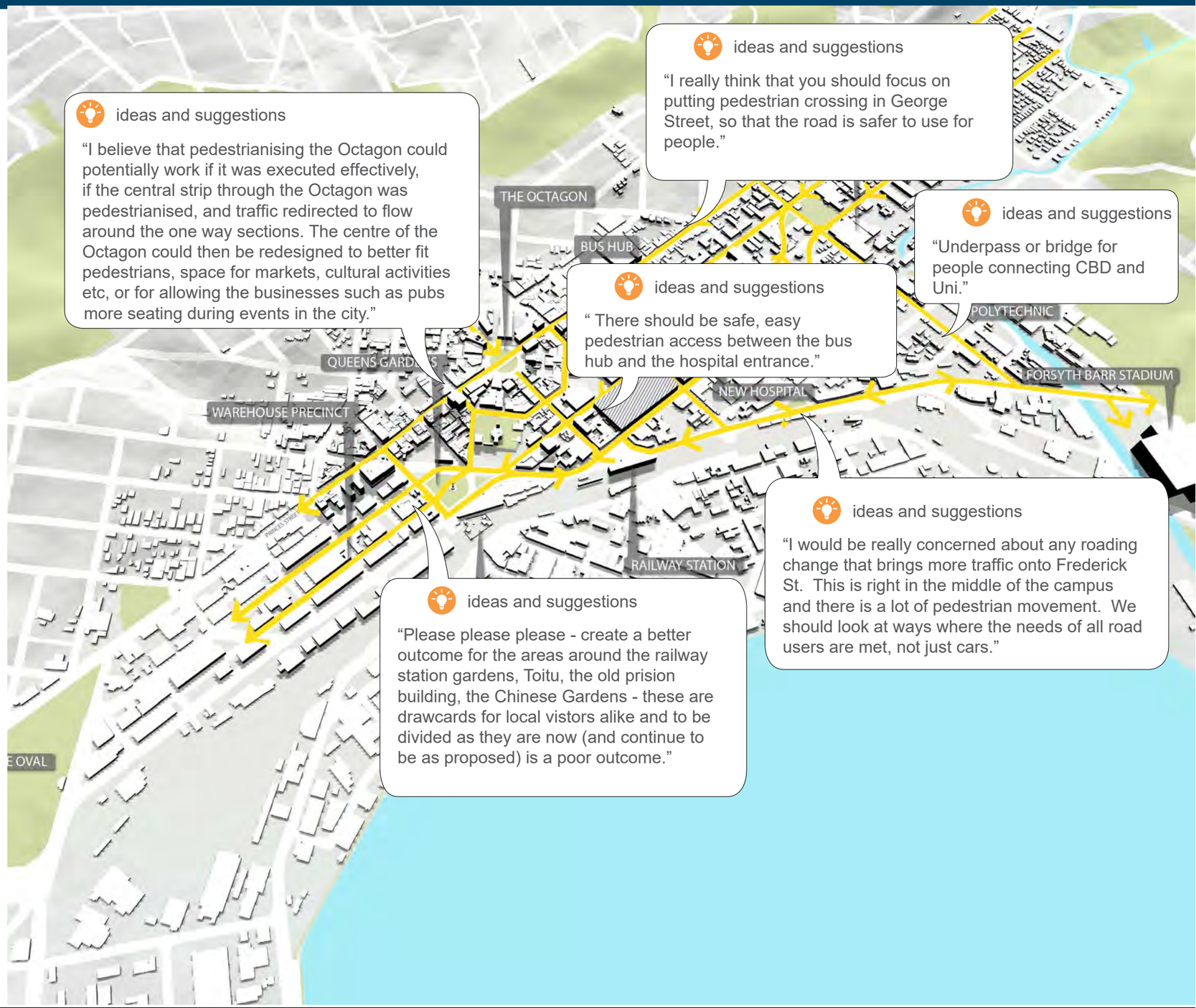
Many comments suggested that roads should be more pedestrian-friendly as they are currently unpleasant due to loud and unsafe traffic. Shelter from the weather conditions was also an issue for people not wanting to walk around the city more, with many comments suggesting covered walkways would help.

Some comments wanted to see fewer cars in the central city to improve the street environment for pedestrians and make it a safer place to walk. More amenity on the streets was also suggested to improve the streets.

A number suggested walking into the city was too far and took too long for them, the surrounding hills were an issue and the weather was too. Some respondents suggested that they do not face any problems walking into and around the city.

The survey indicated that the majority of people felt neutral on the current walking experience along the state highways. Some felt the experience was unappealing or very unappealing. When questioned about the ease of crossing the street when walking in the city centre, the majority of people were satisfied or very satisfied.

Some popular comments are represented by the quotes on the adjacent map.

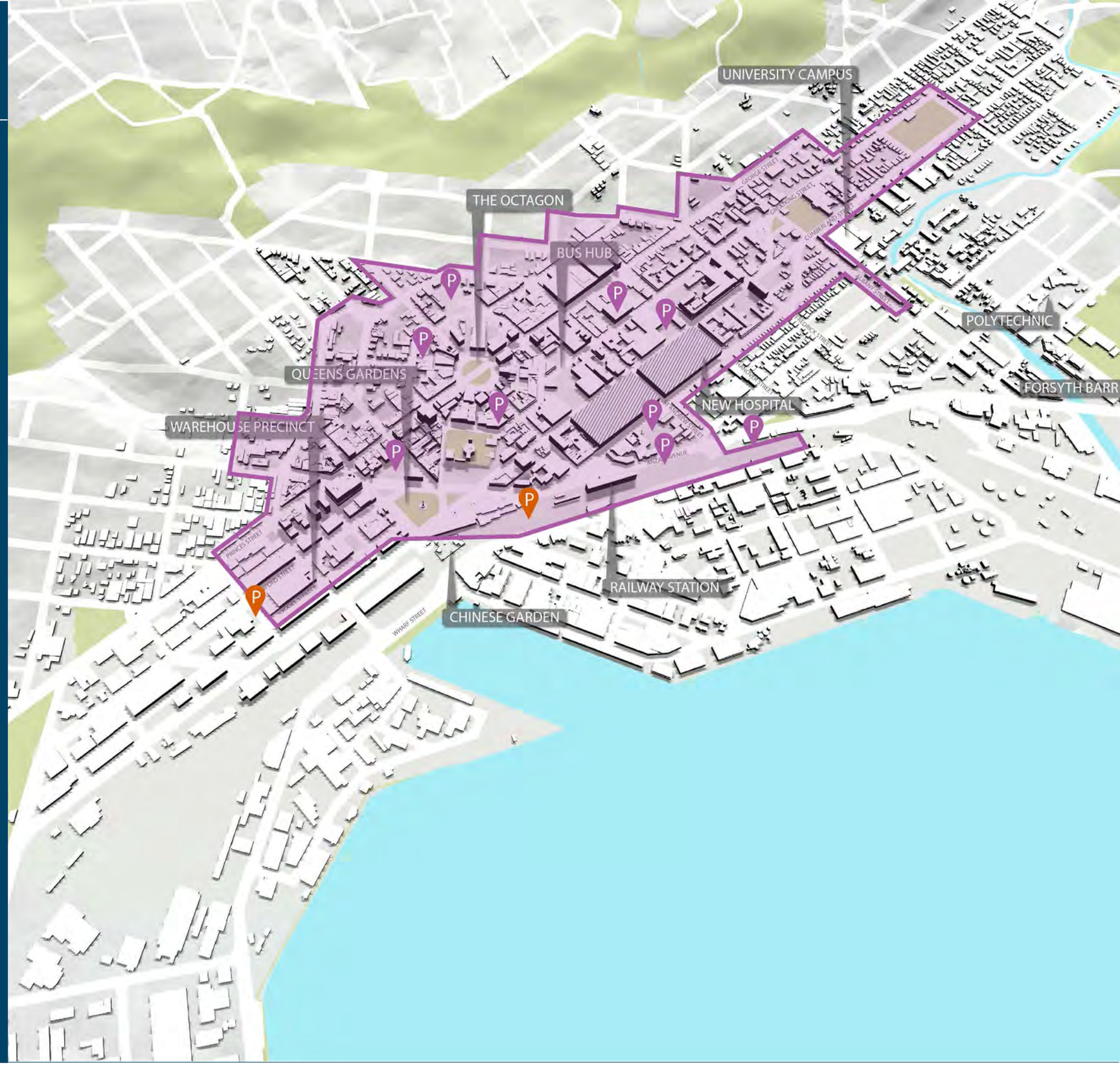


Parking

Another idea is to provide more all day and commuter parking around the edge of the central city but still within walking distance of major destinations and places of work. We are considering new off street parking in two locations:

- In Wharf Street area which could provide for the new hospital and the city centre.
- In the Warehouse Precinct, which would primarily provide for commuters from the south, which is the origin of 65% of commuter traffic.
- Parking will also be managed so that on-street parking spaces in the central city are prioritised to support central city businesses, shops and essential services.

The map shows the central city parking zone and indicative locations of new off street parking facilities (shown in orange).



Parking - key feedback themes

Many respondents suggested that there should be more parking and more parking buildings around the city to service the current parking needs. Many comments suggested a multi-story parking building with close proximity to the new Dunedin hospital would be favourable.

Lots of comments requested that more parking is provided on the outer edge of the city to accommodate commuters and provide more park and ride facilities into and around the city. There was support to reduce the amount of cars in the central city to encourage a more pedestrian friendly space.

A number of respondents commented that they would like to see a focus on more transport options, cycling and walking in Dunedin over the priority for parking on the road. They also commented that parking in the central city should be time restricted for retail purposes and for people with limited mobility.

Some popular comments are represented by the quotes on the adjacent map.



Changes to SH1

Another key part of the project is to investigate how the road network in the central city may need to change to best integrate the new hospital into the central city, while making it safer for people walking and cycling around the surrounding area, and providing a reliable route through the city for vehicles. This includes changes to how State Highway 1 runs through the city and whether it stays one-way or changes to two-way.

One-way system

We know now that if the one-way system is kept as it is, other changes will need to be made to support the new hospital development. These could include:

- Improving Wharf Street and Thomas Burns Street (the Harbour Arterial) so that it can handle more traffic, providing an alternative route bypassing the city centre and avoiding the new hospital during and after construction.
- Moving the main east-west route on St Andrews Street to Frederick Street. Introducing a slow-speed zone (30-40km/hr) on both current north bound and south bound routes.
- Improving pedestrian crossings at key intersections and at key mid-block locations with limited impact on parking.
- Providing areas of planting and seating where space allows.

As part of the oneway system idea the current one-way cycleways would be kept the same.



Changes to SH1

Two-way system

This map shows the ideas for changing the current one-way system through Dunedin to a two-way system. Key features of this option could include:

- Introducing a main city centre through route on the current southbound route, passing behind the new hospital. It's proposed to be a two way route, with minimal parking, a speed limit of 50km/hr and a solid median strip separating the two lanes.
- The existing northbound route passing the front of the new hospital will become a two-way local road. The speed limit of this road, is reduced to 30 km/hr.
- Parking is retained on the local road and there will be improved pedestrian crossings at all intersections and more mid-block pedestrian crossing points linking key destinations.
- Improving Wharf Street and Thomas Burns Street (the Harbour Arterial) so that it can handle more traffic, providing an alternative route bypassing the city centre and avoiding the new hospital during and after construction.
- Moving the main east-west route on St Andrews Street to Frederick Street.

Under this two-way system option, the cycleway would be moved to the local road outside the hospital. It would still be separated from the traffic from the and would be two way, with additional cycleway routes added to link to the Oval.



Changes to SH1 - key feedback themes

The majority of respondents to the survey commented that the current one- way system should be retained as they are - there was concern that if it changed to a two way-system this would impact congestion and reduce the capacity of the existing SH1 network by 50%.

Feedback also indicated that many people do not like the cycle lanes being on the one-way system and suggested they could be located on safer streets.

A key theme of the feedback was support for the introduction of a heavy traffic bypass (the Harbour Arterial) to remove large vehicles from the current system to make it feel safer although there was concern that the road doesn't have the capacity to carry any additional traffic. An increase in trees and amenity on the roads was supported by the majority of people who provided feedback on this issue.

The majority of comments indicated that congestion was the biggest challenge when driving on the current one-way system. The traffic light phasing was also a problem for a high number of respondents. The current cycle lanes on the one-way system was also recorded as being an issue.

Some popular comments are represented by the quotes on the adjacent map.



Changes to SH1 - key feedback themes

The vast majority of respondents felt safe when driving on the current one-way systems however the majority of people were neutral when questioned about the current system being an appealing place to be while driving.

Many respondents commented that the current one-way systems feel unsafe and car dominated which made them undesirable. The majority of people were concerned about congestion if a two-way system were to be introduced. Some support was given to the two-way system commenting that it would create a more cycle and pedestrian friendly space.

The majority of respondents to the survey would prefer to see the one-way system retained as in their opinion this was the best method of integrating the hospital with the city.

Some popular comments are represented by the quotes on the adjacent map.



Cycling

Another goal of the project is to improve the cycle network, aiming to get more people moving around by bike.

Ideas for how we could do this include filling gaps in the existing cycleway network to improve connections between popular destinations and encouraging people to commute to work using a bike.

Other ideas include:

- Adding a new cycleway to Albany Street
- Creating several safe bike hubs in the city, including near the Bus Hub to provide an easier bus/bike travel option



Cycling - key feedback themes

Whilst many respondents were supportive of the proposed changes to the cycle way to provide more connections to the current cycle network to keep cyclists away from busy roads where possible; some felt that cycling wasn't to be encouraged. Improving the current cycle network to be more safe was also noted in the feedback received.

There was support for moving the current separated cycleways from SH1. Some feedback indicted specific areas where cycle network connections were very poor, unsafe or not easy for cyclists to complete a journey easily.

When asked about problems faced when cycling into and around the city centre, the majority of survey responses indicated that the weather, the hills and the feeling of being unsafe were issues. Driver behaviour was also noted as being an issue when cycling.

Of all respondents, the proposal to connect gaps in the current cycle network was both supported and unsupported by a similar number of people with some indicating that they did not support any improvements to the cycle network.

Some popular comments are represented by the quotes on the adjacent map.



Public Transport

Another goal of the project is to improve public transport choice, aiming to get more people moving around by bus.

Ideas for how we could do this include simplifying the bus routes through and to the city centre (from North and the South).

Other ideas include:

- Creating several safe bike hubs in the city, including near the Bus Hub to provide an easier bus/bike travel option
- Reviewing fares to make bus travel easier to calculate and more economical
- Upgrading key bus stops with enhancements such as real time information
- Continued review of the bus network in terms of frequency and timetable
- Introducing bus priority at locations where buses currently experience congestion delays at peak times
- Creating further park and ride options.



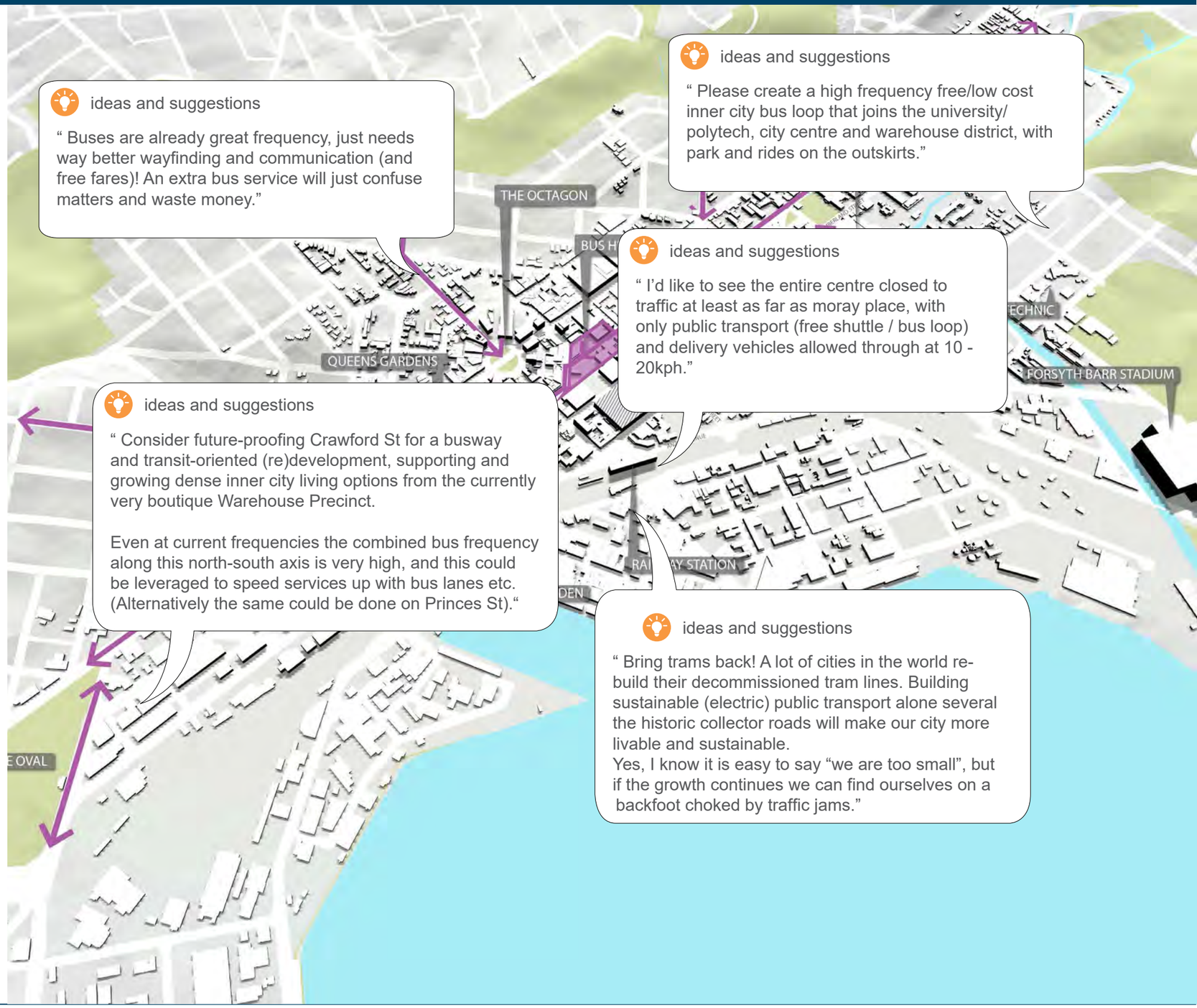
Public transport - key feedback themes

The majority of respondents were supportive of the ideas proposed for improving the bus network. Some commented that the current frequency of the buses were an issue. Many people commented that the buses were too large and suggested that smaller, more frequent buses could help their issues faced. Many people were supportive of increasing the public transport, cycling and pedestrian networks to encourage people away from cars.

The majority of respondents answered that the proposed improvements to the bus network would not encourage them to use the bus more. The main issues they faced when getting the bus into the city centre were the poor frequency, how expensive it was, the time the journey took was too long and it was unreliable.

A high number of respondents answered that they do not get the bus into town. Some comments suggested that an electric bus fleet would be appealing. Many also commented that they have appreciated the free bus service running.

Some popular comments are represented by the quotes on the adjacent map.



What the streets could look like

As part of the project, the Shaping Future Dunedin project team developed some indicative images of what the different streets could look like in the future.

The images focused on showing the possible changes to the current South and North Bound State Highways in key locations, under one-way and two-way system option. This is to give an indication of the street experience whether people are walking, cycling, on the bus or driving.

One way: Crawford - Great King St



Two way: Crawford - Great King St



Key feedback themes

The majority of respondents strongly liked the proposal to provide more trees, landscape planting and places for people to sit along the street network.

Some comments were less supportive of the seats in the roads as they were unsure when people would use them. A high number of respondents commented that they would like more trees on the streets to make them look nicer and be better space as a pedestrian.

There was support for creating a better outcome for the areas around the Dunedin Railway Station gardens, Toitu and the Chinese Gardens. It was felt these are drawcards for both locals and vistors and that currently the roads created a barrier for people to get to them easily.

Many people also commented that they'd like the streets to be more focused as places for people not just places for cars. Providing more green was a popular comment made by many.

One way: Cumberland - Cumberland St



Two way: Cumberland - Cumberland St



Stakeholder feedback

What organisations told us



Stakeholder Feedback

Dunedin City Council (DCC)

The DCC have started work on a variation to the District Plan (Variation 2) to address a shortfall in housing capacity in the medium term based on latest monitoring as required by the National Policy Statement on Urban Development Capacity. The variation will consider and include both intensification and greenfield residential zone changes. All options are being assessed in accordance with the strategic direction policies of the 2GP, which include transportation matters. The identification of known transportation network constraints is part of this work. Council should be consulted if there are changes to transportation constraints.

NZ Automobile Association (NZAA)

- NZAA would need to see evidence that the proposed changes would result in an improved transport system.
- Further traffic modelling is required on the impact the proposed options would have on the transport network.
- A survey of parking demand is required. It is particularly important that sufficient parking is provided for the hospital.
- The upgrade of Wharf Street and Thomas Burns Street ('the Harbour Arterial'), particularly for heavy vehicles, is supported.
- The works on State Highway 1 and the Harbour arterial should be completed before other roading changes are made in the CBD.

Ministry of Education

- The Ministry has a particular interest in George Street Normal School, which is located at 989 George Street, North Dunedin.
- The concerns for the safety of staff and students are primarily in relation to George Street. There are a number of safety issues with the crossing of George Street.
- Overall, the suggested improvements to the road network and traffic speeds will make it easier and safer to get around central Dunedin.

Public Health South - Southern District Health Board

Two-way system

- PHS prefers the two-way system (traffic in both directions) because it will ensure the hospital is less isolated and more easily accessible.
- Re-routing heavy vehicles would create a safer environment for other road users.
- Pedestrians and cyclists should be provided with safe crossing points.
- A road should be created straight from the motorway to the Harbour Arterial rather than being directed down Strathallan Street.

Walking

- Improve the quality of the footpaths, provide seating, and ensure there is adequate street lighting.
- Slow the traffic around the hospital to 30km/h to promote a safer walking environment for pedestrians.
- Include safe and accessible crossing points between intersections, including the provision of pedestrian 'refuge islands'. There are currently no crossing points between the Chinese Gardens and Spotlight on the one-way south.

Parking

- Encouraging a public 'park and walk' or 'walkable parking' environment through the development of a new car parking area / building on the edge of the central city.
- Develop an additional car parking space on Wharf Street.
- Create a park and ride option in the Warehouse Precinct.
- Provide general parking around the hospital.

Cycling

- Install covered and secure bike parking and bike hubs, and parking areas for e-scooters.
- Ensure that cycleways are connected.

Stakeholder Feedback

Public Transport

- Replace wooden bus shelters with glass shelters, enabling people to see when buses are arriving. Ensure bus stops are accessible for people with disabilities, elderly or parents with small children by providing seats rather than places to lean.
- Provide a ‘real time’ schedule online or at each bus stop informing people when the bus is due to arrive, and whether there are delays.
- Ensure adherence to schedules so that buses do not leave stops before scheduled.

Z Energy

Z Energy operates a network of service stations and truck stops, including a truck stop at the corner of Cumberland Street (SH1 southbound) and Wolseley Streets (the truck stop / the site) in central Dunedin. The site is within the wider area to which this review relates and is the focus of this feedback.

The Z Energy truck stop primarily serves vehicles on Cumberland Street which enter the site via the northern crossing and exit via the southern crossing back onto the one-way system. The truck stop also has two crossings on Vogel street which enable northbound vehicles on SH1 to access the site, for instance via Wolseley Street. This layout is best depicted in the site plan below.

The truck stop is dependent on ease and efficiency of site access for its customers and changes to the operation of the one-way system and/or the road layout have potential to impact significantly on the operation of the truck stop. For instance, if the general access and egress arrangements from the site are rendered unsafe or difficult it may make the site uneconomic. This could be caused by a number of changes, including those that reduce visibility, crossing widths or turning circles. Any changes to the road layout in the vicinity of the site are therefore of critical importance to Z Energy.



Z Energy site plan (Supplied with submission)

NZ Heavy Haulage Association (NZHHA)

Submission from the NZHHA on behalf of local transport operators, as well as operators from around NZ that move freight to and from Dunedin and Port Chalmers.

- Oversize freight is different from normal freight and High Productivity trucks in that it can require bridge structures that have higher capacity than for normal freight, and wider and greater road dimension capacity for wide, high and long loads.
- There are a series of oversize routes in and around Dunedin that do currently provide for suitable capacity and these are mainly the state highway routes. These routes are maintained as oversize routes through attention to the design of roading infrastructure.
- Other routes through Dunedin do not generally provide adequate capacity and clearances for oversize loads.

Stakeholder Feedback

- The specific identification of oversize routes through the City needs to be an integral part of this project's outputs.
- Many of the proposed road configuration changes would challenge the ability to provide the required dimensions for oversize loads, in particular median divided roads, and large road-side trees. It is crucial to provide suitable lane width so that oversize transporters can travel on identified oversize routes without being squeezed between parked cars, large planted trees and other traffic.
- The concept of cycle lanes are supported as they can separate vulnerable road users from heavy freight traffic.
- The Harbour Arterial route for oversize freight has major limitations and would not generally be supported as it is currently configured. There are overhead restrictions such as bridges at Anderson Bay Road and Wharf/Jetty intersection which would mean that a suitable alternative route for oversize loads through Dunedin is required.
- If there are changes to be made to these State Highway routes, then these need to be carefully considered and consulted on with the heavy haulage industry through NZHHA.

Stakeholder Workshop 2019

A stakeholder workshop was held on 14 November 2019 with nineteen key stakeholders including Dunedin City Council, Otago Regional Council, AA Otago, Age Concern, Fire and Emergency Services, Southern DHB, and the Ministry of Health. The workshop tested three scenarios:

Scenario 1: Retains one-way system – current through routes remain

Scenario 2: Introduces a two-way system with Castle Street as the main through route.

Scenario 3: Introduces a two-way system with the Harbour arterial as the main through route.

Key issues identified by stakeholders included:

- Pushing the main arterial to the east.
- Greening the space.
- Encouraging active transport options, and more options for walking and cycling.
- Presenting more options for connecting precincts.

Stakeholders strongly supported adopting a mode-shift programme as part of any option selected.

From the stakeholder workshops two scenarios were short-listed that provided one way and two way options, with an associated mode-shift programme and an improved Harbour arterial.

The short-listed options were presented to the combined DCC and ORC Councillors at a workshop in March 2020. The Councillors identified the biggest potential changes as result of the project being:

- Improvements to east-west connections, especially for people on foot, across the city centre linking to the new hospital as well as other destinations such as Toitū, the Railway Station, the Chinese Gardens and the waterfront.
- An upgraded harbour arterial providing a more attractive route to bypass the city centre, avoiding the hospital construction sites.
- A comprehensive mode shift programme including travel demand management; walking; cycling and bus improvements along with improved parking management and some new parking areas

Appendices

Summary of comments and survey responses



Summary of comments made on the maps

Summary of comments made on interactive maps

The comments made on the interactive maps were reviewed and analysed to identify the key themes and issues that can be taken forward as the business case process continues. This analysis is summarised below, together with examples of the comments made in relation to each theme.

All the comments made on the interactive maps will also remain **online** for people to read in more detail.

Public Transport

Theme or Issue	Comments Included
Bus fares / Frequency	Buses are already great frequency, just needs way better wayfinding and communication (and free fares)! An extra bus service will just confuse matters and waste money
	Suggest making centre city busses free
	Please create a high frequency free/low cost inner city bus loop that joins the university/polytech, city centre and warehouse district, with park and rides on the outskirts.
Congestion	This road is heavily congested in the mornings and the buses normally run 30 minutes late everyday in the mornings. So I think the slowing of traffic would be terrible and defiantly would not help the bus system.
	I'd like to see the entire centre closed to traffic at least as far as moray place, with only public transport (free shuttle / bus loop) and delivery vehicles allowed through at 10 - 20kph.
	Consider future-proofing Crawford St for a busway and transit-oriented (re)development, supporting and growing dense inner city living options from the currently very boutique Warehouse Precinct. Even at current frequencies the combined bus frequency along this north-south axis is very high, and this could be leveraged to speed services up with bus lanes etc. (Alternatively the same could be done on Princes St).
More Public Transport Options	It seems probable to me that the future of transportation in Dunedin lies not with increased cycling and use of public transport, but with electrification of the fleet. This is mainly due to Dunedin's topography and climate. If this is the case we shouldn't be looking to decrease capacity in the city's arterial routes, we should be looking at ways to retain or expand the capacity.
	Bring trams back! A lot of cities in the world re-build their decommissioned tram lines. Building sustainable (electric) public transport alone several the historic collector roads will make our city more livable and sustainable. Yes, I know it is easy to say "we are too small", but if the growth continues we can find ourselves on a backfoot choked by traffic jams.
	What about a park and ride parking area at Carisbrook or the old Hillside workshops site where communters coming from the south can catch a shuttle or ride bicycle from?
	Nothing will cope with more and more traffic! We need more people switching to cycle and bus
	Heavy traffic should be placed behind the Railway station, but a better connection to the motorway at the other end at Strathallan St would need to occur, like a flyover. Open up the one way system to alternative modes of transport. Reactivate the rail system, get people communting from Mosgiel and Port and suburbs in between by rail.

Walking

Theme or Issue	Comments Included
Crossings	I really think that you should focus on putting pedestrian crossing in George Street, so that the road is safer to use for people.
Connecting to University Precinct	Underpass or bridge for people connecting CBD and Uni.
	Build an elevated, covered walkway over the current footpath connecting the Uni library to Gt King St. This would remove the dangerous congestion that occurs regularly in this area and provide an enhanced experience for walkers. Access to the museum could also be incorporated.
	I would be really concerned about any roading change that brings more traffic onto Frederick St. This is right in the middle of the campus and there is a lot of pedestrian movement. We should look at ways where the needs of all road users are met, not just cars.
	A foot/cycle bridge outside the University library would be preferable to the multiple pedestrian crossings here. It could even extend all the way across to the Dental School or even the Medical School and keep university foot- and cycle-traffic away from SH1. Well lit and nicely landscaped it could be a really attractive route between university and central city.
	A major walking route is through uni campus. This needs to be considered as part of the city's walking network, not separate to it!

Summary of comments made on the maps

Hospital Site	There should be safe, easy pedestrian access between the bus hub and the hospital entrance. Perhaps consider taking over part/all of the Countdown carpark to turn into a pedestrian friendly green space. This space could be extended past the bus hub to George Street as well, creating a green walkway similar to the one near the Otago Museum reserve (but with more seating). Urban food gardens/orchards?
Road Issues	Make Burlington St, one-way heading down hill and widen the footpaths. This was one way when Moray Place was rejigged and made a much nicer walking route between the Octagon and Queens Gardens. This will also simplify the intersection at the bottom which is overly complicated and confuses some motorists who stop at the wrong place.
	I believe that pedestrianising the Octagon could potentially work if it was executed effectively, if the central strip through the Octagon was pedestrianised, and traffic redirected to flow around the one way sections. The centre of the Octagon could then be redesigned to better fit pedestrians, space for markets, cultural activities etc, or for allowing the businesses such as pubs more seating during events in the city.

Cycling

Theme or Issue	Comments Included
Disconnection	Many cyclists coming up Portsmouth drive either then cross the rail line at the bridges, or go around the station. Making this side of the railway path be one way in the away from town/south direction would cause those cyclists to turn left onto Orari or Strathallan streets, to end up on the north bound road. Can there also be more consideration for fully cross town bicycle paths? St Andrew Street is popular for cyclists but doesn't feel very safe
	There are quite a few people who cycle along Portsmouth Drive who cross at the overbridge instead of going up to St Andrew St. Not everybody is comfortable riding in the traffic over the bridge (especially in peak traffic), and the existing footpath is not really wide enough to accommodate peds and cyclists. I realise space is limited on the over bridge, but is there a way to provide a safer option for cyclists that doesn't require riding on the footpath?
	There has to be a safer passageway over the train lines provided for cyclists coming from Portsmouth Drive and needing to access the southern half of the CBD. It's a high volume route as it stands, and would warrant investment in a better link over. Would benefit recreational riders from the north side of the lines wanting to access the peninsular on the weekend too. Thoughtful integration of the new pedestrian bridge and surrounding bike paths could easily make this critical and missing link
	generally cycling to and through the city needs to be a priority if Dunedin is to be seen as a great small city
Improved Network	Because people on bikes, like people in cars, use public thoroughfares to get between their homes and workplaces, schools, the university, shops, and appointments, very few of which are located on Thomas Burns & Wharf Sts.
	There are no safe cycle routes from the CBD to residential areas above the belt. With more and more e-bikes in Dunedin, this is a missed opportunity for reducing commuter car journeys. Pitt St/Corrie St/Drivers Road, Warrender/Lachlan, Stuart St, City Rd, Serpentine Ave are all wide enough to have some facilities, even if uphill direction only.
	Highgate has a lot of school traffic and is extremely hostile for cyclists. At present we prioritise the right to park one's private car on public land over the safety of cyclists and the quality of the environment for pedestrians. Remove parking on just one side of the road would provide space for a segregated two-way cycle path... and the reduction in car traffic due to school children being able to safely cycle to school will reduce congestion and improve air quality.
Cycle infrastructure	Please don't forget to build a big bike lock-up in the new hospital!!
	The bicycle lights are a terrible idea. Being a cyclist myself I am confused as to why i cant go straight ahead when the cars light is green. Cant motorist work with cyclist when turning?
	The amount of broken glass in the cycleway here pretty much defeats the purpose of having it there. Only a few flats are contributing, but they seem to be treating the new cycleway as extra party space to smash bottles in. Council needs a way to fix this glass issue, building a cycleway that ends up constantly full of broken glass. So no cyclist will ever use this particular stretch of path.
Unsafe cycle ways	People cycle commuting from the south have some good routes, but still end up in dangerous traffic and intersections especially when they meet the city centre, can we have a separate cycle path or just a cohesive cycle path that avoids scary intersections or multiple road crossings? Ideally commuters from the south should be able to connect to the city network of cycle lanes.
	Make Castle St a cycleway with limited, local only, traffic. Landscape the road so it is people friendly. Put security cameras to improve behaviour. Have cycleways through the campus and provide bike storage for park and walk to buildings. Get the cyclists OFF THE ONEWAY SYSTEM. It is a danger to everyone using that thoroughfare, especially cyclists and scooter riders.

	I find using the cycle lane along this section of SH1 feels really unsafe, especially with traffic coming off the motorway at speed. I prefer to use King Edward St and Princes St, then cutting down Bond St. It would be good if this alternative was better recognised. My preference is to keep cycleways separate and away from main arterial routes

Parking

Theme or Issue	Comments Included
Park and Ride	Carpark here for a park & ride bus loop to the Oval and back, down the new 2-way local road created
	Put a carpark building here for a Park & Ride bus loop from here to North east valley, along the newly created two way local road
	A park-and ride carpark adjacent to SH1 north could save a lot of vehicles from entering the city at all. Served by express bus calling at university and bus hub only. If a similar car park were developed at say Burnside, the bus could link the two with further stops at the Exchange and a short detour to The Warehouse car park, thus linking several major traffic destinations. I think this would get much more traffic than the proposed inner-city bus loop.
Parking Near Hospital	This spot is too far away from the new hospital for off-street parking by the general public - the elderly and sick can't be expected to walk 200 metres to get to a clinic at the Hospital.
	A multi level car park, designated for hospital use, including air bridge access to hospital would be a good use of this site. People of all ages and physical abilities would have ease of access to the hospital facilities.
	is any consideration being given to how hospital staff (especially those working afternoon shifts) will be able to find parking, already very difficult. not practical to catch a bus as often do not finish until 23:00. not safe to walk home in the dark.
	Would this parking area be large enough to accommodate hospital staff as well as patients/whanau? Could a free shuttle service to and from the parking area be provided for staff finishing late and the elderly and unwell patients/whanau?
	The hospital should have a car park buiding incorporated on site. How many other city hospitals don't have a separate car parking building? The original 1950's plan for our present hospital included a 1200 car park building which never eventuated.
Carpark Building	As a commuter into this area from the North of the City, at present the parking in this area is full by 7.30am. There are no full day paid options available in this area. Please consider a multi-level parking option in this area.
	We need another central car parking building.
	A multistory car parking building would be pivotal to the success of the hospital. Dunedin already lacks parking spaces, and either an underground or above-ground car park would be a big help

Driving

Theme or Issue	Comments Included
Traffic Light Improvements	A green wave phase already exists down the one-ways set for travel at 45-50kph. If you're not hitting the green phases you're probably speeding...
	Before any of this is done the phasing/staging of the lights needs to be synchronised correctly. Cars having to stop all the time at every set of lights causes more wear to the road surface, vehicles brakes and tyres. Having cars sitting still contributes unnecessary amounts of carbon emissions that could easily be eliminated. Not to mention wastes money for fuel used going nowhere.
	Work will need to be done if more traffic is to go around the wharf area. Traffic is usually backed up down the Caversham bypass in the morning due to the amount of traffic already turning to go to Andy bay & the wharf area which causes an AM peak back to the over bridge by the Kensington. This would be worse if more traffic is go this way without any changes in the layout/timings of this intersection. Also more traffic would need to merge to head south on the bypass which is already an issue
Pedestrian Crossings	We do not need any more barnes dance crossings as suggested in the walking and parking sections. Some of them only give a green light to state highway 1 for 2-3 seconds. That is a joke.
	If this is going to continue to the the state highway and there is going to be reduced capacity the crossing points for pedestrians need to managed/sync-ed so that vehicles do not have to stop at every light/crossing the entire way along from North to South.
More lanes of traffic	Removal of parking and cycle lane along castle street would allow more room to make 3 or possibly 4 lanes of traffic if the footpaths were redesigned. Cycle Lane could be along Cumberland Street. Most of the footpaths along this road are not used much. Would need to have a parking building to replace any loss of parking in the area as it would be needed more for success.
	Why not move the cycle lanes down onto Thomas Burns & Wharf sts and make the current arterial routes 3 lanes wide? This could also create a truck transit lane when needed for the Hosp build. This would relieve the congestion currently.
	How about converting Cumberland/Castle/Cumberland Street route to 4 lanes (2 each way) to take all the arterial traffic, with replacement parking to service what's lost there and the Hospital? It would take all the heavy vehicles further away from the CBD, improve their access to the industrial area and port road, allow local streets to be used for local traffic, and reduce the risk of congestion that would force people on to other roads like George and the currently 1-way part of Cumberland.

Summary of comments made on the maps

Unsafe roads	While seating and planting are great in non-arterial streets and do contribute to pedestrian well being, on main roads (like Highway 1) they add more visual features in an already visually cluttered environment that have to be processed by people already likely to be struggling to cognitively cope with heavy traffic in an urban environment. As such they are potentially hazardous in high-traffic areas.
Connections	Connect ward street to state highway 88 with an over bridge to help make this an better arterial route from the port to southern parts of town.
	Look at improving the connection from Wharf St to the southern motorway without having to use Strathallan Street.
	It would be more natural to avoid Ward Street and build new arterial road south of rail corridor, though existing DCC car park. TR Group would have to relocate.
City Bypass	Dunedin needs an SH1 bypass with a proper heavy vehicle capability and speed regimes of 80+ km/h. We have long overgrown a small town arrangement when the main highway gets through the city centre. I think that the only geographically logical option is Kaikorai valley. Plans need to be developed and dates proposed. I believe, the completion of the Kaikorai Link by 2030 would be reasonable.
	Wasn't the original plan to build a city by-pass up the Kaikorai Valley (which is why the road is so wide) and over a viaduct over the Leith to connect with Highway 1? It would unload the city from through traffic pressure, but can we please have the modelled data mentioned in the FAQs released so we can have an informed debate on this sort of question?
	Dunedin needs a bypass route for all traffic that does not want to stop in Dunedin. Incl. Heavy traffic that would congest our roads if they did not need to travel through the centre of town. This would be a tough proposal to find an alternative route but would be effective.
	Could we not create a bypass for traffic passing thru the city - portsmith Drive/wharf St ? This would take a large degree of heavy traffic off Cumberland and Crawford improving safety, and positively impact congestion. Is Dunedin the only centre in New Zealand that does not have a bypass??

Changes to SH1

Theme or Issue	Comments Included
Two way system	Love shifting traffic off Crawford and onto Cumberland. Allows better pedestrian and cycle connections between the Warehouse Precinct and the city centre.
	This part of Cumberland St needs to be a 'local' road as it has Uni activities on both sides.
	With the southbound cycle lane moved onto Cumberland/Great King Streets and carparking removed (replaced elsewhere if needed) would there not be space for two lanes in each direction? This would maintain North/South capacity but would need to be designed so the street didn't feel like a motorway or encourage unsafe speeds.
	I'm not convinced about removing the current one way system. Traffic is already congested during peak hours on that system. I would like to see some more details of how the proposed traffic flows on the alternative two single lane roads (one local, one state highway) will cope with current and future anticipated traffic.
	I support two-way traffic past the hospital. But with a new link across the car park by Frederick St the present north end one-way system could be retained. The junction at Frederick St will need very careful design too, if more traffic is to come from the harbour and join SH1 here. It is actually easier for pedestrians to cross the one way roads, as there are frequent breaks in the traffic caused by the traffic lights.
Retain the one way traffic	Considering the amount of traffic on the existing one way systems as well as all the heavy traffic passing through the city, I feel it would pointless changing the system for north and south traffic. I agree with the proposed changes for SH 88 traffic.
	This road [Ward Street] is already very busy and doesn't have the capacity to take the volume of traffic being moved from the one way system.
Reduced Capacity	The proposed changes appear to halve the capacity of Highway one, and it therefore appears transit times will rise sharply when the system reaches capacity. What is the proposed system's capacity in relation to 2019 volumes? What is the economic impact of the greater delays to the non-local traffic that has to pass thought Dunedin on the way North or South?
Increase Amenity	Please please please create a better outcome for the areas around the railway station gardens, Toitu, the old prison building, the Chinese gardens â€“ these are drawcards for local and visitors alike and to be divided as they are now (and continue to be as proposed) is a poor outcome.

Summary of survey responses

As part of the engagement, people were also invited to complete an online survey once they'd reviewed the maps and the comments made by others. Below is a summary of the survey responses and examples of some of the comments made in the survey relating to each theme.

Public Transport

Question 1: Do you support our ideas for how we could improve the bus network?

Answer	Number of Responses
Yes	294
No	181
Unsure	221

Question 2: Would the improvements get you using the bus more often?

Answer	Number of Responses
Yes	166
No	378
Unsure	123

Question 3: Are there any problems you face getting the bus into the city centre?

Answer	Number of Responses
It is too expensive	202
Poor service	126
Poor frequency	250
It is unreliable	131
Takes too long	210
It is not accessible for me	90
No, I don't face any problems	84
I do not get the bus into town	216
Other	72

Question 4: Do you have any other comments about using public transport to get into and move around central Dunedin?

Total comments: 345

Theme or Issue	Comments Included:
Improving the bus hub	Bus hub is too far away for me as I have trouble walking, not close to library or octagon
	Bus Hub needs better shelters
	Need priority bus lanes/priority traffic light phasing that reacts to proximity of buses
	I feel that cars - not service vehicles/delivery shouldn't be able to commute through the bus hub. It causes issues for turning onto St Andrew street, because you have not kept the bus lane going straight up. You have chosen to make them try and pull out, get behind traffic and not be able to get through because traffic gets backlogged by the right turn arrow. If you were to extend the bus hub lane there would be the opportunity to put a bus only light in place. This should also be on St Andrew/ George Street corner. Buses get stuck there for up to 3 changes due to lack of arrow or shortness of arrow time.
Bus loop	I'd like to see an express loop bus service that goes from the gardens to some where near the st clair esplande. It makes approx 5 set stops (i.e. it doesn't stop on demand) and includes a couple of public carparks set up at both the north and south of the CBD and a stop either outside the new hospital or the bus hub. Ideally there'd be a bus passing by each stop every 15 minutes with free or low cost rides.
	Easy and frequent bus services between different parts of the city would make me use it more - eg loop bus through town.
	Perhaps considering a free inner city travel zone (such as that used by the Melbourne trams) would encourage more use (i.e. you only pay when you go outside the boundaries). This would allow people to jump on and off for short trips and get around easily.
Improving the bus network	Access to stops is steeply uphill and downhill at some distance, so by the time I get to the stop transport time is substantially more than just getting on my bike or driving.
	Because the changed bus routeing means that the nearest bus stop is over one Km to walk to it is not practical. Before the changes the nearest bus stop was only 270 metres away
	Buses are too big for Dunedin.
	It would be great to see electric buses as the norm.

Summary of Survey Responses

Convenience	Awkward when carrying bags of groceries
Low fares for public transport	I will keep using the bus under the ORC trial of flat $2 fare. At previous fares it would have been more expensive to use bus than drive.
	Because they are making the bus cheaper, I would now consider this option
	Should introduce a “day pass” or a fare that would last from 2 hours to a day so you could hop on, do your shopping, then be back on the bus all under the same fare.
Family use of public transport	Having buses free has been so good. We have teenagers and no vehicle, so this has made life so much easier. If there’s anyway you could keep buses free for kids/students, that would be a massive help for families.
	Buses are great if you go to and from a single destination however our family usually has several destinations when we travel to the city and we are always juggling family members activities across the city.
	The only reason why I don’t use the bus more frequently is because I need to get my children to and from school and it is not the most convenient option when working full time.
Reliability of the bus network	For whatever reason the buses are not reliable - this week alone my partner had two buses fail to appear
	I do get the bus during the week for work, it is reliable during the week but very busy and not that frequent. Buses on the weekend are terrible. They don’t arrive at the times advertised and you find yourself wondering if you have missed it or not, even when you have got there half hour early. One Sunday I waited two hours for a bus to get home.
	Like the idea of interactive times to see if bus is on time or not. Have seen this in Australia and it works well.
Improvements to current bus routes	I support looking into different loops and ideas but really it needs to be as simple as looking at international models that provide free loops, better frequency, lower fares across the wider city and later night services.
	Improvements to route finding and scheduling in the past few years have been greatly helpful, as is the bus hub.
	Bus routes are currently poorly designed. They involve one way loops, multiple variations of routes and are not designed for transferring services. Coverage is also poor. Fewer routes going into town, but terminating at bus hubs out of the CBD with only a few loop routes in the CBD would be advantageous.
	I took the bus one Saturday to show a new Chilean student studying at Polytech how and where to catch the bus from Andersons Bay. It took forever and because of schedule, we missed one bus and had to wait almost an hour for another one. That is crazy. It is not clear where return of loop bus stops are found (eg: to get back once we got to Polytech - no posted schedules or route maps at most stops. It was appalling and confusing.
	Does not cover the area I live in on the Taieri
	Have an express service from Brighton during commuter hours. Currently the bus takes WAY too long, as it detours and stops too frequently.
Timetables and frequency.	Both buses I can catch go with 10 minutes of each other so you cannot walk to one if you miss the other and catch it.
	Smaller buses running more often would be an excellent idea.
	Does not run at times that would allow me to use it.
	Frequency is the biggest issue.

Cycling

Question 5: Are there any problems you face to cycling into and around the city centre?

Answer	Number of Responses
It is too far	137
Feels unsafe	247
The hills are an issue	264
Not enough cycle lanes	100
Too much traffic	110
Driver behaviour	187
It is difficult to cross roads	110
The weather	239
Takes too long	114
Accessibility issues prevent me from cycling	50
No, I do not face any problems	79
Other	126

Summary of Survey Responses

Question 6: Do you like the proposals to connect the gaps in the existing cycle network?

Answer	Number of Responses
Yes	250
No	277
Unsure	136

Question 7: If a two-way system was introduced the main cycleway through the city would be moved from SH1 to the local road. What do you think of this idea?

Total comments: 552

Theme or Issue	Comments Included:
Behaviour	Brilliant. When I ride (less frequent in the past couple years) I intentionally ride the long way around to avoid the SH1 lanes. I'm reasonably healthy and I cycle year round, but Dunedin is easily the most terrifying place I've ever been on two wheels. In my view, this is less down to the infrastructure than to the shocking behavior of drivers and, sadly, of other cyclists, many of whom (both groups) seem to think that none of the rules of the road apply to them.
Cycle lanes feel unsafe for young people	I would love it as I would also feel more comfortable for my child to use the cycle path.
	This is so good the main cycleway being on the highway makes it super unappealing especially for pre-teens and families.
Improved connections	Either proposal seems reasonable, keeping a direct cycle route from Sth Dunedin to the hospital/University is essential, I.e. making as convenient as possible to cycle.
	Great idea! 30km/h traffic and two way separated cycle lanes would be great. The cycle lanes will need to be designed wide enough to allow for turning cyclists, faster ebikes/scooters and slower non electric active transport users. It will be essential to link the main cycle lanes with other roads. The existing cycle lanes on the state highways are completely disconnected from local roads and are illogically switching road sides, that doesn't make any sense.
	How does the Portmouth drive connection happen, especially if you are looking to increase traffic on Wharf St and the DCC has put on hold the cycle bridge at the Chinese Gardens?
	I like this idea, cycling on busy, high volume and speed roads is a little scary. Although the current seperated cycle lanes are great, they would be even better on a quieter road, as they would enable better connections to cross roads, and the central city. The current one way is great if youre going from one end to the other, but turning in the central city to side streets is confusing and sometimes problematic.
Cost of cycle lanes unapealing	A local road would likely be safer, but it seems costly to move the cycleway.
	It is completely unnecessary to waste more money in cycle lanes.
Dedicated cycle spaces	A two way vehicle system is not an option! Cycle lanes north and south should be on a dedicated cycleway.
	Cycleways need to be off the road - see Canberra's cycleways
	Do not support a two-way system or cycle lanes mixed with traffic. Cycle lanes should be independent of roads.
	I think that is a great idea. In Vancouver (where I used to live) they had "shared streets" on the minor roads where bikes and cars shared space and this kept bikes off the main thorough - fares. When the city was talking about what to do with George Street, I was thinking it would be great if it were a bus, bike, and pedestrian only street.
One-way	The One Way pair should remain and the cycleway relocated to George/ Princes St in favour over parking. Which can be accommodated off the Main st. If you are serious about mode shift remove anything more than P10 off George and Princes and operate a shared space for service vehicles, PT peds and cyclists, a la Fort St, Elliot St Auckland.
Cycle lanes not supported	Bad idea the current one way works, would create more issues with cross turning traffic.
	Cycle lanes dominate too much for the number who use them or can use them.
	Do away with it completely, it serves no purpose other than to slow road traffic speeds.
Parking preferred	Bad idea, cost to move and more car parks lost.

Summary of survey responses

Improvements to safety supported	A good idea – may make cycling safer.
	A good idea – turning traffic is always going to be a problem.
	An excellent idea, cycles are too vulnerable on SH1.
	Cycleways should not not be on SH1, they should be removed to a local road.
	Good idea. Even with a cycleway, heavy traffic feels like a hazard at intersections and less compromises would be needed in the cycleway design.
	I cannot see how you are going to rectify the existing problems with the SH1 cycle route. Either cyclists are exposed to being left hooked by poor drivers at each and every intersection, or (as is the case at present) cyclists are stopped at every intersection and only have a tiny window where they have priority. This renders their use painfully slow and frustrating. In addition, cycleways between parking spaces and footpaths pretty much guarantees problems with people moving between the parking and footpath without care.
Support for improved cycle lanes	A good solution. More of the local roads in town need dedicated cycle space.
	As long as traffic speed is controlled and cycle lanes have physical separation to protect cyclists from motor vehicles and parking
	Better, as I have always beleived that cyclists should not be on SH1 anyway, due to heavy traffic which was one of the main reasons I always cycled along George Street instead of the one way system.
	I would support this as it prioritises vehicle travel on SH1 to enhance traffic flow while creating a safer-feeling cycling network where vehicles are hopefully reduced in number are required to travel at a lower speed.
Two way system	I do not support a two way system.

Question 8: Do you have any other comments about cycling?

Total comments: 387

Theme or Issue	Comments Included:
Improved safety for children	I like riding bikes but I have the option to drive a car. My child does not. So making it safer for kids is highly appreciated as you would still be worried for your child riding a bike on the SH1 despite a bike lane.
	Really need to make it easier to cross some roads. I would like to take the kids into town on bikes more often, but it's very unpleasant to try and get there with crossing roads. Lockdown was amazing with less cars on the road, but since then we have gone back to driving.

Cycleways seperated from traffic movement	They should have the cycle ways going both directions on one of the one-ways instead of both as they do sucessfully in Australia. This takes less parking space, less confusion, only one way effected by lights and allows people to know exactly where the cycle ways are for both directions without crossing from one block to another.
	All cycleways should be physically separated - by concrete kerbs or landscaping.
	Dunedin is fantastic for cycling (save worst of winter) and 2-way cycleway on local road will only improve. Don't! separate from traffic by forcing you to ride between parked cars & aimless pedestrians, and do! run north + south in 1 continuous lane. Oh, and if you're working with DCC, do! stress having space to safely park bike (eg. lockable rack) is as important as network to ride bike.
	It needs to be separated from roads to be efficient and safe. But that is likely the too hard basket. I spent 3 years cycling in central chch, despite the latest innovative cycle lane structures and painting, it never feel safe cycling in a cycle lane where you are adjoining traffic on one side and parked cars on another. Not always the fault of drivers, it is just the reality of often being in a cars blind spot with no metal frame to protect yourself. Safest I ever felt was on paths through parks.
	It's better when the bike path doesn't overlap with roadside bus stops. Not to fun to be on a little bike next to a huge bus pulling in or out. Nothing against the bus drivers, who are generally quite kind drivers.
	It's currently difficult to cross from cycle lane on one-way southbound to get across to Princes St, then a cyclist is vulnerable for some time again trying to get across the traffic to get onto South Rd. Andy Bay Rd-Strathallan St corner also a problem as cyclists - suddenly dumped onto busy road. As I driver, sudden appearance of cyclists equally disconcerting. Other point: grit left on the roads to reduce slipping on ice is as hazardous as the ice itself. Sweeper trucks need to be deployed hand in hand with grit trucks.
	The current cycle lanes are dangerous, often you can't see them if you are in a car e.g. the one by Chinese gardens that cars cross over to go up the over bridge.
	The Wharf St cycle way from Andy bay is an accident waiting to happen. Its dodgy in the morning for cyclists to cross, bit there's no other option to get from Andy bay to town. Otherwise it takes too long. The other intersection that's really difficult is the Andy bay crossing by the parihaka memorial - the needs to be lights for cyclists and pedestrians there. Theres lots of examples in Dunedin where it feels dangerous to cycle on the road- princes st from the Octagon to the Oval, macandrew bay road where the cycle way just stops. We need more if Dunedin to be accessible and safe for cyclists from north to south. More separate cycle ways to encourage commuting on actual commuting routes (wharf st- too many close calls as cyclists have to wait a long time to be able to cross to get to the cycleway)
Connections to cycling network	A safe alternative to riding on the footpath on the Wharf St overbridge (without having to go down to St Andrew St).

Summary of survey responses

	Albany St cycleway would be a great addition.
	As many more cycle connections as possible. Particularly with the southern suburbs like Kew, Caversham, St Clair, Forbury, South Dunedin. There are big wide roads here (e.g., Hillside Rd, Forbury Rd, Victoria Rd, and South Rd) that are difficult and scary to bike on (especially with kids) and they could easily accommodate either cycle lanes or separated, raised cycle/pedestrian paths.
	The network around the city is incoherent, a reasonable cycleway will often disappear just where it is needed most (a case in point being SH1 southbound towards Anderson's Bay Road).
	Currently if you want to turn left into Frederick street from Gowland St/SH1 it is practically impossible without getting off your bike and going on the pedestrian crossing. There are a number of points around the city where turning corners and leaving the cycle path is prohibitively difficult.
	Cycleways outside of the main one-ways need to be improved. It is hard to get to the main cycleways because none of the surrounding roads have safe cycle lanes.
	Hurry up and open the Caversham and Chain Hills rail tunnels for cyclists!
	I believe cycling will increase with electric bikes and the best thing to do would be to open up the Tunnels to enable people to bike from Kaikorai Valley, Farfield , Concord and Mosgiel and finish the Peninsula and Port Cycleways enabling more people to bike to town.
	More cycling infrastructure is urgently needed, especially connecting the main north-south route with 'east-west' journeys into town. The current network also needs improvement. Please treat all intersections consistently for example you created a major hazard for cyclists by retaining 3-4 car parks and a shared turn opposite the Railway Station, by the Allied Press building. Consistent treatment is better ie clearer for car drivers too. Currently there is almost no bike parking in town - this should be easy/cheap to address - plenty of 'Sheffield hoops' is fine. Please create traffic light priority for cycle and foot journeys throughout town, and on the north south route. The current priority remains for cars over cyclists on the state highway. Please increase cycle carrying capacity on the buses, improve bus frequency on hill routes including at night, and make short journeys free. This would help address the 'Dunedin has too many hills' perception.
	The cycleways we have only make it easy to travel north or south along SH1. They do not make it easy to actually get into most parts of the city. It is also hard to get from SH1 north to SH1 south in the middle of town because of the poor connections between the cycleways.
Consultation	Good consultation and thought before implementation to avoid eg. problems with the south Dunedin rollout. Take your time.

Improved cycling facilities around the city	I only cycle to town now because of the cycle ways. There are small teething problems but I am impressed how these are addressed by whom ever is working on these. I would like more covered places to lock my bike to in the inner city, someplace near the Octagon would be one. Could the carpark buildings include an area for this?
	Lack of proper bike racks (especially near the Botanic Garden) can be a problem. Also, the cylce lane in front of the garden is horrible - you shouldn't have to cross 2 lanes of traffic to stay on the cycle path.
	I think the cycle racks on the bus`s should remain.
	The bus bike carriers don't fit the tyres of some bikes. Could they be widened please?
	More secure bike parking - maybe some locky docks?!
	Needs to be more lock up areas for bikes, possibly charging stations for the future.
Emergency vehicles	Concrete separation blocks should be removed as they cause problems for emergency vehicles.
Improved safety	Get rid of the rumble strips around town. They make riding near impossible and tend to throw you of the bike . In Taieri Rd they make cycling very frightening and I have now stopped riding down there as they either force you too close to the parked cars or push you out into the traffic.
	At the moment the main frustration is having to cross from one side of SH1 to the other, across two lanes of traffic, between two corners, at a five way intersection. Cyclists do not dismount and cross with the lights, and consequently this is an accident hot-spot and site of multiple close calls and driver/cyclist frustration. Fix this please!
	Bike lanes should be placed between pedestrians and parked cars, not between parked and moving cars. Bike lanes should not be crossed by car lanes, this puts bikes in direct collision path with cars and its not safe, cars stop at bike lanes at traffic lights etc. Bike lanes should be to the left separated from car lanes.
Shared Space	Great King St between the bus hub and museum reserve should be a 30 km shared space, and possibly even with motor traffic southbound only. In practice it is anyway.

Traffic light phasing	Having traveled a lot around the world I see Dunedin's cycle traffic lights and shake my head. Yes, it's extra safe. But it makes a cycle commute slower and when turning cars are unnecessarily delayed by an empty cycle lane with an unnecessary green light for the phantom cyclists I wonder whether this is building hostility towards cyclists and the infrastructure. I was a cyclist growing up in Dunedin and one of the main reasons I wouldn't bother cycle commuting any more is that the traffic lights for cyclists would infuriate me and make my commute noticeably slower than if I were in the flow of traffic. I have been wondering what I would do, and wondered whether orange flashing turn traffic lights and cyclist traffic lights combined with reflective signs saying 'turning traffic give way to cycleway traffic' or something.
Wayfinding	I think what I don't like when cycling in Dunedin is that often cycle lanes are not well conncted or it is hard to find out what is the right way to go. More signs and better connections would be helpful. For instance it is a bit unclear what is the best way to go from university to the peninsula. Sometimes there are lanes and sometimes not. Consistency is important, otherwise cyclist end up using the side walks.

Walking

Question 9: Are there any problems you face to walking into and around the city centre?

Answer	Number of Responses
It is too far	172
Feels unsafe	37
The hills are an issue	134
Too much traffic	60
Driver behaviour	68
It is difficult to cross	70
The weather	181
Takes too long	122
Accessibility issues prevent me from walking	39
No, I do not face any problems	261
Other	57

Question 10. Please rate your experience as you walk along the current state highways (one-way system) – does it feel like an appealing place to be?

Answer	Number of Responses
Very unappealing	123
Unappealing	175
Neutral	277
Appealing	72
Very Appealing	45

Question 11: How satisfied are you with the ease with which you can cross the street when walking in the city centre?

Answer	Number of Responses
Very dissatisfied	26
Dissatisfied	62
Neutral	104
Satisfied	288
Very Satisfied	197

Question 12. Do you have any other comments about the ideas we've shown for improving walking?

Total comments: 323

Theme or Issue	Comments Included:
Unpleasent environment currently due to traffic	Again, driver attitudes are a major issue in Dunedin. More raised tables and shared spaces where appropriate help challenge the assumption that cars own the street.
	Current one way is very unpleasant to walk along, loud, full of exhaust fumes
	I prefer not to walk on the SH1 roads at the moment - too noisy, busy and stinky sheep trucks! But they are relative easy to navigate when I have to. I work at the University so I'm back and forwards across all parts of the campus on foot regularly.
	Love that you are putting peoples experience and activity first instead of cars.
	Make the city centre walking only
	These are great - lots of places to cross and we need to change the emphasis of safe behaviour away from pedestrians to drivers. Drivers need to behave safely as they are the ones who mostly cause the accidents and are safe in their tonnes of metal.

Summary of survey responses

Shelter from bad weather to encourage more walking	A strong incentive for walking / being outside would be covered / sheltered areas. There is little point improving visual appeal if it is not a convenient option, and with Dunedin's weather, this is the main disincentive for walking that I see.
	Get awnings added to the outside of buildings that don't have them, to cover the footpaths from the weather a bit better.
	I only walk where there is shelter, from the rain and sun. At night, I only walk in places with adequate lighting. Loud trucks and buses are incredibly loud and horrible to listen to when you're trying to talk to somebody in the city centre
	I walk wherever I can and am pretty determined to do so but it can be a very miserable experience as there is often a lack of shelter for long stretches which is not pleasant in wet weather. I can understand how many people allow this to prevent them from walking. The other consideration to make walking more appealing is to use a smooth foot path surface - the current cobblestones are uneven and a tripping hazard, and also both the cobbles and road markings (painted surfaces) are extremely slippery in wet conditions for those on crutches and become dangerous.
	more covered footpaths would be nice so I don't get so wet
	More pedestrian shelter options when waiting for traffic lights/crossings or walking from parking areas to the CBD.
	More shelter from the weather for walkers. Reduce visual clutter to make the street environment safer to navigate.
Safer environment for pedestrians	At the moment the experience is poor on the one-ways, especially the southern part where you have to cross 3 lanes and no safe place to do it.
	Fewer cars in town. Shutdown all of city centre to cars (buses and delivery vehicles only) increase parking prices in town dramatically and implement parking at far edge of town so private vehicle commuters from north and south are encouraged to avoid traversing the city in their cars.
	Good, even more pedestrian friendly roads please, two way streets are better, tree lined roads, wide foot paths, plenty of crossings with clear interventions: narrowed roads, sharks teeth, etc, really want to see good solid last mile transport and bike storage to supplement pedestrian friendly streets
	I walk alot to get places and don't really care about seating (weather is often not conducive to sitting) or landscaping. Lighting and safety are very important. Barnes Dance is great.
	Like the idea of improving crossings and footpaths especially around Queens Gardens and the future hospital
	Please prioritize pedestrians. It is really annoying that always cars come first. As pedestrian you always have to wait, for the lights for cars crossing the sidewalk, for cars turning into a street. A pedestrian friendly city should always prioritize the pedestrians. Those are ones that walk in the cold or in the rain. While the car drivers are in their warm cars ;) I am always surprised why the pedestrians are coming last in queue. Even that they have to press a button to get a green light feels to me not right. That symbolizes to me that the pedestrians are not expected to be there. Pedestrians are the weakest so they should always be first.
Improved street amenity to make walking more attractive	An increased level of amenity would make this area more appealing; and mid-block crossings are required for safety.
	I like the idea of more seating and planting. Our main roads are rather ugly.
	I support more tree planting, seating and Barnes Dance crossings.
	I think that selling the health and wellbeing benefits of cycling and walking is the best way to create change.
	It definitely needs to be beautified along the one ways, its so dull and boring at the moment
	It Would be great If there was a bypass for the Stock trucks. I Think the planting etc is great but trees always Seem to be the first thing that goes when Theres a budget blow out
	Looks good, especially adding more green space and having the walkways next to slower roads.
	love the greenery rto make it more visuially appealing, and safer, removed from traffic through barriers. Crossing should always be 'barn crossing' at every intersection
	More trees please
	More vegetation
	Really like the "greening" of the cityscape. And provision for seating is good.
	Sounds like it would make it safer, as well as improving the subjective experience due to landscaping, places to sit, beautification, slower traffic, etc
Seperate cycle / scooter movements from pedestrians	Keep cycles and scooters away from pedestrians. These things are a menace. They should be required to give way to pedestrians at all times and dismount and walk past pedestrians.
	Keep footpaths exclusively for pedestrians & people who cannot walk. No bikes/scooters etc
	Like these ideas, please separate cyclists and pedestrians well.

	LOVE the idea of getting the e-scooters off the footpaths!! I don't feel the slow speed zone needs to be extended as far as what has been proposed.
	Pavements should be for pedestrians only. Scooters should go into the cycle lanes.
	peresterians need to beserperated from cyclists and similar vehicles
	Yes. The footpaths have become infested with cyclists and micro-mobility device users. They are wrecking pedestrian safety in the one place assured to the pedestrian
More barnes dance crossings	Good ideas, prioritising art & feel of place is important too, love the all-direction barnes dances
	More Barnes dances would be great. These have made crossing easier, but need to be in more places. The five way intersections at Knox church and Princes St are very annoying to cross at and need improvement.
	The barnes dances have been a massive improvement to prioritise walking in the city. More please. Better landscaping would enhance the walking experience (see Chch central city development)
	The multiway pedestrian crossings at intersections are fantastic (barnes dance crossings). They make it much more efficient for pedestrians to move around the centre city. Walking after dark doesn't feel safe. Walking on slipery surfaces doesn't feel safe.

Parking

Question 13. Do you have any comments about the ideas we've shown for improving parking?

Total comments: 467

Theme or Issue	Comments Included:
Multi-story parking building	A multistory marking building across the road from the hospital would make a big difference. A smaller parking capacity as close as possible to the emergency department would significantly help reduce stress
	A parking building is needed as it is impossible to find a decent park close to the city centre most times
	Build a multi level carpark next to the hospital
	Build more multi story car parks, both in the central city and on the outskirts, then cars wont need to be parked on the street, then the roads can be used for cars to drive on like they are meant to
	Dunedin is in desperate need of several new parking buildings. Parking close to town is very difficult.
	Need dedicated and easy parking for the hospital. Generally parking seems very cheap.
	large multi story carpark to service the hospital, park and ride, free shuttle bus around the city
	More multi storey car parking,especially for the new hospital
	Parking buildings and loop linking public transport is needed
	Support the idea of new parking buildings in central locations to reduce on street parking
	There will never be enough parking - we need another parking building - especially one attached to the new hospital. This will give security to those who work at the hospital and those who visit. Walking around the streets in the dead of night can be risky at times.
	Too many parks removed
	Yes. More car parks please. I suggest buildings as they take less space
More parking options around the city outskirts	Agree with having dedicated parking areas somewhat removed from busy centre. I would hope that these would take the form of parking buildings, to maximise space efficiency.
	Awesome!! There definately needs to be more parking options around town.
	Dunedin requires all day cheap parking within easy walking distances of the University, Hospital and Central Business Area. The location of the parking will determine the route people travel. i.e parking building linked to railway overbridge would provide direct access to bottom of Stuart St. Access to cark park would be via harbour route
	Getting commuters parking on the outside of the central city is a good idea.
	Go even further, make it a no brainer not to take your car into the city Center, cheap or free parking buildings/ lots including bike parks and lockers and lockers to keep tour bike in, with cheap or free well provided for last mile transport terminating at them, trams scooters small scale buses
	good idea, we dont all need to park dircetly adjacent to out destination,walking is great
	I support the idea of having functional parking buildings/spaces around the perimeter of the main city centre with the main CBD becoming more pedestrian friendly. We also need to create a social change whereby the norm is not to expect to be able to park directly outside the shop and to be prepared to walk a bit further instead of promoting more sedentary behaviour (This excludes those with mobility/disability needs who should always have appropriate access).
	More parking structures on the edges so people don't drive right into the middle of town.
	Park and ride and/or larger car parks around the periphery of the city, encouraging other forms of transport to enter the city itself. Remove parking along George street and princes street in the blocks either side of the octagon.

Summary of survey responses

Focus on movement not parking	As politically unpopular as it is, parking should not be used to determine the best design. The routes are for moving people/vehicles to where they need to be and should not be clogged up and compromised through the constant demand for parking right outside the destination. When will this stop, as the numbers of cars in the city continue to grow, will more and more of the road space be dedicated to parking? Movement must come first, with parking fitted in when it does not compromise traffic flows.
	Fully support less parking in order to gain greater pedestrianisation, cycleways and bus lanes or bus stops.
	I prefer to cycle, walk or take the bus - the city centre should be less for cars than other modes of transport
	I think the parking hubs are a good idea. I don't think there should be any on-street parking on the state highway options. Removing those parks (and providing for them elsewhere in off-street areas) could leave more flexibility to have extra driving lanes or something. Those roads should be prioritised for transit - put parking elsewhere.
	Less car parks is good - more space for alternative modes of transport and active transport will reduce the need for cars and carparks.
	parking is 20th century we should all be on a bike or bus
	Parking will aways be needed, but prioritise those who need it i.e public transport/mobility etc and incentivise those choosing to reduce the need by: walking, cycling, scootering, ride sharing and investing in e-vehicles etc by lowering cost and providing safe, green, well lit parking at a human scale..
	There is still far too much on street parking. There should be none at all on the arterial routes and parking on the local road should be reduced to a very limited number of 5 and 10 minute spots and mobility spaces. The current arrangement which has vehicles stopping and reversing into spaces on SH1 is imbecilic. The vast majority of city centre parking should be off street.
More Park and Ride facilities	Consider options for park and ride, particularly to the south for the high level of commuter traffic.
	Great, fantastic, if buses in central city free from the car parks an absolute no brainer for people to use them. Ridiculous and outdated that people expect to get a car park right outside where they want to go
	more provision for park and ride/stride options is needed. Reduced the time restrictions (to increase turn over for shopping) and increase charges for onstreet parking in the central city, this will push people like commuters further out of the central city, and free up parks for shppers and short term stays.
	Not enough parking and need more park and ride options
	Park and ride at proposed locations seems a reasonable proposal to reduce central city congestion
	Still too much parking in the centre. Put big carparks on the fringes of the city and provide park and ride.
	What about a Park and Ride system slightly further out from the city centre. You could have one north of the city and one in the south. This would drastically reduce the volume of cars entering the CBD and looking for parking spaces. Also rthere is definitely a need for parking within and adjacent to the hospital for both patients, visitors and staff, many of whom are at the hospital late in the evenings on shift work etc
Encourage short term parking in the CBD	Free but time restricted in the CBD to encourage shoppers. More parking garages/infrastructure to support workers needing to park all day
	I think there are a lot of barriers for people with limited mobility and those with very young children. Please give consideration to the extra pressure hospital visitors and staff will put on existing limited inner city parking, as it will potentially make it even more difficult for certain groups of people to access the inner city.
Increase parking costs to discourage people from driving cars	I'd like to see a dramatic increase the price of parking and removal of parking within central city. Move parking further out to oval area, south and north to gardens area.
	Increase the cost of city centre parking except at the hospital which should be free. Install periphery park and ride sites with frequent and cheap bus services (preferably electric) all across the city. Highlight to visitors that they need to park out of town before they get here and get frustrated trying to find parking.
	Parking in Dunedin is too cheap. There is no incentive for people not to drive.
	People hang ups on parking is whats holding this city back in thriving to become a great city to be in. Parking needs to be limited, and expensive to ensure more people use the public transport system, walking or cycling

Summary of survey responses

Driving

Question 14: If you currently drive through, into or around central Dunedin, what, if anything, would encourage you to travel a different way e.g. bus, walk, cycle?

Answer	Number of Responses
Cheaper buses	211
More services	158
More frequency	182
More separated cycle paths	140
Better footpaths	109
Shade / shelter for walking	116
Nothing would make me change my behaviour	319
Other	92

Question 15: What do you think about extending the slower traffic speed zone to include the area around the hospital and between key destinations such as Queens Gardens and the University?

Answer	Number of Responses
Strongly Agree	112
Agree	82
Neutral	88
Disagree	142
Strongly Disagree	287

Question 16: Are there any challenges to using the one-way system as a driver?

Answer	Number of Responses
High speeds	29
Congestion	334
It is complex	57
Traffic light phasing	289
Lots of different types of vehicle / user	109
Too narrow	132
Difficult to cross	54
Cycling conflicts	227
Access	19
Feels unsafe	51
Roadworks	120
Poor wayfinding / signage	59
Poor driver behaviour	184
I avoid the one-way system	39
Other	48

Question 17: How safe do you feel driving on the one-way system?

Answer	Number of Responses
Very safe	297
Safe	256
Neutral	121
Unsafe	46
Very Unsafe	11

Q.18 The experience as you drive using the current state highways (one-way system) – does it feel like an appealing place to be?

Answer	Number of Responses
Very unappealing	71
Unappealing	114
Neutral	266
Appealing	147
Very Appealing	119

Q.19 How satisfied are you with the ease with which you can move around the city centre by vehicle?

Answer	Number of Responses
Very dissatisfied	103
Dissatisfied	166
Neutral	143
Satisfied	239
Very Satisfied	65

Summary of survey responses

Q.20 The experience as you walk or drive in the Queens Gardens area – does it feel like an appealing place to be?

Answer	Number of Responses
Very unappealing	46
Unappealing	101
Neutral	223
Appealing	254
Very Appealing	79

Q.21 Do you have any other comments about the state highways / one-ways?

Total comments: 478

Theme or Issue	Comments Included:
Spaces are dominated by cars	Too many cars. Get people using bus and cycling more
	The current state highways/one-ways cut Central Dunedin in half (into thirds?) and make the surrounding blocks very unappealing places to be.
	Very congested and slow at times. The solution lies in getting more people on to buses, walking and cycling. This will then make the proposed change to a 2way arterial route feasible. Turning the north bound one way into a local road will make this appealing and accessible, especially if landscaped (see road and landscaping changes around chch hospital) for walkers/bikers and locals accessing hospital and city. Cyclists and walkers must have easy access accross the 2 way arterial route
	The state highways through the city make these areas unpleasant to walk through and cycle through. It destroys the peace of this beautiful city.
	I'd appreciate an option to park further away from the central city and catch a loop bus or something similar into the centre of town. I have two small children so the logistics of parking and walking are difficult and I'd imagine this problem would be even more pressing for people on limited incomes and with mobility issues.
	Having a state highway running through the centre of the city is crazy. The more we can divert motor vehicles from these roads and quieten them down, the better. Turning one-way streets to two-way streets is a good way of slowing the traffic.
	So much area is used to move vehicles around the city, and there is a lack of nice green space and pedestrian friendly areas in the city center. The footpaths are all hard up againt the road with buses, trucks, cars all meters from you tavelling at speed. It's a difficult situation to resolve I know. I feel bad for the DCC when they make proposals similar to this, people hate the thought of any changed to the road network.
	Two lanes in either direction works well but I would be willing to give that to make a more pedestrianised city centre with better infrastructure for walking/cycling.
	i'd like like to see a priority on circulation around the city center with a pedestrianised centre (Octagon to Hanover say)
	Needs safer & more convenient pedestrian crossings.
	As a pedestrian and cyclist you feel very exposed to cars and trucks - it feels unsafe and very unappealing which is bad because they are nice areas. The paths feel very open and the public gardens are also very exposed - I would not feel safe bringing a child there as there are no barriers between them and the road with lethal traffic travelling at high speeds.
	they are great at getting people from one end of town to the other, but not in an appealling way., and not at all appealing for walkers.
Queens Gardens area is cut off by the roads	Queens garden area is noisy, it could be really nice but it's so busy.
	Queens Garden has the potential to be lovely, but currently its just a giant roundabout
	The one way systems completely cut off the Queens Gardens and there is limited development around to encourage people into the area
	I think the queens garden area could be further developed to make it more appealing. I think whilst there is a lot of people crossing the oneways we cannot increase the speeds there. I think there are some concerns with the transitions for cyclists on the one ways. Longer term it would be good to develop a city wide cycling turning system as they have in other countries such as Denmark
	As a pedestrian, crossing the state highway is dangerous. The Chinese Gardens Plaza and Queens Gardens are inaccessible urban oases, cut off from the wider city by the State Highways. Overall, the pedestrian routes from the Warehouse Precinct through Queens Gardens to the Railway Station and the Octagon are fragmented, cut off by roads, and without way finding.
Cycle lanes on the state highways are undesirable	Get rid of the cycle lanes and retain the existing one way system.
	Cycle lanes should not be along side SH1 .
	Take the cycle lanes out and put them in a safer place
	Leave them alone and get rid of the cycle lanes and reinstate car parks
	If the cycle lanes were removed from the highway network, the parking could be reinstated. The highway network is an arterial route for traffic flow and should not be encumbered by cyclists. Cyclist should be catered for on secondary streets. Cycling is a mode of traffic for most people by choice. It does not appear to be a choice for Dunedin people

Summary of survey responses

	Remove the cycle ways. They are forcing cars and trucks too close together but apart from that they are still the most effective way to move traffic through Dunedin
	Keep cycling out of it.
	Current one way system should be retained and move cycle lanes to other routes
	Leave them alone and remove the cycleways to keep traffic flowing, use the cyclelane space to green up the oneway systems
More trees and green spaces are desired	More trees and parking and less cycle lanes
	I support the proposed designs with enhanced landscaping, vegetation (greenery) and separated spaces for modes of travel.
	The area should be appealing with grass and trees not tunnel-like/ jail-looking as it is currently. This way drivers wouldn't mind the short distance with lower speeds.
	I think more trees will make it more appealing but not sure how many would use the seating. I think it would not be a pleasant place to sit (too noisy/busy)
Traffic lights could be improved	Lights need to be phased so traffic flows better. Its out of sync at the moment and causes traffic to back up.
	The green wave is a major asset, and it would be pity to loose it. It does need some adjustment in places, and perhaps a more sophisticated timing system to take account of the density of traffic and therefore the speed of the traffic.
	Too many sets of traffic lights now, leading to congestion and easy not too take if you can avoid them.
	Keep the efficiency of movement through the city by better light phasing and no barns dances on that route. Increase the speeds where possible to 60kph.
	The current system works well, but better phasing of lights and better coordination of roadworks will go a long way to improving traffic flow.
	With the introduction of cycle ways on the state highways the traffic signal fazing has not taken into account times when there are no cyclists, I believe that having a cross button similar to pedestrian crossing on the cycle network this would reduce delays experienced by vehicular traffic particularly at night time
	Lights phasing is aweful, some lights on the one way change even when there is no one needing to travel through. Lights around queens garden are aweful and are on too long for the traffic crossing the one way
	Light phasing needs to encourage traffic to move not restrict it and cause congestion

Slower speed zones would improve the roads	The one ways are great. It is easy to move from one end of town to the other smoothly and safely. It is easy to exit where I need to. I would not like to see the speed limit lowered other than around the hospital area only.
	I like your slower inner city route (slower speed), and slightly faster outer city route - both 2-ways! Especially like to see Crawford Street become slower/ no trucks if possible/ no right turn onto Jetty St Bridge, (?), more pedestrian and carpark friendly (slower speed limits and retail friendly i.e. easy to walk across between shops etc.)
	Traffic too fast in central city blocks; encourages inefficient use of roading network by having to drive around entire blocks in order to point yourself in the right direction.
	I feel like there are too many cars in the city center which makes walking around it not very appealing. Slower roads and maybe a faster, bigger arterial route would be preferable.
	Traffic doesn't need to go fast just because it's a state highway. I think good flow is the main thing.
Heavy vehicle bypass	The one-ways should encourage traffic movements through the city in an efficient and safe manner. It would be great if there was a bypass for heavy vehicles
	It would be helpful if large trucks did not need to drive down the one-ways
	The proposal to imporve the wharf Road route makes eminent sense to get traffic out of the main City Centre
They are fine as they are currenly	One-ways with phased lighting provides low impedance traffic flow that is the envy of other cities. Dunedin's one-ways are brilliant.
	Very efficient, make driving very simple and pleasant. Do not remove the system there is absolutely no need. The roads are parallel it is very easy to navigate between the two.
	Leave them one way, remove trees and cycle lanes
	The one way system should be kept as is
	I now almost always ecycle these roads, and the cycle-ways are the reason. I am impressed by the on-going improvements to this system. I do prefer the intersections with the wide green banding to allow me to go through the intersection with the green light though.
	They make for a quicker journey across town. I use them more since the speed bumps were put in Maori Rd to make for a smoother journey.

Summary of survey responses

Q.22 What do you think about the proposal to provide more trees and landscape planting and places for people to sit?

Answer	Number of Responses
Strongly like	211
Like	127
Neutral	138
Dislike	122
Strongly dislike	112

Changes to SH1

Question 23. Which option for the state highway system do you think is best for Dunedin as it grows and develops?

Answer	Number of Responses
Retaining the One Way System	545
Introducing the Two Way System	165

Q.24 Which option do you think is best for integrating the hospital with the city and ensuring everyone can get there?

Answer	Number of Responses
Retaining the One Way System	527
Introducing the Two Way System	182

Q.25 Do you have any other comments about our options?

Total comments: 420

Theme or Issue	Comments Included:
Proposed changes to the road system	Although I would prefer the one way system to be retained (with a public pedestrian raised area over Cumberland Street between Lower Stuart and St Andrew Streets, opening the hospital up to down town Dunedin), I believe a two way system could work if the harbour arterial option was really developed, two lanes each direction etc. Otherwise I believe it will create traffic chaos.
	This has been talked about for years - the two way is the future solution. Just make sure there are suitable places to cross Cumberland in the southern part in order to get to Steamer Basin. There are currently too many barriers created by multiple north south routes - constrain the state highway and make the other routes easier to cross. Look at the development that has happened when minor improvements were made to the Warehouse Precinct - this growth could be expanded to other areas with targeted investment and reduction of the dominance of the state highways on the city.
	The one way system is effective and works. Ambulances can use bus lanes if they are included on the State Highway.
	I'm concerned that a two way system will be more congested and difficult for emergency services to negotiate if they're isn't enough room to pull over completely and there are barriers down the middle
	Excellent idea to move to a two-way system, but with a good bypass available. Then slowing traffic speeds elsewhere, and making these zones pedestrian and bike friendly, trees, seating etc, will also keep people safely separated from SH1 traffic
	Only problem with the two way system is immensely increased congestion. Unless all the parks are removed on both sides and traffic is given two lanes in either direction. Then there's Central Fire Station which will need improved traffic lights. Strathallan St already extremely busy. May be time to consider a raised highway bypass from Andy Bay motorway to somewhere around Anzac Ave?
	Moving to a two way system would impact heavy traffic and vehicles and cause congestion to the centre city making it harder to move through.
	My concern is with congestion at peak traffic times. The present system is not good either.
	I think that a one way system is the best way to move the traffic. roadworks or other blockages would be much harder to manage with a two way - needing re-routing. At least with a one-way, you can usually guarantee one free lane. Two way would involve more crossings and changes for vehicles.
	Both seem reasonable, but the two way system seems like it would be better for making an attractive place for people and businesses to operate, whereas the current system tries to serve as both a main thoroughfare and town centre
	2-way system might work if you're not offering parking. Otherwise nobody will wait and let you park and you'll have accidents because people get impatient and try to overtake. So yes to 2-way system if there are no parks, just cycle lanes, plants, pedestrain and lots of bus/tram stops. Otherwise, retain one-way system
	I believe that maintaining the existing 2 one way streets is the best a safest option, and the possibility of moving the cycle network away from the state highways should be seriously considered for the safety of all users
	although it is really important for people to be able to safely and easily access the new hospital it is equally important to have a safe and easy to use main thoroughfare through the city. At the moment the one way's provide this thoroughfare, although there seems to be some issues with congestion at peak times.
More parking desired	A parking complex with a direct bus or shuttle to the hospital would help a lot of people and eases congestion around the hospital
	Provide good parking near new hospital

	Provide good parking for hospital users, Keep the one Way, gold Coin buses, commuter train from mosgiel and improve cycle ways so they have better flow and are safe
	Park and ride parking areas on the fringes and allow free frequent shuttles.
	Provide better parking adjacent to the hospital including multi story parking.
	Options for park and ride / walk are well worth exploring - anywhere.
	Park and ride options are a good idea to encourage people to park away from central city areas - would need to be easy to access with very frequent “ride” options to stop Dunedinites complaining and refusing to use it!
	there seems to be some idea that people need to park directly outside of the shop they are visiting, as someone who has parked a car I know that simply isnt true for the majority of people, although considerations must be made for people with low mobility I definitely favour moving parking to more centralised parking garages, and there is already a framework in place to allow special parking for those who need it
Improvements to driving routes	The proposed option alongside enhancing the wharf area arterial route as another key travel route is a good start. I think it will be easier to manage with one dedicated state highway route and a safer multi-modal route of lower speed for local travel. I also support the public suggestions for building a multistory carpark building on the SDHB land between Anzac Ave and Castle Street to enhance patient access and experience.
	Reduced speed limits everywhere please unless mandated by NZTA - 30km is enough.
	I like your slower inner city route (slower speed), and slightly faster outer city route - both 2-ways! Especially like to see Crawford Street become slower/ no trucks if possible/ no right turn onto Jetty St Bridge, (?), more pedestrian and carpark friendly (slower speed limits and retail friendly i.e. easy to walk across between shops etc.)
	Improving the bypass is a good idea, but care is needed that the joining intersections do not get congested with traffic backed up.
	Need more parking in the city and better traffic flow
	Please ensure the volume and movement of traffic can be maintained or improved and add more parking options for cars.
Increased amenity supported	Making the area more accessible for all, including planter separated cycle way, reduced vehicle speeds, and overall attractiveness will make the area welcoming to all.
	Basically I like them. Extra seating and planting (of native species) would be welcome. The one way system is pretty awful looking and not a great place to be as a pedestrian.
	More trees - on footpaths. And increase George Street parking spaces. Keep the roadway and the parking.
	I love the idea to shift heavy and through traffic away from the central city, this will hugely improve the feel for the central city, it will move our city into a more progressive, people focused area, and away from being stuck in the past, away from being a car central, semi-rural centre. Dunedin is a growing metropolitan city, we need to make it look like that.
	Plant more trees and plants along the streets this will affect the perceived quality but also affect driver behaviour.
Walking	Safe pedestrian access is essential. We want a Dunedin Central for people not cars.

Q.26 Which parts of the proposed improvements do you like best and why?

Total comments: 364

Theme or Issue	Comments Included:
Cycling improvements	Better safer cycling in the two way concept. The two way system is also good how it gets the heavy traffic off one of the roads.
	As a driver, I like having people and bikes moved away from the main traffic artery - feels safer. As pedestrian/biker, like being well away from noise and speed of SH1, and feel safer.
	Cyclists protected by planters makes the area feel considered and not just an afterthought with substandard concrete dividers. The end result is function and aesthetic. This adds to the area’s much needed greening and soft surfaces. Wide pedestrian crossings is a nice touch as well.
	I like the idea of connecting up the bike lanes more, making them easier/ safer to use. I like the emphasis on improved pedestrian experience.
	Anything to improve cycling and pedestrian access are important. Cities are for people, not just cars!
	I really like the greening of the cityscape. The cycleways on the one road strike me as being a good idea too. Just simpler to access and potentially safer.
	The most important improvements to me are improvements to the cycleways and better connections, and improving the bus service to provide quicker and easier connections.
Driving around the city	Anything that would help with smooth vehicle movements as well as safety for cycling, anything that will improve parking options.
	Having an alternative route to bypass the CBD when travelling across the city.

Summary of survey responses

	I approve of the general scope of the improvements and think that the option to bypass some of the Traffic along Wharf And Ward Sreets is a good idea.
	I like the idea of a free-flowing highway that gets people from one end of the city to the other, on the outer and an interior road that people could use if they want to access the inner city (this includes the hospital - it should only have emergency access to the highway (like the fire station).
	I would like the Harbour Arterial route to be upgraded. It is a fantastic way to get from Anderson's Bay to the city without waiting for lights. It has faster speed limits and so travel is much easier.It also has a cycle way disconnected form the road which works well and has great views of the harbour.
	Sticking to one way system. Better bus routes and more cycle ways.
	Many people already use the Wharf Street area as a bypass of the CBD area, so what a great idea to improve those streets to cope as a bypass/ heavy traffic bypass for those not wanting to enter the CBD.
	The two way system gives the city centre a commercial heart that is not divided by the one way system.
Proposed changes to the current road network	Changing to the two-way system, more cycle lanes, more plantings.
	Emphasis on cycleways, walking and trees and seating in the centre city.
	I like the idea of a local road, where alternate forms of transport can be given greater priority.
	I like your slower inner city route (slower speed), and slightly faster outer city route - both 2-ways! Especially like to see Crawford Street become slower/ no trucks if possible/ no right turn onto Jetty St Bridge, (?), more pedestrian and carpark friendly (slower speed limits and retail friendly i.e. easy to walk across between shops etc.)
	The change to a two-way street system, because it is likely to slow motor vehicle traffic, especially if heavy traffic can be diverted to a route closer to the harbourside.
	The two way system will make it more accessible to the hospital area from central city - so it would feel like the central city had expanded and isn't cut off by the one-ways. Would like more mini green spaces for sitting and having a coffee/lunch/ bask in the sun /have a break from your day.
	Better safer cycling in the two way concept. The two way system is also good how it gets the heavy traffic off one of the roads.
Parking in the CBD	I disagree with the ideology associated with squeezing the private car out of the CBD. This can only disenfranchise many, many businesses who are dependent on convenient ease of access to folk from all over the wider city and the hinterland.

	I like that there will be options to bypass the Central city for those wanting a quick trip, I like the proposal to beautify the area, especially outside the hospital. I think more attention needs to be given to parking and the extra pressure the new hospital will put on existing parking.
Suggested improvements to public transport	Better accommodation of active and public transport, bus improvements, more appealing streetscapes.
	Bus Hub - one place for all the routes, it is now easier to commute.
	Proper bus shelters that actually shelter from the southerly and easterly rains we get should be a high priority if you want more people to use buses.
	I do believe that better bus services including: posting electronic panels for arrival and departure times/routes/maps and better signage will increase public faith in the bus system. I agree that a Free central downtown bus loop would promote access to shops and services ---which may allow people to park their cars a bit further away but still have access to facilities such as the Hospital easily and efficiently.
	I think encouraging more people to use public transport is the part of the plan I like best. I would like the option of improving bus services linking popular destinations in the Centre of Dunedin and a School Service linking several schools with the Bus Hub as the school run is a major barrier to parents and families in regards to using public transport.
	I like the idea of creating nicer public spaces, more covered walkways and looking at public transport options.
	Improvements to public transport system. I have lived abroad and in larger NZ cities where public transport is efficient and useful (and therefore well used) and I wish we had something resembling that here.
	The emphasis on beginning to change social norms and expectations from prioritising private vehicle travel towards prioritising the movement of people, particularly those using active or public transport.
	improve public transport and cycling, improving with landscaping
	I do believe that better bus services including: posting electronic panels for arrival and departure times/routes/maps and better signage will increase public faith in the bus system. I agree that a Free central downtown bus loop would promote access to shops and services ---which may allow people to park their cars a bit further away but still have access to facilities such as the Hospital easily and efficiently.
Status Quo	I prefer the status quo.

Summary of survey responses

Propsed streetscape improvements	Adding more trees and places to sit down.
	Greening up the streetscape.
	I like the idea of creating nicer public spaces, more covered walkways and looking at public transport options.
	More trees and sitting areas. Also linking cycling from the city to South Dunedin looks good.
	I like the idea that we are trying to build a city that is more than just a place for cars. Let's take back some space for other users!
	I like the landscaping ideas and the cheaper buses
	More green spaces - Dunedin is beautiful and we should embrace that
	Emphasis on cycleways, walking and trees and seating in the centre city
	Plantings on back streets makes it a lot nicer to walk down. keeping all the cars over in one spot.
	Two way traffic everywhere; improved cycle and public transport facilities; green landscaping (trees, seating, etc)
	Two way local roads, increased tree planting and seating will start to reclaim the spaces for people, rather than the current emphasis on cars.
	More trees!!! The increased active transport and idea that the city streets should be a nice place to be
Walking in the city currently	A walkable destination city centre is a good idea. I've lived in cities where pedestrian centres work.
	I like the use of more Barnes dance crossings as they are pedestrian focused and encourage people to park once then walk about town rather than driving between places in town. More landscaping along the streets would be and make a more plesant walking/biking/driving environment.
	Focus on safe cycling and walking
	The one way system would be more predetrian friendly if the proposal goes ahead.

Appendix I Modelling Report

Shaping Future Dunedin Transport Business Case

Microsimulation Traffic Modelling Report

PREPARED FOR Waka Kotahi NZ Transport Agency | May 2021

We design with community in mind

Stantec

Revision Schedule

Rev No.	Date	Description	Name			
			Prepared by	Checked by	Reviewed by	Approved by
1	12/02/21	Draft	Bevan Wilmshurst/Vanessa Wong	Christine Holt	Sarah Connolly	Bevan Wilmshurst
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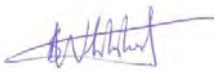
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1.0 INTRODUCTION AND BACKGROUND

1.1 SHAPING FUTURE DUNEDIN TRANSPORT (SFDT) BUSINESS CASE

The Shaping Future Dunedin Transport (SFDT) project is investigating transport network changes through the central Dunedin network. These changes include considering options for reconfiguring the roading network and transport environment in and around the central city and waterfront areas.

1.2 DUNEDIN MODELS AND CITY CENTRE MICROSIMULATION MODEL

1.2.1 City Centre Microsimulation Model Overview

Dunedin has a two-tier transport model system. The regional citywide CUBE model estimates travel demands from land-use by model and trip purpose. The regional model is linked to the operational city centre microsimulation model; the CUBE model provides existing travel patterns and trip demand forecasts to this model. The microsimulation model area is shown in the figure below. The network coverage, detail, form and operation of the microsimulation model mean that it is well-suited to assessing the SFDT options.

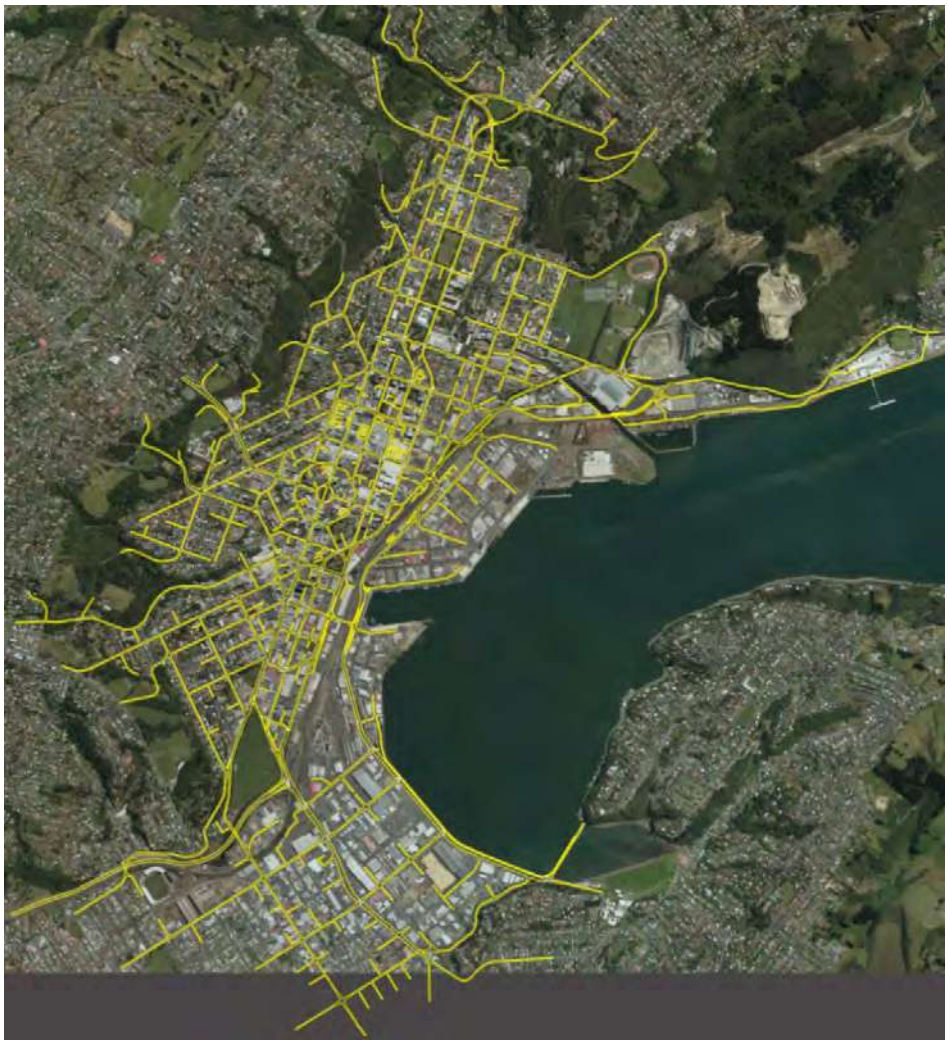


Figure 1-1: Paramics Discovery Dunedin City Centre Microsimulation Model Area

1.2.2 City Centre Microsimulation Model Version

The SFDT microsimulation modelling project started around March 2020. Since then, there have been several modelling stages and a range of scenarios and options tested for the SFDT Business Case. This phase of the business case testing has been carried out using the 2038 forecast model scenarios that were estimated during the original microsimulation model development project in 2017-2018.

Subsequently a 2019 'health check' has been carried out on the base model and, separately, the regional travel demand forecasts have been updated. This work has been used to developed updated Do Minimum 2028 and 2038 microsimulation city centre model scenarios. This version of the city centre model was not ready in time for this phase of the SFDT Business Case option scenario testing.

The SFDT options have been run with the SFDT Travel Demand Management (TDM) strategy. This strategy encourages and supports greater use of active mode and public transport travel. The strategy has been applied in the CUBE regional transport planning model which feeds travel demands to the city centre microsimulation model. The application of the TDM in the microsimulation city centre model reduces the number of vehicle trips in the City Centre area. A version of the 'Do Minimum' scenario has also been created with the SFDT TDM trip reduction applied.

1.3 SFDT BUSINESS CASE MODEL REPORTS

1.3.1 This Microsimulation Traffic Modelling Report

The City Centre microsimulation model has been applied to testing the SFDT option scenarios in various stages. This report provides a full summary of this work and 'final' model outputs.

For the record, details of the previous microsimulation testing and operations results are provided below.

1.3.2 Historical Reporting

1.3.2.1 Option Testing Report

The 'Microsimulation Modelling Option Testing Results, Prepared for Shaping Future Dunedin Transport, 09/06/2020' is the historical 'main report' developed for Shaping Future Dunedin Transport microsimulation modelling. This report provides details on:

- Demand Forecasting, Do Minimum, and SFDT option scenarios ('core' one-way and two-way scenarios).
- Outputs for a range of variations and refinements to the 'core' SFDT option scenarios.
- Harbour Arterial sensitivity test development and outcomes.
- Commentary and discussion on key results from the microsimulation model testing and key aspects of the operation of the scenarios testing.

This report summarised testing a range of refinements and alternatives to the 'core' one-way and two-way SFDT options. The following models and tests were run and reported on in this phase of work:

- Do Minimum
- Harbour Arterial component in isolation:
  - Kensington Ave left-in only, Supermarket access on Hillside Road signalised
  - Jetty Street ramps to/from Wharf Street
- SFDT One-way:
  - Core scenario
  - Cyclists using Barnes Dance signal phase
  - Lower signal cycle times
- SFDT Two-way:
  - Core scenario
  - 4-laning and split signal phases
  - Restricted turning movements, intersection widening and downstream merge-like-a-zip

  - Replacement of Barnes Dance signal phases with Pedestrian Protection phasing
  - 4-laning and replacement of Barnes Dance with Pedestrian Protection phasing
- SFDT Two-way, Harbour Arterial Sensitivity.

The results from these tests enabled the core scenarios to be distilled to a smaller sub-set of options progressed through the Business Case project.

1.3.2.2 Economic Output Report

The 'Dunedin SFDT Economic Outputs from Paramics Model, 16/06/2020' was provided to SFDT Business Case Team for the purpose of the related transport economic assessment. This report includes network zone improvements details and Network Wide Statistics used for Economic Analysis.

1.3.2.3 Option Testing Addendum Report

The 'Dunedin SFDT Microsimulation Modelling Option Testing Addendum Report, Final Results for MCA, 21/07/2020' addendum report was provided to the SFDT Business Case Team as input to aspects of the Multi Criteria Analysis (MCA2).

The addendum provides details on the final summary outputs of the key SFDT option scenarios, including the Do Minimum without Travel Demand Management scenario. The scenarios tested and reported on in this phase of assessment were:

- Do Minimum
- Do Minimum (without TDM)
- SFDT One-way
- SFDT Two-way
- SFDT Two-way, Harbour Arterial Sensitivity.

1.3.2.4 Final Results Report

The Two-way SFDT was reviewed and refined through the Business Case process and traffic engineering/design input alongside the modelling outputs. The 'SFDT Microsimulation Modelling, Final Scenario Results Report, 15/12/2020' provided a finalised set of results on the likely set of option scenarios at this point of time:

- Do Minimum
- Do Minimum (without TDM)
- SFDT One-way
- SFDT Two-way (P2v2)
- Hybrid scenario, two-way network in the north and south and one-way network layout in the CBD area.

1.4 FINALISED MODEL SCENARIOS

In the final section of this report a finalised set of modelling results from the city centre microsimulation model are provided for the following scenarios:

- Do Minimum
- TDM Only (the SFDT Travel Demand Management strategy applied to the Do Minimum)
- SFDT One-way scenario
- SFDT Two-way "P2v3" scenario (minor updates to scenario reported 15/12/2020)
- Hybrid scenario.

More details are provided in this report on the updated Two-way P2v3 scenario. In summary, the two-way arterial route (current southbound one-way carriageway) has 4-lanes south of Queens Gardens, 3-lanes between Queens Gardens and Albany Street (2 southbound and 1 northbound lane), 2-lanes from north of Albany Street.

The Hybrid scenario is a mix of two-way network south of Queens Garden, one-way network between Queens Gardens and the existing one-way 'S-Bends', and two-way network north of Albany Street.



A summary set of outputs only (no explanatory text and commentary) has been provided to the Business Case team for Multi Criteria Analysis (MCA) scoring on 26-01-2021. These results are identical those provided as 'final' in this report.

2.0 TEST FORECASTS AND DO MINIMUM

2.1 FORECASTS AND SFDT TRAVEL DEMAND MANAGEMENT (TDM)

The Dunedin Transport Models were originally developed using transport data predominantly from 2017. Travel demand forecasting was completed in 2017-2018 as part of the original model development project. Land-use and population growth assumptions in Dunedin at that time were relatively low.

The 2038 demands estimated during the original model development project have been used as a basis for testing the SFDT scenarios using the City Centre microsimulation model. Broad current indications are that these 2038 demand levels may be reached within the next 10 years (estimated to approximately represent 2027), mainly because population growth in Dunedin has been faster than expected, with Dunedin moving from a 'low' to a 'medium' growth city in 2019 (StatsNZ).

The Do Minimum and SFDT options all include a Travel Demand Management (TDM) strategy aimed at reducing the level of single occupancy light vehicle trips in the area. This TDM component has been applied to the 2038 demand estimates, reducing the growth to around 2-4% in terms of total city centre trips compared to the 2017 base year demands. Appendix A includes summary growth tables.

The Dunedin transport modelling suite, including forecasts and Do Minimum future year microsimulation models, have recently been updated. This update was not completed in time for this phase of the SFDT Business Case option testing. The details of the updated models, particularly key assumptions relating to the future year Do Minimums, should be considered and confirmed in any future testing and assessment of the SFDT scenarios. Key examples include the assumptions around the Hospital location and larger central city car-parking facilities; this current suite of work is based off the 2017-18 assumptions which at this point included the Hospital in its existing location and minimal changes to large car-parking facilities.

2.2 DO MINIMUM ASSUMPTIONS

2.2.1 Do Minimum Inclusions from 2017-18 Model Development

As described above, the city centre microsimulation models used through the SFDT phase of testing were developed during 2017-18. The Do Minimum network, which has been used as reference to compare the SFDT options, includes the following schemes and network changes that have been made since the development of the 2017 base scenario, or which are planned and committed, with funding allocated.

- **Barnes Dance and Cycle-Way Signal Phasing Changes**: Key intersections along the current State Highway one-way pair, George Street and Moray Place.
- **Intersection Upgrades**: St Andrews Street/Anzac Avenue, Cumberland Street/Howe Street signals, Stuart Street/Castle Street, Toitu Museum pedestrian crossing, Ward Street/Halsey Street roundabout.
- **Bus Hub Changes**: Bus route changes, schedule/service alternations, and associated intersection re-configurations around the area of the hub.
- **George Street Scheme**: 10kph speed limit for four blocks (Albany Street to Moray Place) (committed but not yet in place on the network).
- **Tertiary Precinct**: 30kph speed limit on Union Street, Harbour Terrace, Clyde Street and Forth Street (committed but not yet in place on the network).

2.2.2 Key Do Minimum Exclusions

Several expectations and elements influencing the transport environment have changed since the 2017-18 development of the base and future year transport models. This includes expectations around the likely future land-use and associated changes to the transport environment.

An exhaustive list of the expectation changes between 2017-18 and 2021 is difficult to produce. The most critical changes are understood to be as follows:

- **General Likely Future Land-use Development and Population Growth:** As noted above, in 2019 Dunedin moved from a likely 'low' population growth to 'medium'. Increased and changed Land-use development in areas in the region will be linked with the anticipated higher population growth. The Do Minimum and 2038 forecasts used in the testing to-date are based on the older assumptions and low population growth forecasts.
- **Hospital Location and Associated Transport Network:** Since 2017-18 a clearer picture has developed of the likely change in the Hospital site and associated with this, changes in the transport network around the new site. The microsimulation modelling to-date is based on the current Hospital site location.
- **Car-park Facilities:** The new Hospital site includes demolition of a large existing off-street carpark between the current one-way pair, northeast of St Andrews Street. This carpark remains in the microsimulation modelling to-date. It is also understood that wider review and consideration of central city car-parking may be underway or carried out in the future.



3.0 HARBOUR ARTERIAL AND SFDT SCENARIOS

3.1 HARBOUR ARTERIAL SFDT COMPONENT

3.1.1 Harbour Arterial Overview

The Harbour Arterial route runs from the State Highway 1 (SH1)/Anderson Bay Road intersection, east-west on Strathallan Street, and along the waterfront route (Wharf Street, Thomas Burns Street, and Ward Street). The route is broadly shown in Figure 3-1 below. This figure is from an earlier phase, the Harbour Arterial component no longer extends along Frederick Street.



Figure 3-1: Harbour Arterial Route

Broadly, the Harbour Arterial includes the following aspects:

- **Priority intersections along Wharf Street and Thomas Burns Street**: Right turn restrictions.
- **St Andrew Street/Thomas Burns Street/Ward Street roundabout**: Alterations to roundabout to promote Ward Street route and reduce through traffic on St Andrew Street.
- **Ward Street**: Alternations to increase attractiveness for through traffic.
- **Ward Street/St Andrews Street/Anzac Avenue**: Anzac Avenue closed southbound at intersection.
- **Hanover Street**: Disconnect ramp from eastern end of Hanover Street (at Anzac Avenue) to/from Ward Street.

3.1.2 Preliminary Harbour Arterial Tests

The Harbour Arterial scheme was added to the Do Minimum network during a preliminary phase of transport modelling. This enabled several straightforward tests to be carried out on potential refinements to Harbour Arterial network elements. These tests were carried out using the original 2038 demand forecasts, without any Travel Demand Management (TDM) strategy adjustments. The tests carried out were:

- **Hillside Road and Andersons Bay Road/Kensington Avenue/Strathallan Street**: Tested Kensington Avenue (supermarket access) left-in only, supermarket access on Hillside Road signalised.
- **Jetty Street northern ramp to/from Wharf Street**: Test completed removing these ramps.

These tests found that left-in only at Kensington Avenue had some benefits to the traffic network operation, particularly the Anderson Bay corridor route. Signals at the supermarket access on Hillside Road are a component of the left-in only at Kensington Ave.

Removing the Jetty Street ramps resulted in increased traffic flow and pressure within the key Central Business District (CBD) area. Notably the intersections along the State Highway corridors to the southeast and northeast of the Octagon.

These results were discussed with Stakeholders and it was agreed that the Harbour Arterial component would include Kensington Avenue left-in only and the signalised supermarket access on Hillside Road and also the Jetty Street ramps would remain in place for this SFDT option assessment.

3.1.3 Harbour Arterial Traffic Flow Changes

In the initial phase of SFDT option model testing the same Harbour Arterial network elements were included in all SFDT option scenarios as described above. There are two more notable effects associated with Harbour Arterial changes:

- **Increased traffic flow on the State Highway corridor through the central and southern area of the network**. This appears to be due to the decreased use of the St Andrews Street route (from Thomas Burns Street) and Anzac Avenue route to access CBD areas around the Octagon.
- **Increased traffic flow on Frederick Street**: This appears to be due to the promotion of this route from Thomas Burns Street and along Ward Street, decreased attractiveness of St Andrews Street, closure of Anzac Avenue southbound at Frederick Street, and removal of the ramp to/from Ward Street.

Appendix B provides AM and PM peak hour flow difference plots comparing the Do Minimum and Harbour Arterial component of the SFDT scenarios which demonstrate the effects noted above.

The above factors, particularly the increased flow along Frederick Street, influence the operation and outcomes of the Two-way SFDT scenario. These effects were explored in a sensitivity test, and in later phases of option testing some components of the Harbour Arterial were altered in the Two-way SFDT option scenarios.

3.2 CORE SFDT SCENARIOS

3.2.1 One-way Scenario

Along with the Harbour Arterial changes noted above, the core one-way scenario retains the existing State Highway (SH) northbound and southbound one-way routes through the city centre. The broad scenario is shown in Figure 3-2 below.





Figure 3-2: Core One-Way Scenario

Key changes to the one-way scenario include:

- 40kph speed limit through central city area (both one-way routes)
- Barnes Dance pedestrian signal phases added at Frederick Street, Queens Gardens and Stuart Street.

3.2.2 Two-way Scenario

The core two-way scenario converts the existing one-way routes to two-way streets. A two-way arterial route is formed on the existing southbound one-way route which runs along the eastern edge of the CBD. On the existing northbound route, a two-way local road is formed. The broad scenario is shown in Figure 3-3 below.



Figure 3-3: Original Core Two-Way Scenario

Note, the figure above does not quite reflect the revisions to the Harbour Arterial developed through the sensitivity tests described in Section 4.3.2.

The creation of the two-way streets along the current one-way carriageways includes the following key changes:

- **Two-way arterial route (existing southbound one-way)**: 50kph along whole route, the original core scenario included single left through and right turning lanes at each intersection on the SH (arterial) approaches. Signal phases include right turn phase from SH approach and side road approach. Barnes Dances all-pedestrian signal phases were included at 7 intersections.
- **Two-way local route (existing northbound two-way):** Local road with 30kph speed limit in central area, 2-lane approaches, simple signal phasing, short signal cycle times, and all-pedestrian Barnes Dance signal phases.

4.0 OPTION TESTING AND SFDT SCENARIO REFINEMENT

4.1 BACKGROUND

The SFDT One-way and Two-way scenarios have been through a series of straightforward option layout and operation refinement tests utilising the microsimulation model. This has concentrated on testing the effect of alterations on vehicle flow and efficiency outcomes while maintaining key desired aspects of the scenario, for example in the Two-way scenario maintaining a low-volume slower speed two-way local route on the existing northbound one-way carriageway. This option testing is summarised below, a comprehensive set of model outputs and results can mostly be found in the 'Microsimulation Modelling Option Testing Results, Prepared for Shaping Future Dunedin Transport, 09/06/2020' report.

4.2 ONE-WAY OPTION TESTS

4.2.1 Overview of Tests

The One-way scenario is relatively straightforward and operates similarly to the current network and vehicle traffic environment. Two refinements were tested on the core one-way scenario:

- **Cyclists using Barnes Dance (BD) phase**: In terms of signal operation, the core one-way scenario includes both the current cycle protection phases along the State Highway (SH) one-way routes, and additional Barnes Dance (BD) all-pedestrian phases. This test removed the cycle protection phase allowing cyclists to use the BD phase. There are minimal locations where this change could be implemented – the scenario only features two intersections where an additional BD phases have been added to the existing cyclist protection phase.
- **Lower signal cycle times, Barnes Dance runs every second signal cycle**: This test investigated the effects of lowering the cycling times along the full one-way route. A 60 second cycle time was trialled, and where BD phases exist these were introduced every second signal cycle. A challenge in this scenario was allocating green time at intersections with four-or-more phases (e.g. right turn phases from side roads and cycle protection phases on SH). The lower overall cycle time results in these phases being allocated very short green times, often minimum green times.

4.2.2 Key Outcomes

The tables below provide the overall network travel times and distances compared to the Do Minimum scenario for the One-way scenario option testing as per the options described above.

Table 4-1: AM Period Network Travel Times and Distances, One-Way Scenario Option Tests

AM Network-Wide Statistics	Do Min	One-Way Option			One-Way Option (cyclists use Barnes Dance)			One-Way Option (lower cycle time, BD double cycled)		
		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min	
Average network travel time (min)	4.96	5.15	0.19	3.9%	5.15	0.20	4.0%	5.21	0.26	5.2%
Average network trip distance (km)	2.46	2.47	0.01	0.5%	2.47	0.01	0.4%	2.47	0.01	0.6%

Table 4-2: IP Period Network Travel Times and Distances, One-Way Scenario Option Tests

IP Network-Wide Statistics	Do Min	One-Way Option			One-Way Option (cyclists use Barnes Dance)			One-Way Option (lower cycle time, BD double cycled)		
		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min	
Average network travel time (min)	4.27	4.61	0.34	7.9%	4.49	0.22	5.1%	4.65	0.38	9.0%
Average network trip distance (km)	2.20	2.23	0.02	1.0%	2.23	0.02	0.9%	2.23	0.02	1.0%

Table 4-3: PM Period Network Travel Times and Distances, One-Way Scenario Option Tests

PM Network-Wide Statistics	Do Min	One-Way Option			One-Way Option (cyclists use Barnes Dance)			One-Way Option (lower cycle time, BD double cycled)		
		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min	
Average network travel time (min)	5.34	5.64	0.30	5.6%	5.58	0.24	4.5%	6.68	1.34	25.1%
Average network trip distance (km)	2.29	2.31	0.02	0.7%	2.31	0.02	0.7%	2.32	0.03	1.1%

Although there were only several locations where the cycle protection phase was removed (cyclists use the Barnes Dance phase) this appears to have marginal, but clear, benefits in the Inter-Peak (IP) and PM periods.

The short-signal-cycle test was unsuccessful in reducing vehicle delays. In the PM period, the difficulty in allocating green time to shorter phases (typically dedicated turning phases) appears to be significantly detrimental to network performance. If the minimum green time is not sufficient to clear a critical queue, e.g. a right turn queue filling a right turn bay, this could lead to these queues blocking key movements and propagating through areas of the network.

4.2.3 Finalised One-way SFDT Scenario

Cyclists using the Barnes Dance phase is not a desirable outcome, therefore the finalised SFDT One-way scenario was not altered through the option testing and refinement work phases. This scenario remains as per the original 'core' proposed high-level design and operation.

4.3 TWO-WAY OPTION TESTS

4.3.1 Arterial Route Lane Revision and Intersection Operation Tests

The SFDT Two-way scenario option tests have focused on the two-way arterial route on the current southbound one-way carriageway. This has been carried out across several phases, with refinements and alterations to this scenario and particularly the form and operation of the arterial route continuing over a number of work phases through until January 2021.

Vehicle delay and queuing issues in the original 'core' SFDT Two-way scenario were relatively significant, particularly in the PM Peak. This scenario provided a single through traffic lane along the full length of the two-way arterial route. PM peak network-wide travel times were more than 60% greater than the Do Minimum.

The following is a brief and broad summary of the types of tests and refinements carried out. In a number of cases these options were tested together, for example restricting turn movements was explored as an addition or sub-option in other tests.

- **Signal phasing and timing adjustments**: As per the One-way tests, alternative signal phasing, cycle times, and alternations around the Barnes Dance provisions were tested.
- **Restricting turns**: Tests involved restricting right turn movements at intersections along the central section of the two-way arterial to re-allocate lane space, reduce the number of signal phases required, and re-allocate green time to key movements.
- **Widening/merge arrangement at intersections**: Various arrangements were tested, including approach widening and downstream merge-like-a-zip arrangements to achieve two through lanes at key intersections.
- **4-lane and split signal phase arrangement:** Tested 4-lane cross section (two through lanes in each direction), with shared through-left and through-right lane arrangements at intersections which requires splitting northbound/southbound signal phases.

The tables below provide network-wide travel time and distance outcomes from a key early phase of two-way scenario tests.



Table 4-4: AM Period Network Travel Times and Distances, Two-Way Scenario Option Tests

AM Network-Wide Statistics	Do Min	Two-Way Option (Core scenario: 1-thru lane arterial)			Two-Way Option (2-thru lane arterial, split phase)			Two-Way Option (restrict RTs & zipe-merge)			Two-Way Option (replace BD with Ped Prot)			Two-Way Option (2-lane thru split phase & BD replace w ped prot)		
		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min	
Average network travel time (min)	4.96	5.48	0.53	10.6%	5.51	0.56	11.2%	5.43	0.47	9.5%	5.44	0.49	9.8%	5.43	0.48	9.6%
Average network trip distance (km)	2.46	2.47	0.01	0.6%	2.47	0.01	0.6%	2.47	0.01	0.5%	2.47	0.01	0.5%	2.47	0.01	0.5%

Table 4-5: IP Period Network Travel Times and Distances, Two-Way Scenario Option Tests

IP Network-Wide Statistics	Do Min	Two-Way Option (Core scenario: 1-thru lane arterial)			Two-Way Option (2-thru lane arterial, split phase)			Two-Way Option (restrict RTs & zipe-merge)			Two-Way Option (replace BD with Ped Prot)			Two-Way Option (2-lane thru split phase & BD replace w ped prot)		
		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min	
Average network travel time (min)	4.27	4.57	0.30	7.0%	4.59	0.32	7.6%	4.55	0.28	6.6%	4.48	0.21	5.0%	4.56	0.29	6.7%
Average network trip distance (km)	2.20	2.22	0.02	0.9%	2.23	0.02	1.0%	2.22	0.02	0.9%	2.22	0.02	0.7%	2.23	0.02	1.0%

Table 4-6: PM Period Network Travel Times and Distances, Two-Way Scenario Option Tests

PM Network-Wide Statistics	Do Min	Two-Way Option (Core scenario: 1-thru lane arterial)			Two-Way Option (2-thru lane arterial, split phase)			Two-Way Option (restrict RTs & zipe-merge)			Two-Way Option (replace BD with Ped Prot)			Two-Way Option (2-lane thru split phase & BD replace w ped prot)		
		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min	
Average network travel time (min)	5.34	8.66	3.33	62.3%	7.76	2.42	45.4%	8.92	3.58	67.1%	7.95	2.61	48.9%	7.46	2.12	39.7%
Average network trip distance (km)	2.29	2.32	0.03	1.3%	2.32	0.02	1.1%	2.32	0.03	1.2%	2.31	0.02	0.8%	2.31	0.02	1.0%

The tables above demonstrated that widening sections of the corridor to provide greater intersection capacity, along with some replacement of Barnes Dances with Pedestrian Protection phases in key locations, reduced vehicle delays.

This series of tests, and this broad outcome, lead on to further development of the two-way scenario which is described in the sections below.

4.3.2 Two-way Scenario Harbour Arterial Sensitivity

The flow changes associated with the Harbour Arterial component of the SFDT scheme (ref Section 3.1.3) are important to the operation of the Two-way SFDT scenario. Notably the increased flow on Frederick Street and reduction on St Andrew Street. Frederick Street, and the intersection with the two-way arterial route, is a critical pinch-point for vehicle traffic in the SFDT Two-way scenario. Components of the Harbour Arterial scheme were compounding vehicle flow and delay issues in the area of the network northeast of the Octagon.

A sensitivity test was developed where the Harbour Arterial changes immediately to the east of CBD have been reverted to the Do Minimum layout (St Andrews Street, Hanover Street ramp, and Anzac Avenue). This was carried out to investigate the sensitivity of these elements to the operation and outcomes of the SFDT Two-way scenario.

The potential operational and vehicle efficiency benefits of these revisions to the Harbour Arterial components were clearly identified in this testing. In the PM peak the high delays and congestion along Frederick Street was demonstrated to reduce significantly; from over 17mins in the ‘core’ two-way option to 1-to-2 mins in this sensitivity test. Other route travel times also improved in the sensitivity test.

Differences between the Harbour Arterial and other scenarios are minimal in the AM and IP periods and the overall LOS intersection outcomes are similar.

In the PM peak-hour the Harbour Arterial sensitivity shows consistent reductions in delays compared to the other two-way scenarios. Improvements are most apparent in the key central CBD area, northeast of the Octagon.

In terms of traffic volumes, in the sensitivity scenario flows are higher on Anzac Avenue and St Andrews Street and lower on Ward Street as expected. There does not appear to be any significant volume changes in the other key areas of the network.



The Harbour Arterial sensitivity scenario changes were carried forward into future two-way scenarios and the final reported two-way SFDT option. These Harbour Arterial component changes include:

- Maintaining two-way traffic flow along Anzac Avenue south of Frederick Street
- Retaining the Ward Street ramps to Anzac Avenue
- Not downgrading the section of St Andrews between Wards Street and Anzac Avenue.

4.3.3 Final Stages of Two-Way Scenario Development

The on-going Business Case project and the associated traffic engineering/design work, review of key considerations, and continued discussion of the results from the testing and investigation completed above, led to further development and refinements of the Two-way scenario.

In particular, the on-going Business Case project identified that the corridor in the central section would not be sufficiently wide enough to allow for four traffic lanes (mid-block), a median, and a narrow shoulder that could be used for cycling if a confident cyclist were to use the arterial. There were also concerns that additional capacity north of Albany Street may not be required given that two thirds of the traffic is generated from the south of the city and returns south at the end of the day. Four laning of this northern section would therefore be 'gold plating', and would worsen severance effects for the University, which has its frontage on the proposed two-way arterial.

Exploration of these issues and detailed consideration of the modelling outputs and network constraints led to the development of the 3-lane layout through the central area of the network. In broad terms, the key aspects of this on-going work identified:

- **Southern part of the central city network from Queens Gardens south:** 4-lanes can be readily provided through this area and there is significant traffic demand to/from the south of the city.
- **Central area, from north of Queens Gardens to north of Albany Street**: 3-lanes are possible through the mid-block sections of this area. Traffic flows, volumes, and time-of-day considerations demonstrate that the most appropriate arrangement is 2-lanes southbound and 1-lane northbound.
- **Northern part of the central city network from north of Albany Street:** Desire for 2-lanes in mid-block road sections through this area of the network.

Note, in the December 2020 model outputs provided[1] the modelled scenario differed slightly to the above description. The central 3-lane area started from Stuart Street rather than just north of Queens Garden, 4-lanes were provided between Frederick Street and Albany Street along the 'S-Bends' (rather than 3-lanes), and 4-lanes were provided in the northern area of the network. Reducing to 3-lanes along the S-Bends was the most significant change from the previously reported scenario (P2v2) to the finalised two-way scenario (P2v3).

4.3.4 Two-Way Scenario Discontinued Tests

Several times through this testing process scenario tests were initiated and not continued, i.e. a full set of reported model results was not delivered. This was either because preliminary results from the model indicated no value in progressing (an example of this may have been that a visual check of the model run showed excess congestion), or more often Stakeholder's resources were better allocated in other areas.

The more notable discontinued, or revised, tests that outputs were not provided for include:

- **Two-way Scenario (loosely P2v2) with right turn bans**: The right turn bans were inherited from the preceding Two-way Harbour Arterial sensitivity testing option. Testing for this option was ceased due to the inclusion of right turns operating well in the 3-lane scenario and this being a preferred provision.
- **Two-way Scenario with one-way operation westbound on St Andrews Street and eastbound on Hanover Street, between Castle Street and Cumberland Street**. This option showed an increased traffic flow on key intersections north of the Central Octagon area, around this one-way circuit. This result in an almost a 'roundabout effect', and increased the pressure on intersections in this area, i.e. there were no immediate or obvious traffic flow / delay benefits from this arrangement.
- **Two-way Scenario with 30kph and 1-lane on St Andrews Street**. Although it is understood that this configuration is likely as part of the Hospital Redevelopment, this option was discontinued as it is not

[1] SFDT Microsimulation Modelling, Final Scenario Results Report, 15/12/2020

comparable to the final One-way option scenario previously run and with other summary outputs available and reported on. It is understood that a more detailed and thorough assessment of this area if the network may follow in subsequent projects and assessment phases.

4.4 INTRODUCTION OF HYBRID SCENARIO

Towards the final stages of the SFDT option testing, discussion with Stakeholders raised the possibility of a 'Hybrid' scenario which mixes two-way traffic network layout to the north and south, and one-way traffic network through the central area. This scenario has been modelled and consists of:

- Two-way routes south of Queens Garden (based on the Two-way scenario as above).
- One-way northbound on Cumberland Street and one-way Southbound on Castle Street from Leviathan Hotel to the current state highway one-way S-Bends (based on the One-way scenario as above).
- Removing the northbound s-bend and taking northbound traffic through Emily Siedeberg Place to re-join as a two-way arterial route on the south approach to the Albany Street intersection.
- Two-way routes north of Albany Street (at the point this option was developed, this area of the network was based on the P2v2 Two-Way scenario).

4.5 OTHER TESTING NOT COMPLETED IN MICROSIMULATION MODELS

Other testing and investigations relating to reconfiguration of the City Centre transport network has been carried out by various parties using other tools. For example, cut-and-cover tunnel options around the Stuart Street, St Andrews Street and Hanover Street areas that were tested in the regional CUBE transport planning model.

This report only describes the option testing and model scenarios run in the microsimulation city centre models.



5.0 FINALISED SFDT SCENARIOS AND OPERATION

5.1 OVERVIEW OF FINAL SCENARIOS

The final set of tests have been developed through discussions with the SFDT Business Case team, Stakeholders, and the Stantec modelling team. The final set of models and summary outputs were narrowed down to four core options.

The final four scenarios assessed using the 2038 City Centre microsimulation model. investigated in this final testing, and reported in the sections below, consist of:

- **Do Minimum**: This model is used as a reference to compare SFDT options – includes Barnes Dance and cycle-way signal phasing changes, bus hub changes, and potential George Street scheme.
- **TDM Only:** This is the Do Minimum scenario with the SFDT Travel Demand Management (TDM) strategy applied which reduces light vehicle trip demands in the central city area. The option scenarios below also include the TDM strategy.
- **Final One-Way SFDT Option**: This is the core SFDT one-way scenario used in the economics testing stage. This retains the existing State highway northbound and southbound one-way routes through the city centre, has a 40kph speed limit through central city area, and provides additional Barnes Dance pedestrian phases and pedestrian crossings. It also includes the TDM strategy.
- **Final Two-Way SFDT Option, 4-lane / 3-lane / 2-lane Scenario (P2v3)**. This is based off the Two-Way Harbour Arterial Sensitivity option from previous testing. On the two-way arterial route; 4-lanes are provided south of Queens Gardens, 3-lanes (1-lane northbound and 2-lanes southbound) are provided from north of Queens Gardens to north of Albany Street, and 2-lanes are provided north of Albany Street. The right turns have been re-instated in this final scenario as there is space to provide right turn bays at these intersections and available green-time due to the revised signal phasing (removal of split-phasing). It also includes the TDM strategy.
- **Hybrid Option**: This is a mixture of the above one-way and two-way options. South of Queens Gardens the network is as per the Two-way Scenario, between Queens Gardens and the 'S-Bends' the network is as per the one-way Scenario, and north of the S-Bends a two-way network is provided. It also includes the TDM strategy.

5.2 MODEL SCENARIOS KEY OPERATIONAL OBSERVATIONS

The four core model scenarios have been coded, checked, run and this work has included observing and noting key aspects, constraints, and operational elements of each scenario.

The core model scenarios and their notable findings within the study area relating to vehicle traffic movement and traffic delays are briefly and broadly noted below.

5.2.1 Do Minimum

Key observations relating to the future Do Minimum scenario, relative to the operation of the current network and base model include:

- Increased delays at the George Street/London Street/Frederick Street intersection, this intersection is a notable constraint / pressure point in the network. This is due to the signal phasing required at this intersection as a result of the number of approaches and movements allowed. Delays and this constraint at this intersection are also observed for all other scenarios.
- Intersections located in the central city to the north of the Octagon are strained due to the Barnes Dance pedestrian phases added on both State Highway routes along with the cycle-way signal phasing.
- Eastbound and westbound traffic going in and out of the city centre is affected and delayed by the requirement to cross one of the one-way routes in order to access the other. A particular and notable example is during the PM peak vehicles travelling south must cross the northbound one-way in the



eastbound direction and can be delayed turning right onto the southbound one-way. This is also apparent in the SFDT one-way scenario.
- In general terms, and related to each of the above points, traffic moving through the area of the network to the northeast of the Octagon is constrained and experiences delays particularly in the PM peak.

5.2.2 Final SFDT One-Way Scenario

The SFDT one-way scenario has a similar network layout to the Do Minimum and largely experiences the same issues as those noted above. Two key observations are noted:

- The Harbour Arterial aspect of the SFDT Scenarios increases traffic along Frederick Street, adding to pressure along Frederick Street and at the 5-arm George Street/London Street/Frederick Street intersection.
- The addition of several more Barnes Dance signal phases increases the general pressure delays to vehicle traffic.

5.2.3 Final SFDT Two-Way Scenario

The Two-Way scenario includes several of the aspects and elements described above relating to the Do Minimum and One-way scenarios. In addition, key points include:

- Intersections in the central area of the network along the two-way arterial route are under increased vehicle delay pressure as the overall intersection volume at these locations is increased.
- As per the One-way scenario, increased flow along Frederick Street increases vehicle delays and pressures along this route.
- In the PM peak Frederick Street/Castle Street and Hanover Street/Castle Street are key points in the network.

5.2.4 SFDT Hybrid Scenario

The Hybrid Scenario is a mix of the One-way and Two-way scenarios and some of the issues noted above in both the One-way and Two-way scenarios occur in the Hybrid scenario. Key points include:

- The One-way scenario constraint when it comes to traffic travelling having to cross the one-way carriageways to travel in/out of the city and eastbound/westbound is present in the Hybrid scenario. For example, in the PM peak there is difficulty crossing the northbound one-way and trying to turn right onto Castle Street (southbound one-way) to in order to travel south out of the City.
- The split one-way pairs re-join as a two-way arterial south of Albany Street. The Albany Street/Castle Street and Frederick Street/Castle Street intersections are under increased pressure in the Hybrid scenario. Total flow through the Albany Street/State Highway intersection in the PM period is higher in the Hybrid scenario than the Two-way scenario.



6.0 HIGH LEVEL MODEL RESULTS

6.1 OVERVIEW OF MODEL RESULTS

The tables below provide modelled results for the Do Minimum (Do Min), the Do Minimum with the SFDT TDM strategy applied (TDM Only), the final One-way SFDT scenario, the final Two-way SFDT scenario, and the Hybrid scenario.

The difference between the Do Minimum and the option scenarios is calculated from the Do Minimum without the TDM strategy (Do Min).

6.2 KEY LINK VOLUMES

For key locations in the central city area the tables below provide peak hour traffic volumes and, in the following section, heavy vehicle volumes and percentage splits.

Table 6-1: AM Peak Hour Key Volumes

AM PEAK HOUR VOLUMES		Do Min	TDM Only	Final One-Way		Final Two-Way		Hybrid	
		vph	vph	vph	Diff to DM	vph	Diff to DM	2way Flow	Diff to DM (no TDM)
University	Great King Street (Union to St David)	964	904	858	-106	112	-851	112	-852
	Cumberland Street (Union to St David)	1,355	1,185	1,109	-245	1,171	-184	1,309	-46
	George Street (Union to St David)	716	660	721	6	1,235	519	1,178	462
	Malcolm Street	1,206	1,092	857	-348	369	-837	238	-968
	Gowland Street	1,495	1,317	1,132	-363	1,267	-229	1,028	-468
Health Precinct	Frederick Street (Cumberland to Castle)	1,226	1,154	1,057	-169	1,035	-191	916	-311
	St Andrew Street (Cumberland to Castle)	809	761	640	-169	508	-302	723	-87
	Cumberland Street (Stuart to St Andrew)	1,750	1,668	1,372	-378	439	-1,310	1,284	-466
	Cumberland Street (St Andrew to Hanover)	1,684	1,605	1,277	-407	366	-1,318	1,304	-380
	Castle Street (Stuart to St Andrew)	1,469	1,336	1,152	-317	1,557	88	848	-621
Tourism (Attractions, Queens Gardens, new bridge)	Castle Street (Stuart to Dunbar)	1,425	1,314	1,044	-382	1,663	238	776	-649
	Queens Gardens N (Queens G to Dowling)	2,035	1,957	1,688	-347	354	-1,681	262	-1,773
	Queens Gardens S (Dowling to Queens G)	1,679	1,544	1,234	-446	2,049	370	2,227	547
Warehouse Precinct	Crawford (Liverpool to Water)	1,825	1,821	1,632	-194	533	-1,292	502	-1,324
	Cumberland (Police to Water)	1,242	1,150	1,035	-207	1,856	614	2,024	782
	Jetty (Bond to Princes)	873	827	794	-79	785	-88	793	-80
	Princes (Rattray to Water)	580	552	599	19	744	165	699	120
Harbour Arterial	Anzac Avenue (Hanover to Frederick)	862	768	340	-523	805	-57	770	-92
	Ward Street (Devon to Bauchop)	397	381	979	582	827	431	800	404
	Ward Street Bridge	829	782	985	156	960	131	911	82
	St Andrew Street (roundabout to Anzac)	1,615	1,523	1,238	-377	1,557	-57	1,511	-103
	Thomas Burns Street (Willis to Cresswell)	2,357	2,248	2,016	-341	2,292	-65	2,261	-96
	Wharf Street (Strathallan to Kitchener)	2,926	2,935	2,906	-20	2,953	27	2,889	-38
	Strathallan Street (Otaki to Portsmouth Drive)	583	577	911	328	883	300	837	253

Colour scale key:	-1,000
	1,000

For the One-way scenario, the table above shows the effects of the Harbour Arterial changes in combination with the reduced speed limits on the one-way routes. The Harbour Arterial changes result in more traffic using Strathallan Street, Thomas Burns Street, and Ward Street. The speed reductions on the one-way corridor results in reductions on these routes along with the overall trip volume reductions associated with the TDM strategy.

In the two-way scenario, the above flow differences from the Harbour Arterial changes can also be seen. In addition, the conversion of the northbound one-way (Crawford Street, Queens Garden North, Cumberland Street, Malcolm Street, Great King Street) to a local road reduces the flows on this route significantly and correspondingly flows increase on the two-way arterial route and sections of George Street.



Table 6-2: IP Hour Key Volumes

IP PEAK HOUR VOLUMES		Do Min	TDM Only	Final One-Way		Final Two-Way		Hybrid	
		vph	vph	vph	Diff to DM	vph	Diff to DM	vph	Diff to DM
University	Great King Street (Union to St David)	865	832	739	-126	72	-792	92	-773
	Cumberland Street (Union to St David)	816	802	759	-57	1,016	200	980	164
	George Street (Union to St David)	427	438	504	77	844	418	878	451
	Malcolm Street	975	962	795	-180	255	-720	223	-752
	Gowland Street	958	938	845	-113	1,160	202	744	-214
Health Precinct	Frederick Street (Cumberland to Castle)	913	928	786	-127	843	-70	690	-224
	St Andrew Street (Cumberland to Castle)	624	622	535	-89	522	-102	557	-67
	Cumberland Street (Stuart to St Andrew)	1,137	1,130	961	-176	292	-846	915	-222
	Cumberland Street (St Andrew to Hanover)	1,226	1,227	968	-258	264	-962	951	-275
	Castle Street (Stuart to St Andrew)	1,081	1,068	902	-179	1,205	124	687	-394
Tourism (Attractions, Queens Gardens, new bridge)	Castle Street (Stuart to Dunbar)	1,180	1,167	911	-268	1,277	98	716	-464
	Queens Gardens N (Queens G to Dowling)	1,229	1,229	1,091	-138	238	-990	225	-1,004
	Queens Gardens S (Dowling to Queens G)	1,344	1,341	1,050	-294	1,514	170	1,590	246
Warehouse Precinct	Crawford (Liverpool to Water)	1,178	1,192	1,111	-67	316	-862	339	-839
	Cumberland (Police to Water)	1,064	1,078	891	-173	1,354	290	1,437	373
	Jetty (Bond to Princes)	517	507	555	38	531	14	563	46
	Princes (Rattray to Water)	400	382	422	22	547	147	530	131
Harbour Arterial	Anzac Avenue (Hanover to Frederick)	532	551	151	-381	530	-2	519	-13
	Ward Street (Devon to Bauchop)	176	189	700	524	448	272	449	273
	Ward Street Bridge	377	393	671	294	503	126	492	116
	St Andrew Street (roundabout to Anzac)	1,127	1,141	755	-371	1,231	105	1,186	60
	Thomas Burns Street (Willis to Cresswell)	1,332	1,346	1,221	-111	1,491	159	1,448	117
	Wharf Street (Strathallan to Kitchener)	1,777	1,772	1,824	47	1,869	93	1,847	70
	Strathallan Street (Otaki to Portsmouth Drive)	624	634	648	24	638	14	615	-9

Colour scale key:	-1,000
	1,000

In the inter-peak, the flow change patterns are largely similar to those described above for the AM peak.

Table 6-3: PM Peak Hour Key Volumes

PM PEAK HOUR VOLUMES		Do Min	TDM Only	Final One-Way		Final Two-Way		Hybrid	
		vph	vph	vph	Diff to DM	vph	Diff to DM	vph	Diff to DM
University	Great King Street (Union to St David)	1,520	1,473	1,425	-95	223	-1,297	211	-1,309
	Cumberland Street (Union to St David)	1,229	1,138	1,063	-166	1,392	163	1,383	154
	George Street (Union to St David)	859	754	845	-14	1,377	519	1,424	565
	Malcolm Street	1,551	1,474	1,247	-304	596	-955	405	-1,145
	Gowland Street	1,708	1,553	1,258	-449	1,500	-208	947	-761
Health Precinct	Frederick Street (Cumberland to Castle)	1,233	1,175	1,102	-131	1,111	-121	1,010	-222
	St Andrew Street (Cumberland to Castle)	976	936	849	-127	883	-93	810	-165
	Cumberland Street (Stuart to St Andrew)	1,538	1,502	1,368	-170	597	-941	1,266	-272
	Cumberland Street (St Andrew to Hanover)	1,670	1,630	1,472	-199	645	-1,025	1,391	-279
	Castle Street (Stuart to St Andrew)	1,983	1,930	1,628	-354	1,640	-342	1,190	-793
Tourism (Attractions, Queens Gardens, new bridge)	Castle Street (Stuart to Dunbar)	2,150	2,157	1,781	-369	1,915	-235	1,358	-792
	Queens Gardens N (Queens G to Dowling)	1,659	1,608	1,469	-190	520	-1,139	371	-1,288
	Queens Gardens S (Dowling to Queens G)	2,499	2,529	2,134	-365	2,364	-134	2,592	93
Warehouse Precinct	Crawford (Liverpool to Water)	1,581	1,559	1,462	-119	630	-951	599	-983
	Cumberland (Police to Water)	1,825	1,988	1,752	-73	2,114	289	2,261	437
	Jetty (Bond to Princes)	776	792	835	59	826	50	831	56
	Princes (Rattray to Water)	821	817	885	64	1,071	250	1,046	225
Harbour Arterial	Anzac Avenue (Hanover to Frederick)	940	826	280	-661	979	39	945	5
	Ward Street (Devon to Bauchop)	469	353	1,026	557	829	360	810	341
	Ward Street Bridge	946	805	1,138	193	1,175	229	1,129	183
	St Andrew Street (roundabout to Anzac)	1,335	1,546	1,278	-57	1,646	311	1,579	244
	Thomas Burns Street (Willis to Cresswell)	2,006	2,104	2,193	187	2,455	449	2,427	421
	Wharf Street (Strathallan to Kitchener)	3,162	3,216	3,096	-66	3,064	-98	3,081	-81
	Strathallan Street (Otaki to Portsmouth Drive)	754	782	667	-88	749	-5	700	-54

Colour scale key:	-1,000
	1,000

Again, as with the AM and IP periods, the flow change patterns are similar. In the PM peak the flow increase on the two-way arterial are not as evident as in the AM and IP periods (e.g. Castle Street, Stuart to St Andrew). This is likely to be because this route is at capacity during the PM peak and traffic is re-assigning off the two-way arterial and onto other routes.

It is worth noting that the PM peak hour flows in key areas of the network (e.g. in the areas around the Octagon) are markedly higher than in other time periods. The two-way arterial route carries around 2,000vph and greater in the PM peak in these areas, and generally less than 2,000vph in the AM peak in these areas.

6.3 PEAK HOUR HEAVY VEHICLE VOLUMES AND PERCENTAGES

Heavy vehicle volumes and percentage splits are provided for the core one-way and two-way scenarios in the tables below.

Table 6-4: AM Peak Hour Key Heavy Volumes and Percentages

AM PEAK HOUR HEAVY VEHICLE VOLUMES AND PERCENTAGE SPLIT		Do Min		TDM Only		Final One-Way			Final Two-Way			Hybrid		
		vph	% heavy of all vehicles	vph	% heavy of all vehicles	vph	% heavy of all vehicles	Diff to DM	vph	% heavy of all vehicles	Diff to DM	vph	% heavy of all vehicles	Diff to DM
University	Great King Street (Union to St David)	48	5%	50	6%	47	5%	-1	3	3%	-45	4	4%	-44
	Cumberland Street (Union to St David)	45	3%	40	3%	39	3%	-6	67	6%	22	71	5%	26
	George Street (Union to St David)	37	5%	36	6%	40	6%	3	55	4%	18	56	5%	18
	Malcolm Street	49	4%	50	5%	43	5%	-6	8	2%	-41	8	3%	-41
	Gowland Street	54	4%	48	4%	45	4%	-10	70	6%	16	43	4%	-11
Health Precinct	Frederick Street (Cumberland to Castle)	51	4%	54	5%	53	5%	2	47	5%	-4	48	5%	-3
	St Andrew Street (Cumberland to Castle)	56	7%	57	8%	40	6%	-16	24	5%	-32	39	5%	-17
	Cumberland Street (Stuart to St Andrew)	85	5%	84	5%	76	6%	-9	10	2%	-75	67	5%	-17
	Cumberland Street (St Andrew to Hanover)	78	5%	76	5%	66	5%	-12	15	4%	-63	68	5%	-10
	Castle Street (Stuart to St Andrew)	78	5%	79	6%	76	7%	-1	105	7%	27	57	7%	-21
Tourism (Attractions, Queens Gardens, new bridge)	Castle Street (Stuart to Dunbar)	97	7%	95	7%	76	7%	-21	119	7%	23	66	9%	-31
	Queens Gardens N (Queens G to Dowling)	86	4%	90	5%	82	5%	-5	12	4%	-74	11	4%	-75
	Queens Gardens S (Dowling to Queens G)	105	6%	101	7%	82	7%	-23	127	6%	22	132	6%	27
Warehouse Precinct	Crawford (Liverpool to Water)	67	4%	72	4%	70	4%	3	14	3%	-53	13	3%	-54
	Cumberland (Police to Water)	86	7%	83	7%	67	6%	-20	99	5%	13	107	5%	21
	Jetty (Bond to Princes)	26	3%	24	3%	31	4%	4	27	3%	0	27	3%	1
	Princes (Rattray to Water)	70	12%	67	12%	70	12%	-1	79	11%	9	79	11%	9
Harbour Arterial	Anzac Avenue (Hanover to Frederick)	53	6%	55	7%	21	6%	-32	50	6%	-3	50	7%	-3
	Ward Street (Devon to Bauchop)	32	8%	34	9%	83	8%	51	61	7%	29	64	8%	32
	Ward Street Bridge	71	9%	67	9%	83	8%	12	67	7%	-4	67	7%	-3
	St Andrew Street (roundabout to Anzac)	94	6%	95	6%	48	4%	-46	75	5%	-19	70	5%	-25
	Thomas Burns Street (Willis to Cresswell)	104	4%	105	5%	119	6%	14	128	6%	24	130	6%	26
	Wharf Street (Strathallan to Kitchener)	119	4%	122	4%	142	5%	23	138	5%	20	140	5%	21
	Strathallan Street (Otaki to Portsmouth Drive)	57	10%	60	10%	74	8%	17	72	8%	15	70	8%	13
Colour scale key:	-50													
	50													

Table 6-5: IP Peak Hour Key Heavy Volumes and Percentages

IP PEAK HOUR HEAVY VEHICLE VOLUMES AND PERCENTAGE SPLIT		Do Min		TDM Only		Final One-Way			Final Two-Way			Hybrid		
		vph	% heavy of all vehicles	vph	% heavy of all vehicles	vph	% heavy of all vehicles	Diff to DM	vph	% heavy of all vehicles	Diff to DM	vph	% heavy of all vehicles	Diff to DM
University	Great King Street (Union to St David)	39	5%	37	4%	37	5%	-3	2	3%	-37	3	3%	-36
	Cumberland Street (Union to St David)	46	6%	42	5%	43	6%	-3	66	6%	20	64	6%	18
	George Street (Union to St David)	27	6%	27	6%	29	6%	2	40	5%	13	40	5%	12
	Malcolm Street	44	5%	41	4%	38	5%	-6	5	2%	-39	5	2%	-39
	Gowland Street	51	5%	49	5%	45	5%	-6	74	6%	23	42	6%	-9
Health Precinct	Frederick Street (Cumberland to Castle)	47	5%	49	5%	50	6%	4	45	5%	-2	45	7%	-2
	St Andrew Street (Cumberland to Castle)	57	9%	56	9%	43	8%	-14	24	5%	-33	48	9%	-9
	Cumberland Street (Stuart to St Andrew)	72	6%	73	6%	67	7%	-5	6	2%	-67	57	6%	-15
	Cumberland Street (St Andrew to Hanover)	64	5%	63	5%	54	6%	-10	8	3%	-56	57	6%	-8
	Castle Street (Stuart to St Andrew)	72	7%	71	7%	68	7%	-4	98	8%	27	50	7%	-22
Tourism (Attractions, Queens Gardens, new bridge)	Castle Street (Stuart to Dunbar)	89	8%	89	8%	67	7%	-22	110	9%	21	59	8%	-30
	Queens Gardens N (Queens G to Dowling)	84	7%	81	7%	76	7%	-7	10	4%	-74	10	4%	-74
	Queens Gardens S (Dowling to Queens G)	91	7%	94	7%	70	7%	-21	115	8%	24	112	7%	21
Warehouse Precinct	Crawford (Liverpool to Water)	79	7%	76	6%	73	7%	-6	12	4%	-66	13	4%	-66
	Cumberland (Police to Water)	78	7%	80	7%	58	6%	-21	94	7%	15	97	7%	18
	Jetty (Bond to Princes)	28	5%	30	6%	30	5%	1	31	6%	2	32	6%	3
	Princes (Rattray to Water)	52	13%	52	14%	55	13%	3	64	12%	12	65	12%	13
Harbour Arterial	Anzac Avenue (Hanover to Frederick)	56	10%	58	10%	13	9%	-42	51	10%	-5	55	11%	-1
	Ward Street (Devon to Bauchop)	33	18%	34	18%	91	13%	58	61	14%	28	64	14%	31
	Ward Street Bridge	64	17%	63	16%	79	12%	15	54	11%	-10	55	11%	-9
	St Andrew Street (roundabout to Anzac)	107	9%	106	9%	47	6%	-60	92	7%	-15	92	8%	-15
	Thomas Burns Street (Willis to Cresswell)	109	8%	111	8%	121	10%	12	139	9%	30	138	10%	29
	Wharf Street (Strathallan to Kitchener)	146	8%	145	8%	159	9%	13	168	9%	22	176	10%	30
	Strathallan Street (Otaki to Portsmouth Drive)	85	14%	85	13%	94	15%	9	93	15%	9	99	16%	14

Colour scale key:	-50
	50

Table 6-6: PM Peak Hour Key Heavy Volumes and Percentages

PM PEAK HOUR HEAVY VEHICLE VOLUMES AND PERCENTAGE SPLIT		Do Min		TDM Only		Final One-Way			Final Two-Way			Hybrid		
		vph	% heavy of all vehicles	vph	% heavy of all vehicles	vph	% heavy of all vehicles	Diff to DM	vph	% heavy of all vehicles	Diff to DM	vph	% heavy of all vehicles	Diff to DM
University	Great King Street (Union to St David)	32	2%	32	2%	32	2%	0	4	2%	-28	3	2%	-29
	Cumberland Street (Union to St David)	30	2%	33	3%	28	3%	-3	42	3%	11	37	3%	6
	George Street (Union to St David)	42	5%	43	6%	48	6%	6	59	4%	17	64	5%	22
	Malcolm Street	31	2%	33	2%	31	3%	1	9	2%	-22	4	1%	-26
	Gowland Street	58	3%	58	4%	43	3%	-15	58	4%	0	30	3%	-28
Health Precinct	Frederick Street (Cumberland to Castle)	65	5%	67	6%	74	7%	9	68	6%	4	76	8%	11
	St Andrew Street (Cumberland to Castle)	68	7%	65	7%	49	6%	-19	51	6%	-17	52	6%	-16
	Cumberland Street (Stuart to St Andrew)	56	4%	54	4%	45	3%	-11	10	2%	-47	35	3%	-21
	Cumberland Street (St Andrew to Hanover)	45	3%	48	3%	47	3%	2	16	2%	-29	39	3%	-6
	Castle Street (Stuart to St Andrew)	80	4%	77	4%	74	5%	-6	93	6%	13	59	5%	-22
Tourism (Attractions, Queens Gardens, new bridge)	Castle Street (Stuart to Dunbar)	86	4%	84	4%	77	4%	-9	96	5%	10	63	5%	-23
	Queens Gardens N (Queens G to Dowling)	58	3%	56	3%	46	3%	-12	11	2%	-47	8	2%	-50
	Queens Gardens S (Dowling to Queens G)	98	4%	93	4%	86	4%	-11	104	4%	6	100	4%	2
Warehouse Precinct	Crawford (Liverpool to Water)	53	3%	51	3%	44	3%	-9	16	3%	-37	13	2%	-40
	Cumberland (Police to Water)	96	5%	92	5%	86	5%	-10	98	5%	2	95	4%	-1
	Jetty (Bond to Princes)	17	2%	20	3%	22	3%	5	20	2%	4	23	3%	6
	Princes (Rattray to Water)	65	8%	66	8%	67	8%	3	75	7%	10	73	7%	8
Harbour Arterial	Anzac Avenue (Hanover to Frederick)	36	4%	35	4%	26	9%	-11	39	4%	2	35	4%	-1
	Ward Street (Devon to Bauchop)	10	2%	10	3%	30	3%	20	18	2%	8	23	3%	13
	Ward Street Bridge	37	4%	35	4%	41	4%	4	39	3%	2	36	3%	-1
	St Andrew Street (roundabout to Anzac)	49	4%	52	3%	27	2%	-22	54	3%	5	52	3%	3
	Thomas Burns Street (Willis to Cresswell)	38	2%	41	2%	44	2%	6	55	2%	16	59	2%	21
	Wharf Street (Strathallan to Kitchener)	49	2%	48	1%	45	1%	-4	58	2%	9	60	2%	11
	Strathallan Street (Otaki to Portsmouth Drive)	10	1%	12	2%	12	2%	2	20	3%	9	21	3%	11

Colour scale key:	-50
	50

The heavy vehicle volume changes in the SFDT scenarios demonstrate similar traffic volume changes to the total traffic flows; increased volumes on the Harbour Arterial promoted routes and generally decreased volumes along

the State Highway corridor. The two-way scenario SH arterial route carries higher volumes of heavy traffic compared to the single direction one-way Do Minimum scenario.

6.4 NETWORK WIDE OUTCOMES

The tables below provide the average network-wide travel times and distances between origin and destination (OD) zones in the city centre network.

Table 6-7: AM Period Network-Wide Travel Time and Distance Compared to Do Minimum

AM Network-Wide Statistics	Do Min	TDM Only			Final One-Way			Final Two-Way			Hybrid		
		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min	
Average network travel time (min)	5.14	4.97	-0.2	-3.3%	5.18	0.0	0.8%	5.32	0.2	3.5%	5.34	0.2	4.0%
Average network trip distance (km)	2.49	2.48	0.0	-0.4%	2.49	0.0	-0.2%	2.47	0.0	-0.9%	2.47	0.0	-0.8%

In the morning peak period the Two-Way and Hybrid options have marginally higher overall network travel times than the One-way and Do Minimum scenarios.

Table 6-8: IP Period Network-Wide Travel Time and Distance Compared to Do Minimum

IP Network-Wide Statistics	Do Min	TDM Only			Final One-Way			Final Two-Way			Hybrid		
		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min	
Average network travel time (min)	4.38	4.32	-0.1	-1.4%	4.56	0.2	4.0%	4.52	0.1	3.1%	4.64	0.3	5.8%
Average network trip distance (km)	2.24	2.23	0.0	-0.8%	2.25	0.0	0.2%	2.23	0.0	-0.5%	2.24	0.0	-0.4%

In the inter-peak, the Hybrid option has the highest overall network travel times, the One-way the second highest, and travel times in the Two-way scenario are only around 3% higher than the Do Minimum.

Table 6-9: PM Period Network-Wide Travel Time and Distance Compared to Do Minimum

PM Network-Wide Statistics	Do Min	TDM Only			Final One-Way			Final Two-Way			Hybrid		
		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min		Result	Diff to Do Min	
Average network travel time (min)	5.48	5.07	-0.4	-7.5%	5.42	-0.1	-1.1%	6.27	0.8	14.4%	6.24	0.8	13.8%
Average network trip distance (km)	2.34	2.32	0.0	-0.9%	2.33	0.0	-0.1%	2.33	0.0	-0.3%	2.33	0.0	-0.4%

In the evening peak the Hybrid and Two-way scenarios show increases in travel times. Average travel times are around 1-to-2 minutes higher than the Do Minimum and One-way scenario. Some trips in the network will experience a larger increase in travel time than the average[2] and people would require a period of time to adjust to these higher travel times if the Two-way or Hybrid network layout was implemented in this form.

[2] E.g. in the Hybrid scenario in the PM period the percentage of trips with travel times greater than 10mins is around 30% compared to around 22% in the One-way scenario.

7.0 OPERATIONAL MODEL RESULTS

7.1 OVERVIEW OF MODELLING OUTPUTS

The sections below provide Route Travel Times and Intersection Delay/Level-of-Service (LOS) outcomes.

Intersection delays can be challenging to measure in the central city area of the network where the intersections are relatively close together. The delays/LOS only measure from the upstream intersection through the downstream intersection stopline, this may not fully capture delays and queueing associated with a specific intersection.

The route travel times provide a fuller picture of the performance and network operation of vehicles travelling through a number of intersections.

7.2 SIGNIFICANT INTERSECTION DELAY CHANGES

The tables below highlight the significant performance/operational changes identified in the intersection Delay and LOS results (summarised in Appendix C) and provides some short commentary on any identifiable notable changes to specific movements at these intersections. The central section of the table identifies which SFDT option scenarios the change from the Do Minimum is present in.

Table 7-1: AM Peak Hour Significant Delay Changes and Notable Movements

Intersection	IP Pk Hr Change	Scenario With Change?			Description
		One-Way	Two-Way	Hybrid	
SH88 / Frederick Street	Delays reduced by 50-to-55 seconds	No	Yes	Yes	Due to the reconfiguration of this intersection and changes in flows through the area, particularly associated with the Harbour Arterial.
George Street / Park Street / Regent Road	Delays increase by 25-30 seconds	No	Yes	Yes	Priority intersection using the 'worst-movement' LOS method to determine the overall intersection LOS. Delays increase due to increasing opposing flows on George Street. Through movement from Regent Street northwest approach has highest delay, although small movement and delays on other higher volume movements remain low.
Cumberland Street / Stuart Street	Delays increase by 20 to 30 seconds	Yes	Yes	Yes	Reduced speed limits and alterations to progression increase northbound delays on the State Highway corridor which are low in the existing Do Minimum arrangement.
Castle Street / Stuart Street	Delays increase by 10-to-20 seconds	Yes	Yes	Yes	Low delays in the Do Minimum due to existing 50kph speeds and one-way progression, Two-Way changes Castle Street to a local road and the Hybrid scenario includes a slower speed limit and reduced effectiveness of signal progression.
Queens Gardens / Cumberland Street	Delays increase by 10-to-20 seconds	Yes	Yes	Yes	Low delays in the Do Minimum, reduced speed limits, additional phases, and reduced effectiveness of signal progression.
Wharf Street / Strathallan Street / Portsmouth Drive	Delays increase by 20 seconds	Yes	Yes	Yes	Harbour Arterial; increased flow on west approach causes signal timings to be re-balanced to accommodate this flow, increases delay for northbound movements along Portsmouth Drive.
Orari Street / Portsmouth Drive	Delays increase by 10-to-20 seconds	Yes	Yes	Yes	As above, increased delay for northbound movements along Portsmouth Drive.

Table 7-2: IP Hour Significant Delay Changes and Notable Movements

Intersection	IP Pk Hr Change	Scenario With Change?			Description
		One-Way	Two-Way	Hybrid	
SH88 / Frederick Street	Delays reduced by 30-to-50 seconds	Yes	Yes	Yes	Due to the reconfiguration of this intersection and changes in flows through the area, particularly associated with the Harbour Arterial.
Union Street / Cumberland Street	Delays increase by 30-seconds	No	Yes	Yes	Due to additional movements and associated signal phases.
Queens Gardens / Cumberland Street	Delays increase by 10-to-20 seconds	Yes	Yes	Yes	Low delays in the Do Minimum, reduced speed limits, additional phases, and reduced effectiveness of signal progression.

Table 7-3: PM Peak Hour Significant Delay Changes and Notable Movements

Intersection	PM Pk Hr Change	Scenario With Change?			Description
		One-Way	Two-Way	Hybrid	
SH88 / Frederick Street	Delays reduced by 70-to-75 seconds	No	Yes	Yes	Due to the reconfiguration of this intersection and changes in flows through the area, particularly associated with the Harbour Arterial.
George Street / Park Street / Regent Road	Delays increase by approx. 100-seconds	No	Yes	Yes	Priority intersection using the 'worst-movement' LOS method to determine the overall intersection LOS. Delays increase due to increasing opposing flows on George Street. Through movement from Regent Street northwest approach has highest delay, although small movement and delays on other higher volume movements remain low.
Cumberland Street / St David Street	Delays increase by 30-seconds	No	No	Yes	Due to additional movements and associated signal phases.
Union Street / Cumberland Street	Delays increase by 20-to-30 seconds	No	Yes	Yes	Due to additional movements and associated signal phases.
Frederick Street / Castle Street	Compared to the Do Minimum with TDM, up to 30-second higher	No	Yes	Yes	Delays along Frederick Street eastbound, due to the increased flows on Frederick Street and the additional movements and associated signal phases at intersections around this area.
Thomas Burns St / Ward St / St Andrews Street / Mason St	Delays increase by 40-to-50 seconds	No	Yes	Yes	Due to a significant increase in flows through the roundabout because of the changes associated with the Harbour Arterial aspect of the SFDT options. Delays increase significantly for traffic exiting Mason Street (southeast approach) due to increases in the opposing movements from the north and northwest.
Queens Garden / Dowling Street / Burlington Street	Delays increase by 25-seconds	No	Yes	No	Due to large increase in overall flows through intersection and accommodating signal phasing and timings.

7.3 ROUTE TRAVEL TIMES

7.3.1 SFDT Route Travel Times

The tables below provide the key route travel times through the network as per previous SFDT reporting.



In the section following, route travel times for a shorter core section of the network are provided as requested by Dunedin City Council (DCC).

Table 7-4: AM Peak Hour, Key Route Travel Times

Route	Do Min	TDM Only		Final One-Way		Final Two-Way		Hybrid	
		TT	Diff to DM	TT	Diff to DM	TT	Diff to DM	TT	Diff to DM
SH1 NBD	8.75	8.37	-0.4	9.94	1.2	10.03	1.3	11.30	2.5
SH1 SBD	7.62	7.38	-0.2	8.26	0.6	9.49	1.9	8.69	1.1
Harbour Arterial Nbd	6.56	6.29	-0.3	5.26	-1.3	4.16	-2.4	4.07	-2.5
Harbour Arterial Sbd	4.26	4.22	0.0	4.31	0.1	4.23	0.0	4.26	0.0
Princes - George NBD	6.64	6.40	-0.2	6.73	0.1	6.89	0.2	6.68	0.0
Princes - George SBD	7.93	7.76	-0.2	8.05	0.1	8.61	0.7	8.74	0.8
Frederick Route Ebd	7.07	6.60	-0.5	5.88	-1.2	6.85	-0.2	6.49	-0.6
Frederick Route WBD	7.68	6.99	-0.7	8.33	0.7	6.93	-0.7	9.40	1.7
St Andrew Route Ebd	6.20	5.93	-0.3	5.51	-0.7	6.09	-0.1	6.04	-0.2
St Andrew Route Wbd	6.53	6.20	-0.3	6.27	-0.3	6.08	-0.5	6.33	-0.2
Western Relief Route Ebd	4.97	4.80	-0.2	4.90	-0.1	5.30	0.3	5.26	0.3
Western Relief Route Wbd	4.79	4.48	-0.3	4.82	0.0	5.06	0.3	4.98	0.2

Colour change key:	-2.0
	5.0

In the morning peak all the scenarios show a similarly low level of travel time increase along SH1 northbound and southbound (1-to-2 minutes). All options also show improved travel times along the Harbour of 1-to-3 minutes. The Hybrid scenario shows an increase of 2-minutes along Frederick Street westbound.

Table 7-5: IP Hour, Key Route Travel Times

Route	Do Min	TDM Only		Final One-Way		Final Two-Way		Hybrid	
		TT	Diff to DM	TT	Diff to DM	TT	Diff to DM	TT	Diff to DM
SH1 NBD	7.84	7.79	0.0	9.31	1.5	8.95	1.1	11.86	4.0
SH1 SBD	7.30	7.26	0.0	8.26	1.0	8.98	1.7	7.88	0.6
Harbour Arterial Nbd	4.10	4.15	0.0	3.66	-0.4	3.58	-0.5	3.58	-0.5
Harbour Arterial Sbd	3.90	3.90	0.0	3.95	0.0	3.84	-0.1	3.82	-0.1
Princes - George NBD	6.22	6.19	0.0	6.39	0.2	6.56	0.3	6.49	0.3
Princes - George SBD	7.16	6.96	-0.2	7.38	0.2	7.58	0.4	7.66	0.5
Frederick Route Ebd	5.22	5.07	-0.2	5.35	0.1	5.07	-0.2	6.34	1.1
Frederick Route WBD	6.34	6.29	0.0	7.52	1.2	5.14	-1.2	6.37	0.0
St Andrew Route Ebd	5.13	5.07	-0.1	5.09	0.0	5.17	0.0	5.52	0.4
St Andrew Route Wbd	5.90	6.08	0.2	5.75	-0.2	5.39	-0.5	6.24	0.3
Western Relief Route Ebd	3.97	3.95	0.0	4.19	0.2	4.19	0.2	4.07	0.1
Western Relief Route Wbd	4.23	4.16	-0.1	4.51	0.3	4.55	0.3	4.82	0.6

Colour change key:	-2.0
	5.0

In the inter-peak the Hybrid scenario shows an increase in travel time along SH1 northbound of around 4 minutes. If this scenario were to be progressed, this outcome should be investigated further.

Table 7-6: PM Peak Hour, Key Route Travel Times

Route	Do Min	TDM Only		Final One-Way		Final Two-Way		Hybrid	
		TT	Diff to DM	TT	Diff to DM	TT	Diff to DM	TT	Diff to DM (no TDM)
SH1 NBD	9.40	9.01	-0.4	10.22	0.8	11.85	2.5	10.94	1.5
SH1 SBD	7.92	7.57	-0.4	8.63	0.7	11.86	3.9	11.79	3.9
Harbour Arterial Nbd	5.17	4.59	-0.6	5.38	0.2	4.74	-0.4	4.58	-0.6
Harbour Arterial Sbd	4.86	4.26	-0.6	4.45	-0.4	5.02	0.2	5.12	0.3
Princes - George NBD	6.78	6.64	-0.1	6.90	0.1	7.76	1.0	7.61	0.8
Princes - George SBD	7.80	7.42	-0.4	7.90	0.1	9.11	1.3	9.29	1.5
Frederick Route Ebd	10.27	8.14	-2.1	6.07	-4.2	7.32	-2.9	6.73	-3.5
Frederick Route WBD	9.15	7.91	-1.2	9.96	0.8	7.70	-1.4	8.66	-0.5
St Andrew Route Ebd	7.88	7.54	-0.3	7.13	-0.8	8.79	0.9	10.29	2.4
St Andrew Route Wbd	12.46	9.42	-3.0	8.18	-4.3	8.00	-4.5	9.78	-2.7
Western Relief Route Ebd	5.11	4.78	-0.3	5.07	0.0	6.01	0.9	6.12	1.0
Western Relief Route Wbd	7.95	7.34	-0.6	7.13	-0.8	7.57	-0.4	7.85	-0.1

Colour change key:	-2.0
	5.0

In the PM peak the Two-way and Hybrid scenarios show similar 2-to-4 minute increases on SH1 northbound and southbound. All scenarios show an improvement on Frederick Street eastbound. The Hybrid scenario shows an increase of 2-to-3 minutes along St Andrews Street eastbound.

7.3.2 DCC Shorter Key Route Travel Time Sections

As requested by DCC, the tables below provide shorter section key route travel times and a range of modelled differences between the Baseline Travel time and the SFDT scenarios.

Table 7-7: AM Peak Hour, Shorter Route Section Travel Times

Route	Baseline Travel Time		Travel Time One-Way Option	Change in Travel Time		Travel Time Two-Way Option	Change in Travel Time		Travel Time Hybrid Option	Change in Travel Time	
	MinTT	MaxTT	AvgTT	Between		AvgTT	Between		AvgTT	Between	
SH1 South to CBD NBD	4min	6min	6min	0min	3min	5min	1min	3min	4min	1min	2min
SH1 North to CBD SBD	3min	5min	4min	0min	2min	6min	0min	5min	4min	0min	4min
Frederick EBD	3min	5min	2min	1min	2min	3min	0min	3min	3min	0min	2min
Frederick WBD	3min	6min	5min	0min	4min	4min	1min	3min	7min	0min	5min
St Andrews EBD	4min	7min	4min	1min	2min	4min	0min	2min	4min	0min	3min
St Andrews WBD	3min	6min	4min	1min	2min	3min	1min	1min	4min	1min	2min

Table 7-8: PM Peak Hour, Shorter Route Section Travel Times

Route	Baseline Travel Time		Travel Time One-Way Option	Change in Travel Time		Travel Time Two-Way Option	Change in Travel Time		Travel Time Hybrid Option	Change in Travel Time	
	MinTT	MaxTT	AvgTT	Between		AvgTT	Between		AvgTT	Between	
SH1 South to CBD NBD	4min	5min	5min	0min	1min	7min	0min	4min	7min	0min	4min
SH1 North to CBD SBD	3min	7min	4min	0min	4min	5min	0min	8min	5min	0min	7min
Frederick EBD	2min	6min	2min	1min	2min	3min	0min	3min	2min	0min	3min
Frederick WBD	3min	8min	6min	0min	5min	4min	1min	5min	5min	0min	5min
St Andrews EBD	4min	7min	4min	1min	2min	6min	0min	4min	7min	0min	6min
St Andrews WBD	4min	10min	5min	2min	3min	4min	0min	0min	6min	2min	3min

The above tables show that travel times in the PM peak are much longer than in the AM, particularly for the Two-way and Hybrid scenarios. The northbound route along State Highway 1 (south to CBD) experiences the largest change in travel time for both these scenarios, with a maximum of between 7-8 minutes.



7.4 INTERSECTION LEVEL OF SERVICE (LOS)

The tables below provide a summary count of the number of intersections in the network at each Level of Service (LOS) level. See Section 7.2 above for commentary on more significant intersection/movement delay changes.

Appendix C provides intersection delays and LOS outcomes for each key intersection in the city centre study area.

Appendix D provides LOS heatmaps.

Table 7-9: AM Peak Hour, Summary of LOS Intersection Changes

Count of Intersections at LOS Level	Do Min	Only TDM	Final One-Way		Final Two-Way		Hybrid	
			Number	Diff to Do Min	Number	Diff to Do Min	Number	Diff to Do Min
LOS D or Higher	13	11	11	-2	13	0	18	5
LOS A	8	8	6	-2	7	-1	7	-1
LOS B	20	22	23	3	13	-7	14	-6
LOS C	27	27	27	0	35	8	29	2
LOS D	9	8	8	-1	11	2	16	7
LOS E	2	1	1	-1	1	-1	1	-1
LOS F	2	2	2	0	1	-1	1	-1

The One-way and Two-way scenarios shows similar intersection delay outcomes to the Do Minimum. The Hybrid scenario shows a minor level of increase in intersection delay across the network, although it should be noted that this appears to be intersections moving from LOS C to D, one threshold change.

Table 7-10: IP Hour, Summary of LOS Intersection Changes

Count of Intersections at LOS Level	Do Min	Only TDM	Final One-Way		Final Two-Way		Hybrid	
			Number	Diff to Do Min	Number	Diff to Do Min	Number	Diff to Do Min
LOS D or Higher	4	5	5	1	5	1	9	5
LOS A	13	12	11	-2	9	-4	9	-4
LOS B	28	30	24	-4	29	1	26	-2
LOS C	23	21	27	4	25	2	24	1
LOS D	2	3	4	2	4	2	8	6
LOS E	1	1	1	0	1	0	1	0
LOS F	1	1	0	-1	0	-1	0	-1

Similar to the AM period, the Hybrid scenario shows some intersections moving from LOS C to LOS D.

Table 7-11: PM Peak Hour, Summary of LOS Intersection Changes

Count of Intersections at LOS Level	Do Min	Only TDM	Final One-Way		Final Two-Way		Hybrid	
			Number	Diff to Do Min	Number	Diff to Do Min	Number	Diff to Do Min
LOS D or Higher	20	16	18	-2	28	8	26	6
LOS A	5	5	5	0	3	-2	4	-1
LOS B	11	20	14	3	11	0	9	-2
LOS C	32	27	30	-2	26	-6	29	-3
LOS D	11	11	13	2	19	8	17	6
LOS E	6	2	3	-3	7	1	7	1
LOS F	3	3	2	-1	2	-1	2	-1

In the PM peak period both the Two-way and Hybrid scenarios show a number of intersections from LOS B/C to LOS D. The number of intersections at LOS E and F, experiencing higher delays, is similar across all scenarios.

8.0 SUMMARY AND CONCLUSIONS

8.1 SHAPING FUTURE DUNEDIN TRANSPORT BUSINESS CASE

The SFDT Business Case is investigating potential traffic network and transport environment changes across central Dunedin. This includes considering options which reconfigure the roading layout, one-way routes, intersections layouts and operations, and traffic network connections.

8.2 TRANSPORT MODELLING

The City Centre microsimulation model has been applied to investigate the traffic operation and key outcomes from alternative SFDT scenarios and options. This model is well designed for the purpose of providing measures of the potential impacts and changes associated with these scenarios. The model has been used to estimate:

- Traffic volume and heavy vehicle volume changes in the key regions of the network
- Network wide travel times and distances in the central city study area
- Route travel times for sections of key routes through the network
- Intersection movement delays and overall intersection delay/Level of Service.

8.3 SFDT OPTION TESTING AND FINALISED REPORTING

The two core SFDT scenarios include retaining the current State Highway 1 (SH1) one-way routes through the city centre (the 'One-way scenario') or converting these existing one-way routes to two-way roads (the 'Two-way scenario'). In addition, a Hybrid scenario has been analysed which mixes one-way and two-way roads.

Several phases of assessment and analysis work have been carried out investigating refinements and alternative options to these scenarios.

Option testing of the One-way scenario was straightforward and limited benefits were identified from alternatives.

The original Two-way scenario provided a single through lane on the two-way arterial route (currently southbound one-way carriageway) and this demonstrated higher levels of delay and congestion. A number of layout operation and refinement tests were carried out to develop alternative Two-way scenario options.

The results and key outcomes from this option testing work were documented in several reports through 2020.

This report summarises the modelling work associated with the option testing and scenario refinements. It provides finalised results for the SFDT scenarios as outlined below.

8.4 FINALISED SFDT SCENARIOS

The finalised scenarios developed through the Business Case process and option testing phases are outlined below.

- **Do Minimum**: This model is used as a reference to compare SFDT options. It includes Barnes Dance and cycle-way signal phasing changes, bus hub changes, and a potential George Street scheme.
- **TDM Only:** This is the Do Minimum scenario with the SFDT TDM strategy applied.
- **Final One-Way SFDT Option**: This retains the existing State highway northbound and southbound one-way routes through the city centre, has a 40kph speed limit through central city area, and provides additional Barnes Dance pedestrian phases and pedestrian crossings.
- **Final Two-Way SFDT Option, 4-lane / 3-lane / 2-lane Scenario (P2v3)**. This is based off the Two-Way Harbour Arterial Sensitivity option from previous testing. On the two-way arterial route, 4-lanes are provided south of Queens Gardens, 3-lanes (1-lane northbound and 2-lanes southbound) are provided from north of Queens Gardens to north of Albany Street, and 2-lanes are provided north of Albany Street.

- **Hybrid Option**: This is a mixture of the above one-way and two-way options. South of Queens Gardens the network is as per the Two-way Scenario, between Queens Gardens and the 'S-Bends' the network is as per the one-way Scenario, and north of the S-Bends a two-way network is provided.

A comprehensive set of model outputs for these scenarios is provided in this report.

8.5 KEY OUTCOMES

In the weekday morning peak there are only minimal differences between the scenarios. The Two-way and Hybrid scenarios show a 3-4% increase in network-wide travel times compared to the Do Minimum and 1-to-2-minute increases on key routes.

In the weekday inter-peak period all scenarios show a 3-6% increase in network travel time and the Two-way scenario shows lower travel times than the One-way and Hybrid scenarios. The Hybrid scenario shows a 4-minute increase on SH1 northbound which should be investigated further if this scenario is progressed.

Congestion is most prevalent in the weekday afternoon/evening peak. This time period is perhaps the most critical in terms of delay and congestion outcomes. The One-way scenario operates similarly to the Do Minimum. The Two-way and Hybrid scenarios show a 14% increase in network-wide travel times and a 2-to-4 minute increase in travel times on key routes.



Appendices

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Appendix A DEMAND FORECASTING OVERVIEW

Demand growth summary tables from demands used for SFDT Business Case testing.

A.1 DEMAND FORECAST SUMMARY

A.1.1 2017-18 Based 2038 Forecasts

The total demand matrix growth between the 2017 base year model ('Base') and the 2038 estimated growth ('Future) are shown in the table below from the original land-use forecasts developed in 2017/2018.

Table A-1: Original 2038 Forecasts (2017-18 based assumptions)

			Citywide Model		Citywide Model Growth		City Centre Model		City Centre Model Growth	
			Base	Future	Abs	%	Base	Future	Abs	%
2038	AM	Light	41,361	44,043	2,681	6.5%	41,254	43,981	2,727	6.6%
		Heavy	2,718	2,723	6	0.2%	1,853	1,868	15	0.8%
	IP	Light	111,445	118,669	7,224	6.5%	35,038	37,456	2,418	6.9%
		Heavy	6,744	6,765	21	0.3%	1,497	1,507	10	0.7%
	PM	Light	72,066	76,577	4,512	6.3%	72,161	76,788	4,627	6.4%
		Heavy	3,010	3,023	13	0.4%	1,552	1,600	49	3.1%

A.1.2 SFDT TDM Applied 2038 Forecasts

The table below provides the same information as above, with the SFDT Travel Demand Management (TDM) strategy applied which reduces vehicle trips in the region.

These forecasts have been applied to the testing summarised in this report.

Table A-2: 2038 Forecasts (2017-18 based assumptions) with SFDT TDM Applied

			Citywide Model SFDT TDM		Citywide Model Growth		City Centre Model SFDT TDM		City Centre Model Growth	
			Base	Future	Abs	%	Base	Future	Abs	%
2038 TDM	AM	Light	41,361	41,841	480	1.2%	41,254	41,914	660	1.6%
		Heavy	2,718	2,725	7	0.3%	1,853	1,868	16	0.8%
	IP	Light	111,445	116,053	4,608	4.1%	35,038	36,626	1,589	4.5%
		Heavy	6,744	6,765	21	0.3%	1,497	1,508	11	0.8%
	PM	Light	72,066	74,355	2,290	3.2%	72,161	74,663	2,501	3.5%
		Heavy	3,010	3,020	9	0.3%	1,552	1,593	42	2.7%

Appendix B HARBOUR ARTERIAL FLOW CHANGE PLOTS

The flow difference plots below are from an initial phase of SFDT project testing. They compare the Do Minimum to just the Harbour Arterial components of the SFDT schemes.

B.1 PEAK HOUR HARBOUR ARTERIAL FLOW CHANGES



Figure B-1: AM Peak Hour Network Flow Differences, Harbour Arterial vs. Do Minimum

Appendix B Harbour Arterial Flow Change Plots



Figure B-2: PM Peak Hour Network Flow Differences, Harbour Arterial vs. Do Minimum

Appendix C INTERSECTION LOS RESULTS

Overall Intersection Delay and LOS Results.

Appendix C Intersection LOS Results

Table C-1: AM Peak Hour, Intersection Delays and LOS

Intersection	Do Min		Only TDM		Final One-Way			Final Two-Way			Hybrid		
	LOS	Delay	LOS	Delay	LOS	Delay	Diff to Do Min	LOS	Delay	Diff to Do Min	LOS	Delay	Diff to Do Min
North Rd / Great King St / Opoho Rd	C	27	C	27	C	26	-1	C	32	5	C	32	5
Great King St / SH1	B	12	A	10	A	10	-2	B	16	4	B	17	5
Duke St / George St	B	15	B	15	B	14	0	B	15	0	B	15	0
Duke St / Great King St	A	8	A	8	A	8	1	B	18	10	B	16	9
George St / Warrender St / Howe St	B	20	B	20	B	20	0	C	22	2	C	22	2
Howe St / Great King St	B	20	B	19	B	17	-3	B	17	-3	B	18	-2
Howe St / Cumberland St	E	39	D	35	D	35	-4	C	22	-17	C	35	-4
Dundas St / Great King St	B	18	B	16	B	18	0	B	18	-1	C	21	3
Dundas St / Cumberland St	B	17	B	17	B	17	0	C	28	11	C	32	15
George St / Park St / Regent Rd	A	9	B	15	B	14	5	D	35	26	D	34	25
St David St / Great King St	B	16	B	16	B	17	2	B	19	3	B	20	4
St David St / Cumberland St	B	12	B	11	B	11	0	C	24	13	C	28	17
Union St W / Great King St	A	9	A	9	B	19	10	C	27	18	C	29	20
Union St W / Cumberland St	C	21	B	14	B	16	-5	C	25	4	D	38	17
Ravensbourne Rd / SH88	A	10	A	9	A	9	0	A	8	-1	A	9	-1
George St / London St / Frederick St	F	106	F	92	F	95	-11	F	100	-6	F	100	-6
Cumberland St / Frederick St	C	28	C	23	D	36	9	C	32	5	C	31	3
Castle St / Frederick St	C	29	C	26	C	30	1	D	41	12	D	43	14
SH88 / Frederick St	F	81	F	76	F	100	19	C	26	-54	C	26	-55
Hanover St / George St	D	47	D	43	D	41	-6	D	48	1	D	50	3
Hanover St / Great King St	B	19	B	18	B	18	-1	B	18	-1	B	19	0
Hanover St / Cumberland St	C	25	C	24	C	24	-1	C	27	2	C	25	0
Hanover St / Castle St	B	15	B	14	B	20	5	C	28	13	B	17	1
Ward St / Halsey St	A	2	A	2	A	6	3	A	8	6	A	8	6
Stuart St / Queens Dr	C	30	C	28	C	28	-2	D	43	14	D	43	14
Stuart St / London St	B	20	B	18	B	20	0	C	22	3	C	21	2
St Andrews St / Filleul St	B	15	B	14	B	13	-2	B	15	-1	B	14	-2
St Andrews St / George St	C	31	C	30	C	29	-3	C	34	3	C	34	3
St Andrews St / Great King St	C	24	C	23	C	24	0	C	26	1	C	23	-1
St Andrews St / Cumberland St	D	40	D	39	D	40	0	D	36	-4	D	46	6
St Andrews St / Castle St	D	39	D	36	C	30	-8	D	49	10	D	37	-2
St Andrews St / SH88	C	30	C	28	C	21	-9	C	24	-6	C	24	-5
George St / Moray Pl (north)	C	34	C	33	C	33	-1	C	35	2	D	36	2
Smith St / Stuart St	C	26	C	25	C	28	2	C	28	2	C	27	1
Moray Pl / Stuart St (west)	B	17	B	18	B	17	0	B	18	0	B	18	0
George St / The Octagon (north)	C	21	C	21	B	20	-1	C	22	1	C	23	2
George St / The Octagon (south)	C	24	C	24	C	24	-1	C	26	1	C	27	2
Moray Pl / Stuart St	C	32	C	30	C	30	-2	C	30	-3	C	32	0
Cumberland St / Stuart St	A	9	A	9	C	32	22	C	21	11	D	37	27
Castle St / Stuart St	B	13	B	13	C	24	11	C	27	14	C	33	20
Thomas Ward St / Ward St / St Andrews St	A	8	A	7	A	8	1	A	6	-2	A	7	-1
Rattray St / Arthur St / York Pl	C	24	C	23	C	26	2	C	23	-1	C	22	-2
George St / Moray Pl (south)	D	40	D	37	D	40	0	D	40	0	D	39	-1
Dowling St / Princes St	B	14	B	13	B	12	-2	A	9	-5	A	8	-6
Queens Garden / Dowling St / Burlington St	C	29	C	25	C	31	2	C	32	2	B	16	-13
Dowling St / SH1	C	27	C	27	C	34	7	C	28	1	D	38	11
Rattray St / Broadway / Maclaggan St	C	27	C	24	C	24	-3	C	27	0	C	27	0
Rattray St / Princes St	C	35	C	34	C	29	-5	C	30	-5	C	29	-5
Queens Gardens / Crawford St	C	24	C	21	B	20	-4	C	27	3	C	24	0
Queens Gardens / Cumberland St	B	13	B	12	C	23	10	C	33	20	D	36	23
Thomas Burns St / Wharf St / Fryatt St	D	35	E	40				0			0		
Broadway / High St / Manse St	C	26	C	21	C	25	-1	C	27	1	C	25	-1
Princes St / Jetty St / Manse St	E	60	D	52	E	59	-1	E	62	2	E	59	-1
Jetty St / Crawford St	D	38	C	35	D	37	-2	D	45	6	D	47	9
Princes St / Carroll St	A	9	A	8	B	11	2	A	8	-1	A	6	-3
Jervois St / SH1	C	23	C	21	C	28	5	B	19	-5	B	18	-5
Gordon St / Crawford St / Andersons Bay Rd	B	16	B	15	B	15	-1	A	10	-5	A	10	-6
Andersons Bay Rd / SH1	D	36	C	35	C	35	-1	C	27	-9	C	28	-8
Andersons Bay Rd / Strathallan St	D	41	D	39	B	19	-22	B	18	-23	B	17	-24
Wharf St / Strathallan St / Portsmouth Dr	C	22	C	21	D	47	24	D	41	19	D	40	18
Hillside Rd / King Edward St	C	33	C	31	D	39	6	D	43	10	D	39	6
Hillside Rd / Andersons Bay Rd / Orari St	D	49	D	46	C	33	-16	D	43	-7	D	42	-7
Portsmouth Dr / Orari St	B	11	B	11	C	35	24	C	26	15	C	23	12
King Edward St / Macandrew Rd	C	29	C	26	C	23	-6	C	24	-5	C	23	-6
Andersons Bay Rd / Macandrew Rd / Midland	C	31	C	32	C	29	-2	C	28	-3	C	28	-3
Portsmouth Dr / Midland St	C	21	B	19	B	18	-3	B	18	-3	B	19	-2
Bay View Rd / King Edward St / Prince Albert	B	12	B	12	B	12	0	B	11	0	B	11	0
Bay View Rd / Portobello Rd / Andersons Bay	B	14	B	11	A	6	-8	A	6	-8	A	7	-7

Appendix C Intersection LOS Results

Table C-2: IP Hour, Intersection Delays and LOS

Intersection	Do Min		Only TDM		Final One-Way			Final Two-Way			Hybrid		
	LOS	Delay	LOS	Delay	LOS	Delay	Diff to Do Min	LOS	Delay	Diff to Do Min	LOS	Delay	Diff to Do Min
North Rd / Great King St / Opoho Rd	C	22	C	21	C	22	-1	B	20	-2	B	20	-2
Great King St / SH1	A	7	A	6	A	6	-1	B	17	11	B	18	12
Duke St / George St	A	10	A	10	A	10	0	A	9	0	A	10	0
Duke St / Great King St	A	7	A	7	A	7	1	B	15	9	B	17	10
George St / Warrender St / Howe St	B	15	B	15	B	15	0	B	16	1	B	17	2
Howe St / Great King St	B	18	B	18	B	14	-3	B	17	-1	B	18	0
Howe St / Cumberland St	C	24	C	22	C	23	-2	C	21	-4	D	36	12
Dundas St / Great King St	B	13	B	12	B	14	2	B	19	6	B	17	4
Dundas St / Cumberland St	B	17	B	17	B	17	0	B	15	-1	C	32	16
George St / Park St / Regent Rd	A	6	A	6	B	14	7	C	24	18	C	21	15
St David St / Great King St	B	13	B	13	B	16	3	B	17	4	B	15	3
St David St / Cumberland St	B	17	B	17	B	16	0	B	19	3	C	29	13
Union St W / Great King St	B	13	B	13	C	21	8	C	24	11	C	30	17
Union St W / Cumberland St	B	12	B	11	B	13	2	B	20	8	D	39	27
Ravensbourne Rd / SH88	A	7	A	6	A	6	0	A	6	-1	A	6	-1
George St / London St / Frederick St	E	58	E	59	E	60	3	E	62	4	E	63	5
Cumberland St / Frederick St	B	19	B	17	C	35	16	C	24	5	C	25	7
Castle St / Frederick St	C	24	C	23	C	32	8	C	27	3	D	37	13
SH88 / Frederick St	F	66	F	68	D	32	-33	B	16	-49	B	16	-50
Hanover St / George St	C	35	D	36	C	33	-2	D	39	4	D	42	6
Hanover St / Great King St	B	16	B	16	B	16	0	B	16	0	B	17	1
Hanover St / Cumberland St	B	20	B	20	C	26	5	C	25	4	C	28	8
Hanover St / Castle St	B	16	B	15	C	23	6	B	20	3	B	19	2
Ward St / Halsey St	A	1	A	1	A	2	1	A	5	3	A	5	3
Stuart St / Queens Dr	A	8	A	9	A	8	0	A	10	1	A	10	1
Stuart St / London St	B	19	B	18	B	20	1	B	15	-4	B	15	-4
St Andrews St / Filleul St	B	13	B	13	B	13	0	B	13	0	B	13	0
St Andrews St / George St	C	30	C	29	C	28	-2	C	30	0	C	30	0
St Andrews St / Great King St	C	34	C	35	C	35	1	C	35	1	D	37	2
St Andrews St / Cumberland St	D	38	D	37	D	44	6	C	35	-3	D	45	7
St Andrews St / Castle St	C	35	C	34	C	29	-6	D	39	4	C	35	-1
St Andrews St / SH88	B	17	B	16	B	16	-1	B	16	-1	B	17	0
George St / Moray Pl (north)	C	33	C	33	C	32	-2	C	34	0	C	34	0
Smith St / Stuart St	C	29	C	27	C	30	1	C	29	0	C	29	0
Moray Pl / Stuart St (west)	B	14	B	14	B	15	1	B	15	1	B	15	1
George St / The Octagon (north)	C	21	B	20	B	20	0	C	23	2	C	24	3
George St / The Octagon (south)	C	23	C	23	C	22	-1	C	25	2	C	24	1
Moray Pl / Stuart St	C	30	C	29	C	29	0	C	29	-1	C	31	2
Cumberland St / Stuart St	B	16	B	16	C	27	11	B	20	4	C	27	11
Castle St / Stuart St	B	11	B	11	C	21	10	B	20	10	B	12	1
Thomas Ward St / Ward St / St Andrews St	A	4	A	4	A	6	2	A	4	0	A	4	0
Rattray St / Arthur St / York Pl	B	14	B	13	B	14	0	B	14	0	B	13	0
George St / Moray Pl (south)	C	33	C	33	C	35	1	D	37	3	D	37	3
Dowling St / Princes St	A	10	A	9	A	10	0	A	7	-3	A	7	-3
Queens Garden / Dowling St / Burlington St	C	21	B	20	C	26	5	C	25	4	B	12	-9
Dowling St / SH1	C	25	C	26	D	37	12	C	29	4	C	22	-3
Rattray St / Broadway / Maclaggan St	B	16	B	16	B	16	0	B	18	2	B	18	2
Rattray St / Princes St	C	23	C	23	C	23	0	C	24	1	C	24	1
Queens Gardens / Crawford St	B	14	B	14	B	14	0	B	19	4	B	17	3
Queens Gardens / Cumberland St	B	15	B	15	C	25	10	C	25	9	C	34	19
Thomas Burns St / Wharf St / Fryatt St	A	6	C	22				0			0		
Broadway / High St / Manse St	B	12	B	11	B	14	2	B	14	2	B	14	2
Princes St / Jetty St / Manse St	D	46	D	46	D	48	2	D	48	2	D	48	2
Jetty St / Crawford St	C	27	C	27	C	28	1	C	25	-2	C	26	-2
Princes St / Carroll St	A	2	A	2	A	2	0	A	2	0	A	3	1
Jervois St / SH1	B	16	B	16	B	15	-1	B	15	-1	B	15	-2
Gordon St / Crawford St / Andersons Bay Rd	B	13	B	13	B	12	-1	B	11	-2	B	11	-2
Andersons Bay Rd / SH1	C	24	C	24	C	26	2	C	21	-3	C	21	-3
Andersons Bay Rd / Strathallan St	C	25	C	25	B	20	-5	B	20	-5	B	20	-5
Wharf St / Strathallan St / Portsmouth Dr	B	12	B	12	B	14	2	B	13	1	B	13	1
Hillside Rd / King Edward St	C	28	C	28	C	28	0	C	32	4	C	32	4
Hillside Rd / Andersons Bay Rd / Orari St	C	27	C	27	C	30	3	C	32	5	C	32	6
Portsmouth Dr / Orari St	B	11	B	11	B	13	1	B	14	3	B	14	3
King Edward St / Macandrew Rd	C	23	C	23	C	24	1	C	24	1	C	24	1
Andersons Bay Rd / Macandrew Rd / Midland	C	26	C	26	C	27	1	C	27	1	C	28	1
Portsmouth Dr / Midland St	B	20	B	19	B	18	-2	B	19	-1	B	20	0
Bay View Rd / King Edward St / Prince Albert	A	8	A	8	A	8	0	A	8	0	A	8	0
Bay View Rd / Portobello Rd / Andersons Bay	A	5	A	5	A	5	0	A	5	0	A	5	0

Appendix C Intersection LOS Results

Table C-3: PM Peak Hour, Intersection Delays and LOS

Intersection	Do Min		Only TDM		Final One-Way			Final Two-Way			Hybrid		
	LOS	Delay	LOS	Delay	LOS	Delay	Diff to Do Min	LOS	Delay	Diff to Do Min	LOS	Delay	Diff to Do Min
North Rd / Great King St / Opoho Rd	D	41	C	35	D	36	-5	D	41	0	D	39	-2
Great King St / SH1	C	18	B	15	C	17	-1	C	21	3	C	22	4
Duke St / George St	B	16	B	16	B	16	0	B	17	2	B	18	3
Duke St / Great King St	A	9	A	9	A	9	-1	C	21	11	C	23	14
George St / Warrender St / Howe St	C	27	C	26	C	26	-1	C	33	6	C	31	4
Howe St / Great King St	C	21	C	21	B	19	-2	C	23	3	C	21	0
Howe St / Cumberland St	D	30	D	30	D	30	0	C	27	-3	C	25	-5
Dundas St / Great King St	C	22	B	19	C	23	1	B	19	-4	C	21	-1
Dundas St / Cumberland St	C	32	C	29	C	33	1	D	41	9	D	39	7
George St / Park St / Regent Rd	C	18	C	24	B	15	-3	F	91	73	F	124	106
St David St / Great King St	B	20	B	19	C	21	1	C	24	4	C	25	5
St David St / Cumberland St	B	18	B	17	B	17	-1	C	24	6	D	50	32
Union St W / Great King St	B	17	B	16	C	26	9	C	32	15	C	33	16
Union St W / Cumberland St	C	22	B	17	B	20	-1	D	45	23	D	53	32
Ravensbourne Rd / SH88	A	8	A	8	A	7	-1	A	7	-1	A	7	-1
George St / London St / Frederick St	F	113	F	106	F	97	-16	F	105	-7	F	109	-4
Cumberland St / Frederick St	C	30	C	24	C	34	5	D	36	7	C	33	3
Castle St / Frederick St	C	34	C	31	C	32	-2	D	48	13	D	52	17
SH88 / Frederick St	F	103	F	82	F	126	23	C	30	-73	C	28	-75
Hanover St / George St	D	53	D	48	D	51	-2	E	66	13	E	79	26
Hanover St / Great King St	C	26	C	25	C	26	0	C	28	2	C	32	6
Hanover St / Cumberland St	C	35	C	34	D	41	6	C	34	-1	D	37	2
Hanover St / Castle St	C	22	B	19	C	21	-2	C	34	12	C	21	-1
Ward St / Halsey St	A	5	A	2	A	4	0	A	8	4	A	8	3
Stuart St / Queens Dr	B	12	B	12	B	12	-1	B	15	3	B	13	0
Stuart St / London St	C	34	C	30	C	35	1	D	38	4	C	34	0
St Andrews St / Filleul St	C	21	B	19	B	19	-2	B	20	-1	C	23	2
St Andrews St / George St	D	42	D	40	D	42	0	D	47	4	D	53	11
St Andrews St / Great King St	E	70	E	67	E	60	-10	E	62	-8	E	71	1
St Andrews St / Cumberland St	E	65	E	62	D	51	-14	D	54	-11	E	59	-6
St Andrews St / Castle St	E	56	D	46	D	36	-20	E	56	0	D	50	-5
St Andrews St / SH88	D	54	C	35	C	23	-31	C	31	-23	C	30	-24
George St / Moray Pl (north)	D	44	D	41	D	42	-3	D	49	5	D	48	3
Smith St / Stuart St	D	53	D	50	D	54	1	E	61	7	E	61	8
Moray Pl / Stuart St (west)	C	32	C	31	C	32	-1	C	35	2	C	34	1
George St / The Octagon (north)	C	23	C	21	C	21	-1	C	28	5	C	26	3
George St / The Octagon (south)	C	26	C	26	C	24	-1	C	31	5	C	29	3
Moray Pl / Stuart St	C	33	C	33	C	33	0	C	34	1	D	39	6
Cumberland St / Stuart St	C	23	C	21	D	37	14	C	25	3	C	33	10
Castle St / Stuart St	B	14	B	14	C	32	18	C	31	16	B	12	-2
Thomas Ward St / Ward St / St Andrews St	C	21	B	12	B	16	-5	E	60	39	E	68	47
Rattray St / Arthur St / York Pl	C	23	C	21	C	23	0	D	36	12	C	33	10
George St / Moray Pl (south)	E	57	D	54	E	57	1	E	61	4	E	59	3
Dowling St / Princes St	B	14	B	12	B	14	0	B	12	-1	B	11	-3
Queens Garden / Dowling St / Burlington St	C	23	C	24	C	34	12	D	49	26	C	24	2
Dowling St / SH1	C	27	C	27	C	34	6	D	54	26	D	51	24
Rattray St / Broadway / Maclaggan St	C	23	C	21	C	23	0	C	26	3	C	27	4
Rattray St / Princes St	C	27	C	26	C	26	-1	C	32	5	C	31	4
Queens Gardens / Crawford St	C	21	B	20	B	18	-3	C	29	8	C	25	4
Queens Gardens / Cumberland St	B	19	B	19	C	26	8	D	39	20	D	36	17
Thomas Burns St / Wharf St / Fryatt St	F	122	F	59				0			0		
Broadway / High St / Manse St	C	23	B	20	C	27	4	C	31	8	C	28	5
Princes St / Jetty St / Manse St	E	56	D	53	E	57	1	E	63	7	E	59	3
Jetty St / Crawford St	C	35	C	33	C	34	-1	D	42	7	D	41	6
Princes St / Carroll St	A	4	A	3	A	4	1	A	5	2	A	4	1
Jervois St / SH1	C	24	C	22	B	16	-8	B	17	-6	B	17	-7
Gordon St / Crawford St / Andersons Bay Rd	B	15	B	15	B	15	0	B	12	-3	B	13	-2
Andersons Bay Rd / SH1	D	36	C	29	C	33	-3	C	30	-6	C	30	-6
Andersons Bay Rd / Strathallan St	D	48	D	36	C	24	-24	B	20	-28	B	20	-28
Wharf St / Strathallan St / Portsmouth Dr	C	25	B	17	C	31	6	D	49	24	C	33	7
Hillside Rd / King Edward St	D	40	C	34	C	33	-8	C	33	-7	C	32	-8
Hillside Rd / Andersons Bay Rd / Orari St	E	61	D	52	D	54	-7	D	53	-8	D	50	-11
Portsmouth Dr / Orari St	B	17	B	13	B	12	-5	B	20	2	B	14	-3
King Edward St / Macandrew Rd	D	46	D	37	D	41	-4	D	43	-2	D	45	-1
Andersons Bay Rd / Macandrew Rd / Midland	C	35	C	34	D	38	3	D	38	3	D	37	2
Portsmouth Dr / Midland St	C	26	C	23	C	23	-2	C	23	-3	C	23	-3
Bay View Rd / King Edward St / Prince Albert R	B	11	B	11	B	11	0	B	11	0	B	11	0
Bay View Rd / Portobello Rd / Andersons Bay	A	8	A	8	A	8	0	B	11	2	A	9	0

Appendix D PEAK HOUR LOS HEATMAPS

Intersection Delay (LOS) Heatmap Plots.



D.1 DO MINIMUM

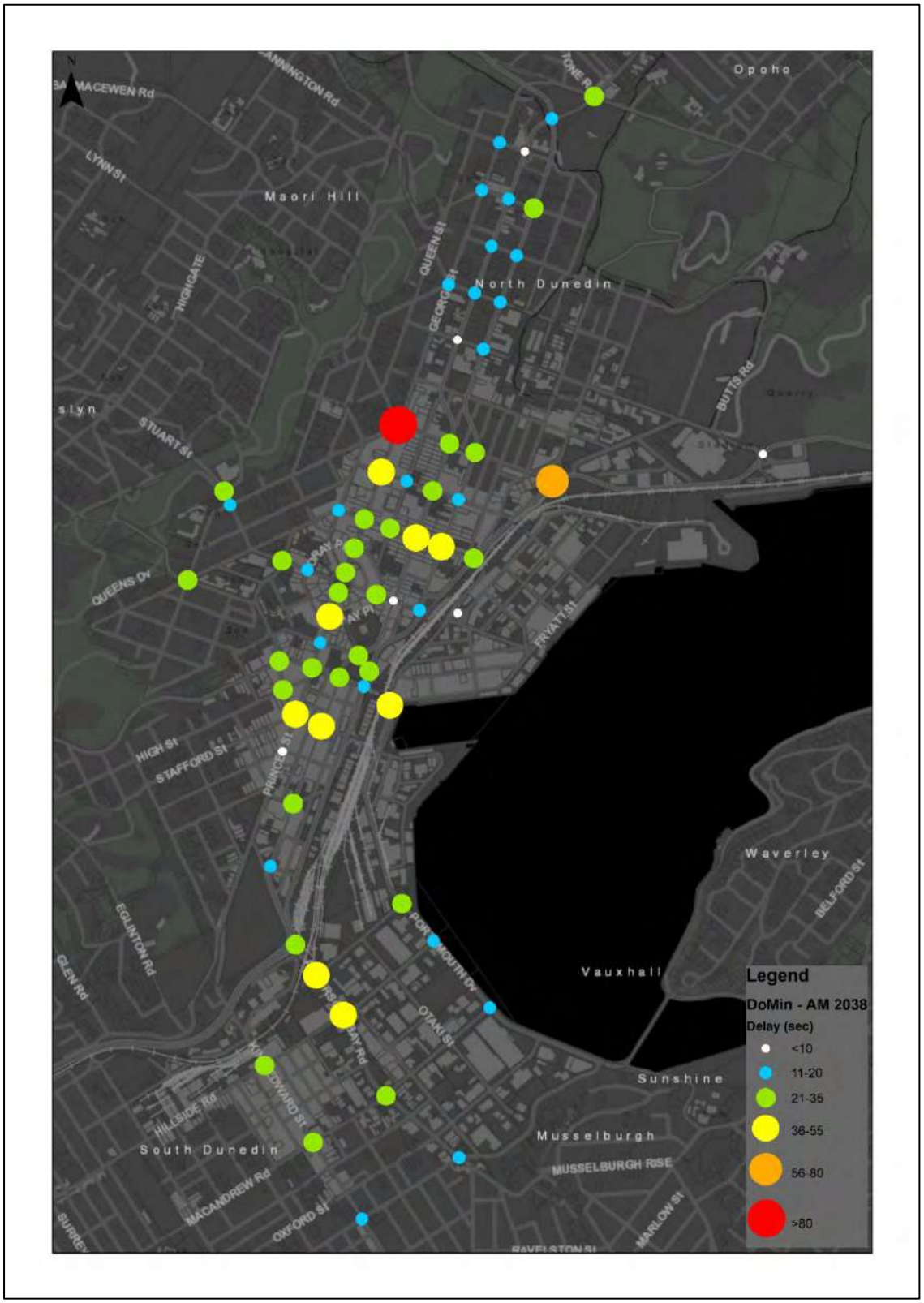


Figure D-1: AM Peak Hour, Do Minimum LOS Heatmap



Figure D-2: PM Peak Hour, Do Minimum LOS Heatmap

D.2 SFDT ONE-WAY SCENARIO

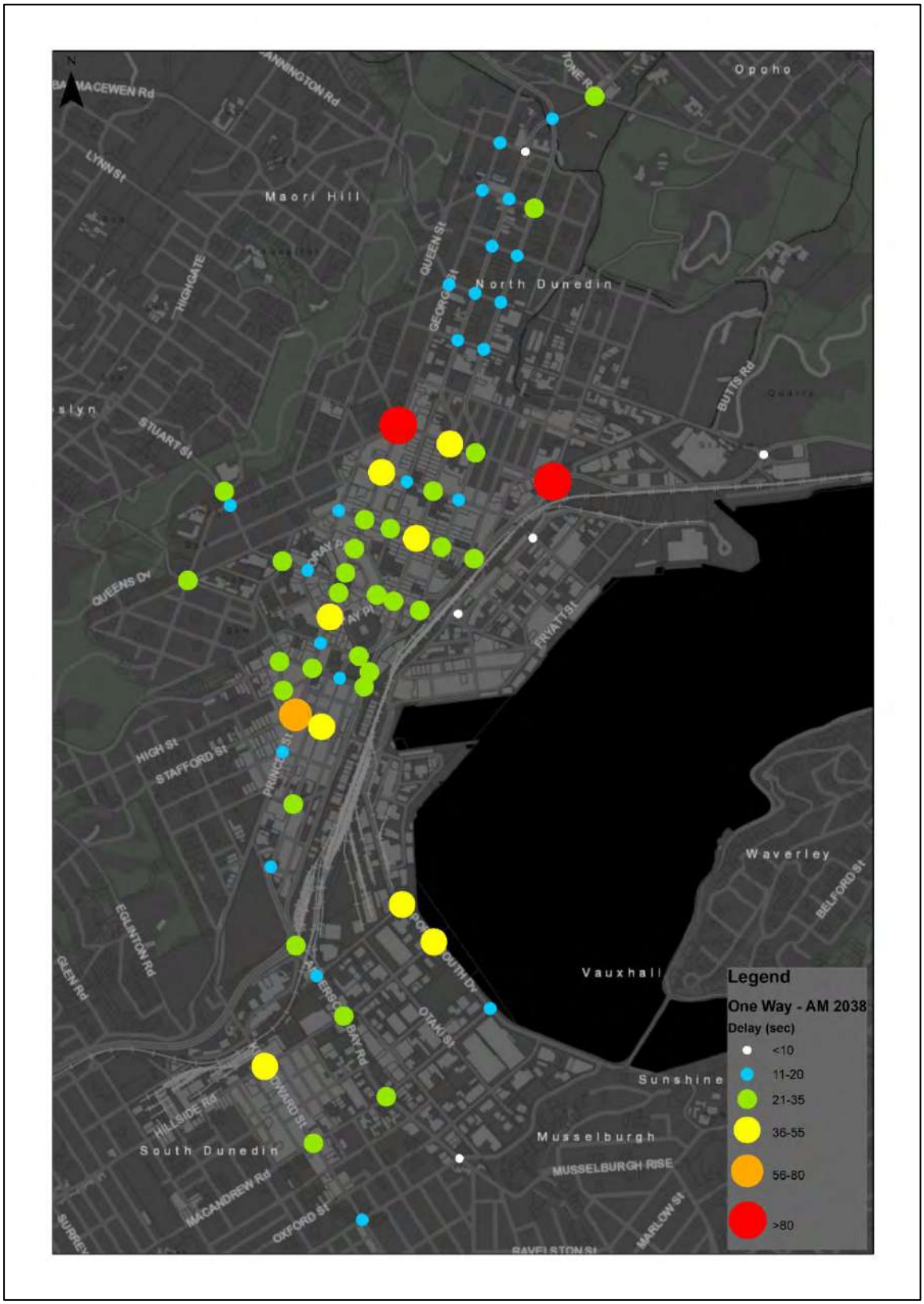


Figure D-3: AM Peak Hour, SFDT One-way Scenario LOS Heatmap



Figure D-4: PM Peak Hour, SFDT One-way Scenario LOS Heatmap

D.3 SFDT TWO-WAY SCENARIO

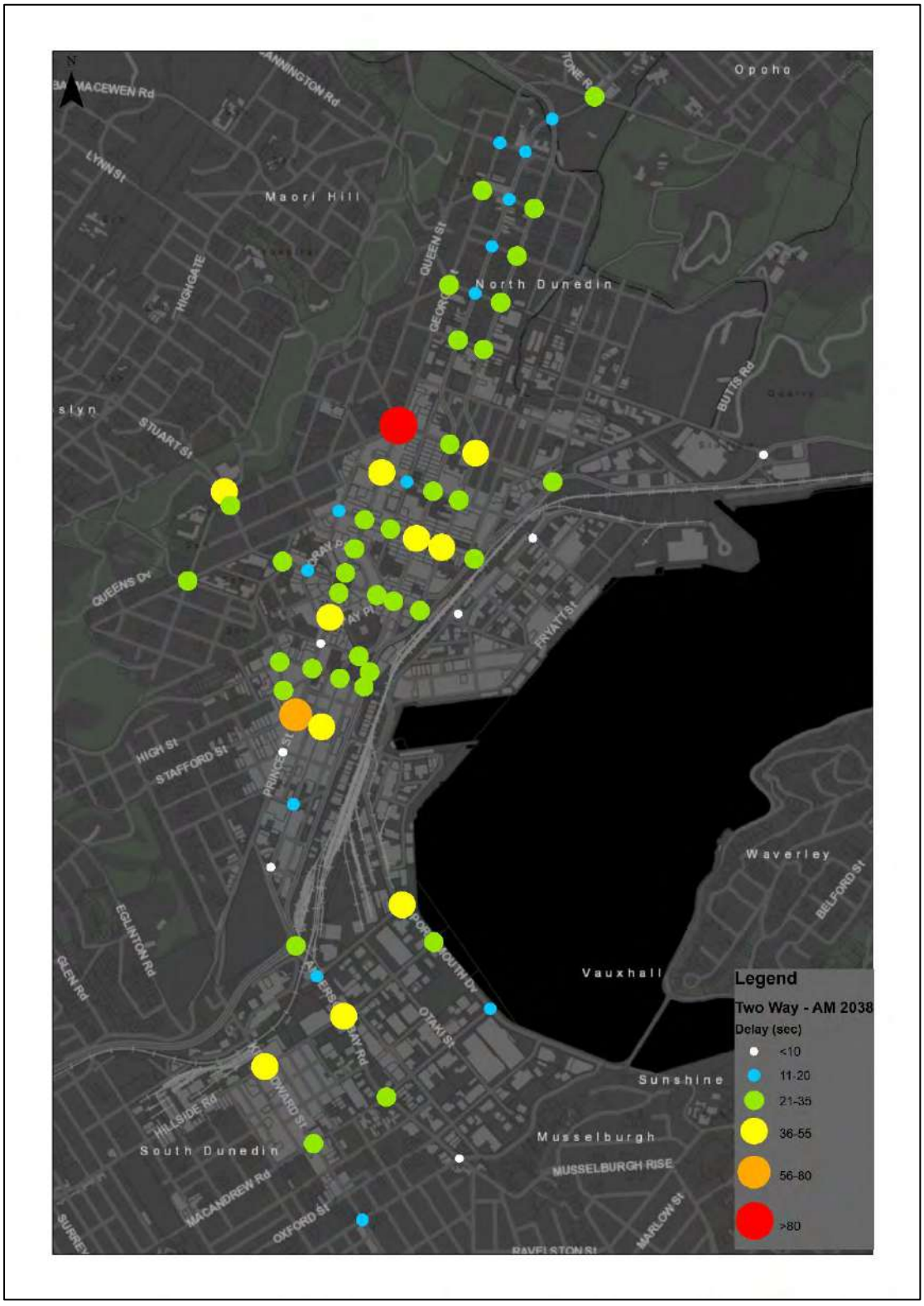


Figure D-5: AM Peak Hour, SFDT Two-way Scenario LOS Heatmap

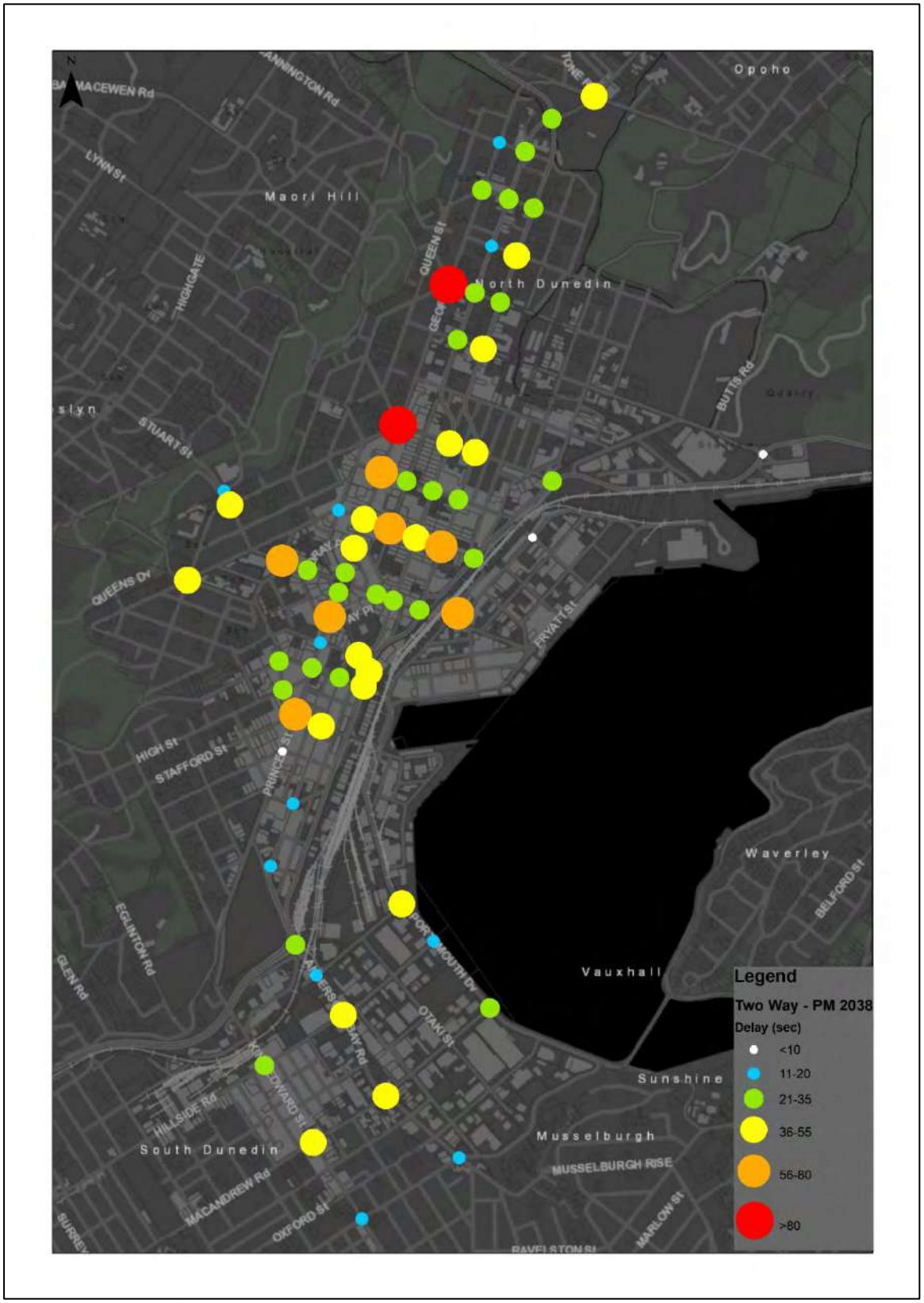


Figure D-6: PM Peak Hour, SFDT Two-way Scenario LOS Heatmap

D.4 HYBRID SCENARIO

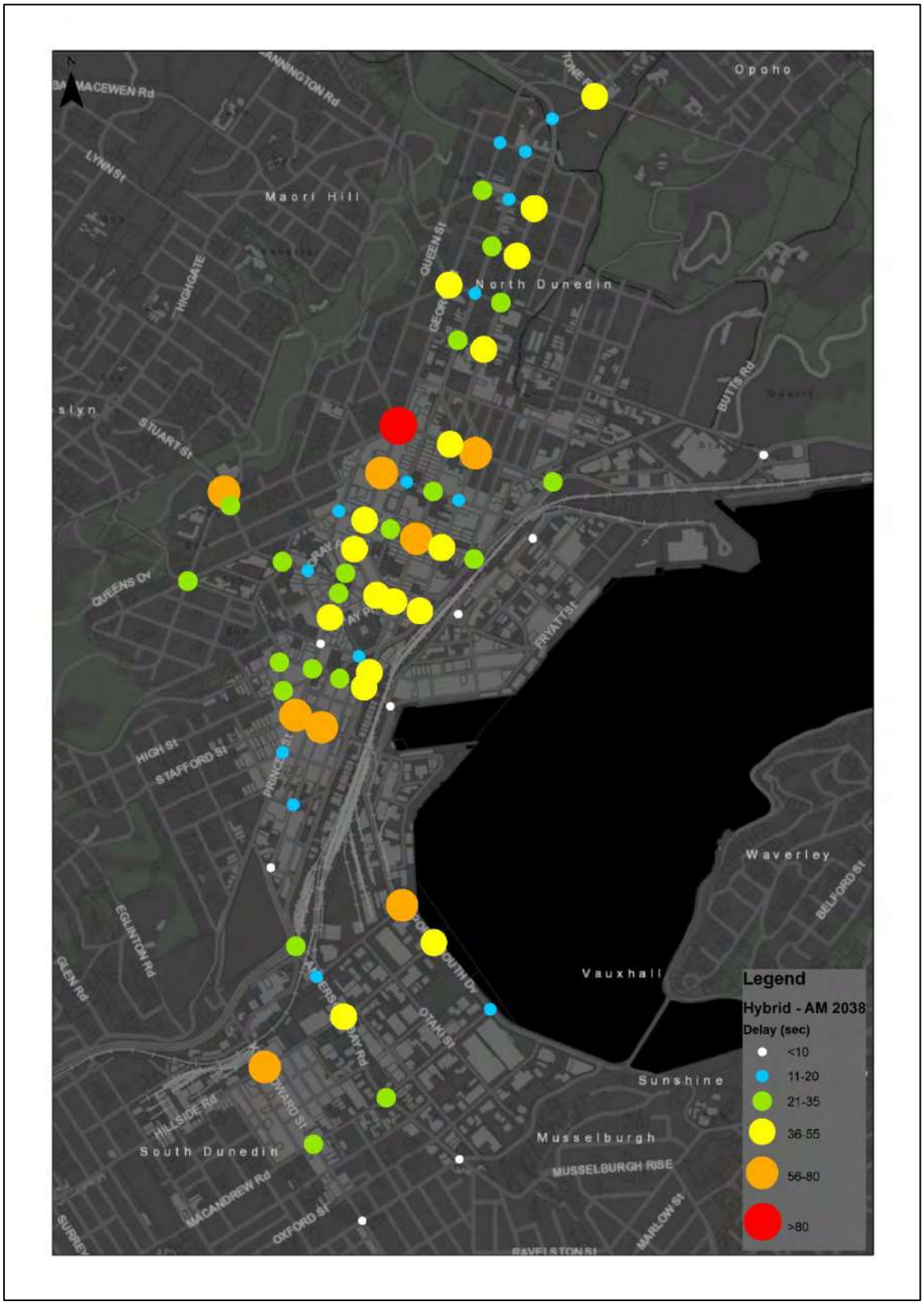


Figure D-7: AM Peak Hour, Hybrid Scenario LOS Heatmap

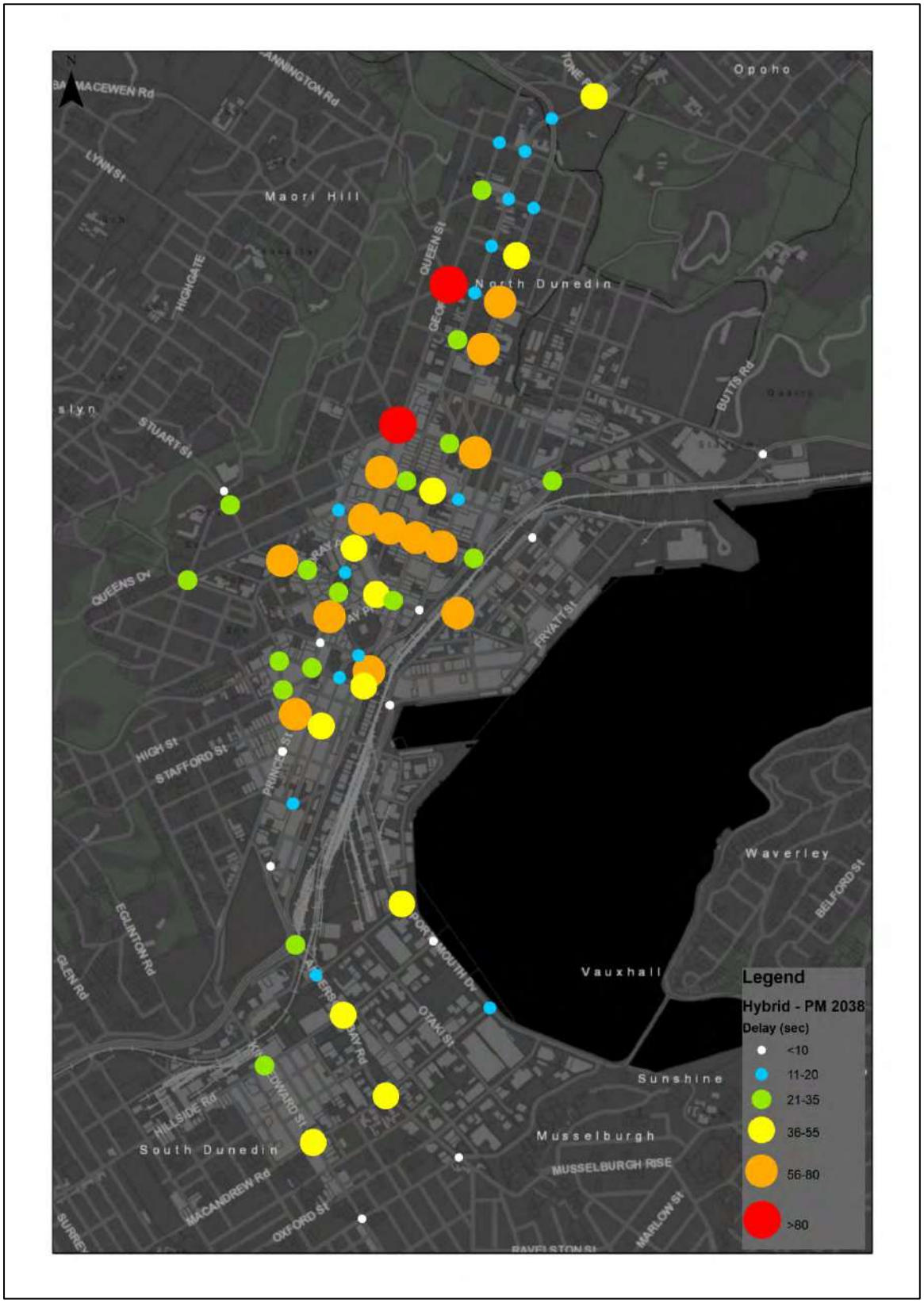


Figure D-8: PM Peak Hour, Hybrid Scenario LOS Heatmap

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Appendix J Liveability Report



Shaping Future Dunedin Transport PBC

Estimation of the wider economic benefits – using a population and community driven approach

NZIER report to New Zealand Transport Agency (NZTA)

15 June 2020

About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice.

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NZIER was established in 1958.

Authorship

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It was quality approved by Gareth Chaplin.

The assistance of Eugene Isack and Sarah Spring is gratefully acknowledged.

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Executive summary

The objective of this work is to assess the wider economic benefits of the scenarios proposed for Shaping Future Dunedin Transport (SFDT) project by New Zealand Transport Agency (NZTA). NZIER worked closely with the client and our partners, Stantec (lead) and Boffa Miskell, to ensure a comprehensive assessment of the outcomes of SFDT, using a range of assessment tools. NZIER used its Regional Investment Tool (RIT) as a complementary tool for this assessment, to account for the (hard to quantify) wider economic benefits (WEBs).

In this technical report, we provide details on our assessment framework.

In our assessment we have applied our methodology to compare the two scenarios that have been developed for the project. We have also been asked to address the similarities of each scenario to the 'do-minimum' scenario. We have not sought to describe the scenarios in detail in this report, the detail on the scenarios can be found in the project's companion papers.

We should also be clear that this report assesses the wider economic benefits of the scenarios. These are **not** the net benefits for each scenario or for each scenario in conjunction with the similarities we were asked to model (cost, scheduling and financing are not considered in these options[1]).

Our results suggest $19.9 million (annual) benefits from scenario 1, $138 million benefits from scenario 2 and $92 million benefits from their similarities

The similarities, scenario 1 and scenario 2 improve wellbeing of Dunedin residents by 0.6, 0.13 and 0.9 percent, respectively. We used the 12 domains typically used to assess wellbeing. The minimum (annual) benefits[2] from the proposed changes are as follows:

- $92 million for the similarities
- 19.9 million for scenario 1
- $138 million for scenario 2.

The value added to liveability is $12 million for scenario 1, $84.5 million for scenario 2 and $56.2 million for their similarities

The RIT defines the value of improvements in factors of the living space based on the priority that (Auckland) population puts on them.[3] That is, it captures lived experience, and is not driven by the perceptions of researchers and policy-makers. Accordingly, the value of liveability will be realised through improvements in socioeconomic diversity, good neighbourhood design, accessibility, public transport, safety (less crime) and sense of cohesiveness.

1 These factors were out of scope of NZIER's assessment.

2 The annual benefit is not additive – i.e. the improvement benefits the economy by a percentage and then keep maintaining that size of the economy every year.

3 The advantage of our approach is that our estimated values are valid for the New Zealand population. This is a significant improvement on other approaches where the values estimated for major overseas metro populations are normally used. However, we have used generic New Zealand data based on Auckland studies. We would suggest commissioning Dunedin-specific datasets as part of the SSBC phase of the project.

Or results suggest that, out of the total benefits, the value from each scenario in terms of liveability outcomes for Dunedin resident is $56.2 million for the similarities, $12 million for scenario 1 and $84.5 million for scenario 2.

The most significant wider effects from SFDT will be improved accessibility and higher residential satisfaction for Dunedin residents

The similarities between the two scenarios lead to improvements in cultural identity, sense of belonging, households' subjective wellbeing (SWB) from having a cleaner environment, improvements to physical health, improved amenities, improved residential satisfaction, improved walkability and better public transport.

In comparison with scenario 1, the scenario 2 leads to significant improvements in households' SWB from a cleaner environment, and most other outcomes. Interestingly, scenario 2 generates negative impacts in terms of cultural identity while scenario 1 is neutral for that factor. It also seems clear that scenario 1 generates better outcomes in terms of satisfaction with housing and neighbourhood.

Our results capture the trade-offs that Dunedin will face and provide a framework to help do this. Our framework is based on the value that New Zealanders put on each of the wellbeing factors that Dunedin will weigh up in choosing between scenarios

In our assessment, we defined the value of different outcomes of the proposed SFDT interventions based on the value that New Zealand communities put on them. There are positives and negatives associated with each scenario, but the net $ figure provides a robust understanding of the gains and losses to Dunedin communities.

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1 Introduction

The objective of this study is to estimate the wider economic benefits (WEBs) of the scenarios proposed for Shaping Future Dunedin Transport (SFDT) project by New Zealand Transport Agency (NZTA). This technical report provides details on our estimation approach and the results.

NZIER used its Regional Investment Tool (RIT) to estimate the economic and wellbeing effects of the proposed scenarios at a granular outcome level. Wellbeing effects included cultural identity, safety (less crime) and communities' assessment of accessibility outcomes. Aggregate outcomes, such as liveability and wellbeing, are based on a combination of factors/drivers and the relative weights given to them by New Zealand communities and policy-makers.

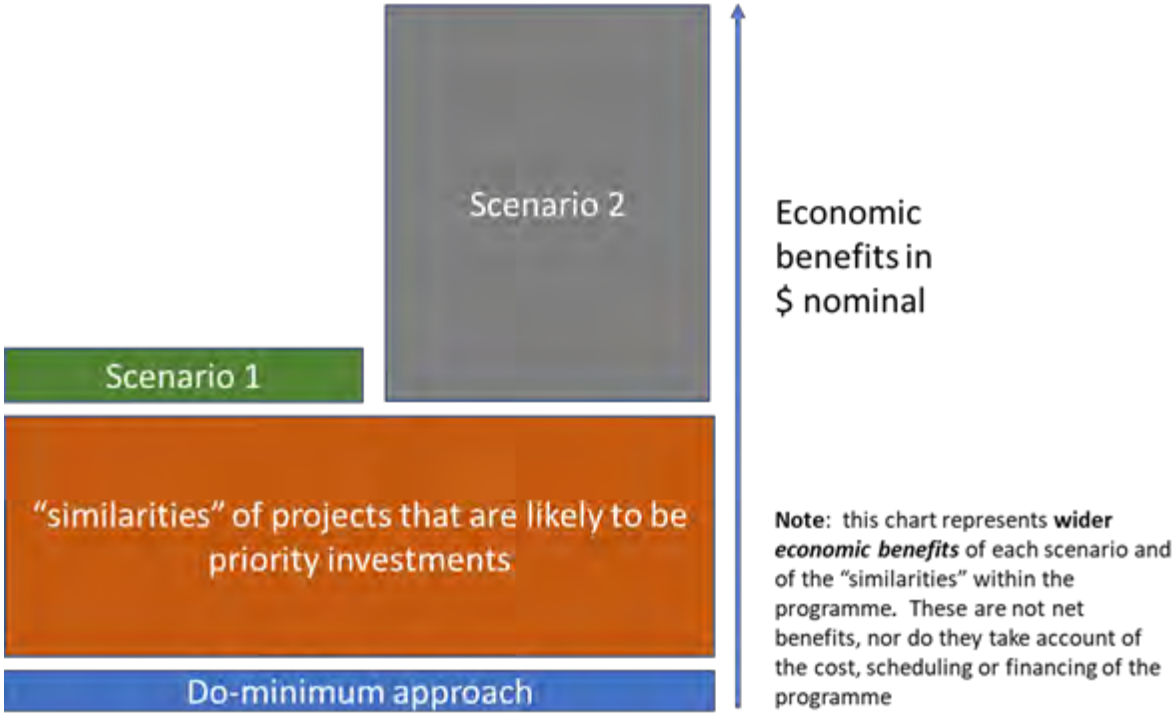
The logic of our assessment framework is rooted in clustering of businesses and households. Improved street access leads to relocation of a range of businesses and there are economic gains from the benefits of agglomeration. The additional benefits go to households who enjoy using the services provided by these relocated activities, but that comes at a cost to some other businesses and households, as we will briefly describe in the next sections of this response.

In the next section, we present a brief description of the scenarios. Then, given the novelty of our approach, we review the relevant literature. In section 4 we present our methodology for estimating wider economic benefits at a granular level. In section 5 we outline our results.

2 Scenario definitions

In this report, we assess the impact of two scenarios and their similarities. As illustrated in Figure 1, we compare scenario 1 and scenario 2 with the 'do-minimum' scenario. Separately we compare the similarities between scenarios 1 and 2 with the 'do-minimum' scenario. Therefore, the estimated benefits from scenarios 1 and 2 are additive to the impact of their similarities.

Figure 1 Schematic representation of the scenarios being assessed



Source: NZIER

Table 1 shows the similarities between the scenarios proposed for SFDT. Accordingly, the similarities include more frequent public transport (as per Table 2), amenity and active travel, and behaviour change. The net impacts of the similarities are shown in Table 3, these are based on Stantec's expert advice on the impact of the similarities on mode shift. We use the mode shift outcomes to quantify the WEBs of the similarities. Our evaluation excludes the impact of work from home (WFH).

Table 1 Similarities between the two scenarios

Outcomes	For both scenarios 1 and 2
SH1	Slow speed zone in core (30kmh)
Freight	SH88 relocated to Frederick Street
Harbour arterial	Low-moderate cost route upgrade using existing infrastructure to improve efficiency.
Amenity and active travel	St Andrew Street pedestrian focused between hospital sites. Pedestrian priority at signals on hospital frontage. Increase cycle use of harbour circuit and SH1 cycleway by additional protected cycle routes on Albany and St Andrew Streets.

Outcomes	For both scenarios 1 and 2
Public transport	Significant improvement to bus services – bus priority, more frequent and direct Mosgiel service, Park and Ride at Mosgiel and/or Burnside, RTPI, $2 flat fare, free bus gardens to Oval. Primary bus route on Princes street for buses to south.
Parking	Prioritise based on need. Price for 85% occupancy. New parking building on Harbour arterial (700 space) for city centre, hospital and waterfront, and on SH1 (Police/Jervois) for commuters (150 space). Divest some existing parking. New revenue to support buses.
Behaviour change	Travel plans through major employers to encourage mode shift. Increased support for current work with schools. Travel planning for targeted suburbs.
Land use	Continue with 2GP policies which support more people living in city centre; new residential development near public transport routes. Review minimum parking requirements for central zones, expand heritage grants scheme.

Source: Shaping Future Dunedin Transport. 2020. Client workshop; 13 February 2020.

Table 2 Similarities between the two scenarios – public transport

Proposed change	Description
More frequent/direct service from Mosgiel and the south	Increase peak frequency from Mosgiel to every 15 minutes on new route 77x via Southern Motorway to Brighton off ramp, then Green Island super stop, then motorway/ Caversham Bypass to bus hub. Retain existing 77 service every 30 minutes to serve Kinmont and Fairfield. Extend peak route 70 from Brighton from Green Island to City Centre every 30 minutes via South Dunedin (timed with route 77x express to city centre at Green Island). Take Abbotsford out of route 70 in the peak and have half-hourly peak direct City Centre service. Merge routes 80 & 81 Mosgiel Loop into core route 77 Mosgiel service.

Source: Stakeholder workshops, 2020

Table 3 Impact of similarities between the two scenarios

Mode	2013	2030
Work from home	7%	13%
Bus	3%	8%
Bicycle	3%	5%
Walk or Jog	11%	14%
TOTAL % Active/PT/WFH	24%	40%

Source: Stantec

Table 4 illustrates the differences between the two proposed scenarios. Accordingly, there will be differences in the direction of the streets, amenities and parking, active travel and public transport frequency.

Table 4 Differences between the two scenarios

Outcomes	Scenario 1	Scenario 2
SH1	One-way pair as existing. Green wave.	Two-way system: arterial route (current SH1 southbound) and a local road (current SH1 northbound). Arterial route has one through lane in each direction and green wave.
Amenity/place	Targeted plantings and build outs on hospital frontage (Cumberland Street), Queens Gardens and Uni Wellness Corridor.	Arterial route: Avenue with trees on each side and planted median (trees) in core. Outer is arterial with solid median and targeted plantings. No parking. Local road: City Street with planted central median and trees on both sides.
Parking	No change on SH1	Arterial route: minimal parking Local road: Additional parking added at north and south ends.
Active travel	Mid-block signals outside hospital. Protected cycleways stay but may need to change side.	Arterial route: no cycle facilities Local road: New mid-block signals outside hospital, route to Waterfront and Wellness Corridor. Barnes Dance crossings at other signals. Two-way protected cycle spine from Oval to Gardens.
Public transport	Buses to/from north via George Street	Buses to/from north via local road.

Source: Shaping Future Dunedin Transport. 2020. Client workshop; 13 February 2020.

In section 4 we quantify the magnitude of the proposed changes on the features of suburbs and roads, and then identify their potential impact on the composition of economic activities.

3 Background

In this section we describe WEBs and how they differ from a conventional cost benefit analysis (CBA), which is covered in NZTA's Economic Evaluation Manual (EEM), and the economy-wide benefits. Then, we describe the findings from the economics literature on WEBs and liveability.

A comprehensive framework for the assessment of a transport intervention provides estimates of a conventional CBA, WEBs and the economy-wide impacts of the transport intervention:

- Conventional CBA: this includes how evaluators traditionally use capital and operational expenditures (CAPEX and OPEX), as well as the benefits to road users (including public transport and private vehicle users) and non-road users (those who do not directly use the road). Asset values may also be part of this analysis if care is taken to avoid double counting.
- WEBs: this goes beyond the outcomes that evaluators traditionally capture, and account for gains from agglomeration.
- Economy-wide effects: capture flow-on effects, which consider the interactions between businesses, households and the government.

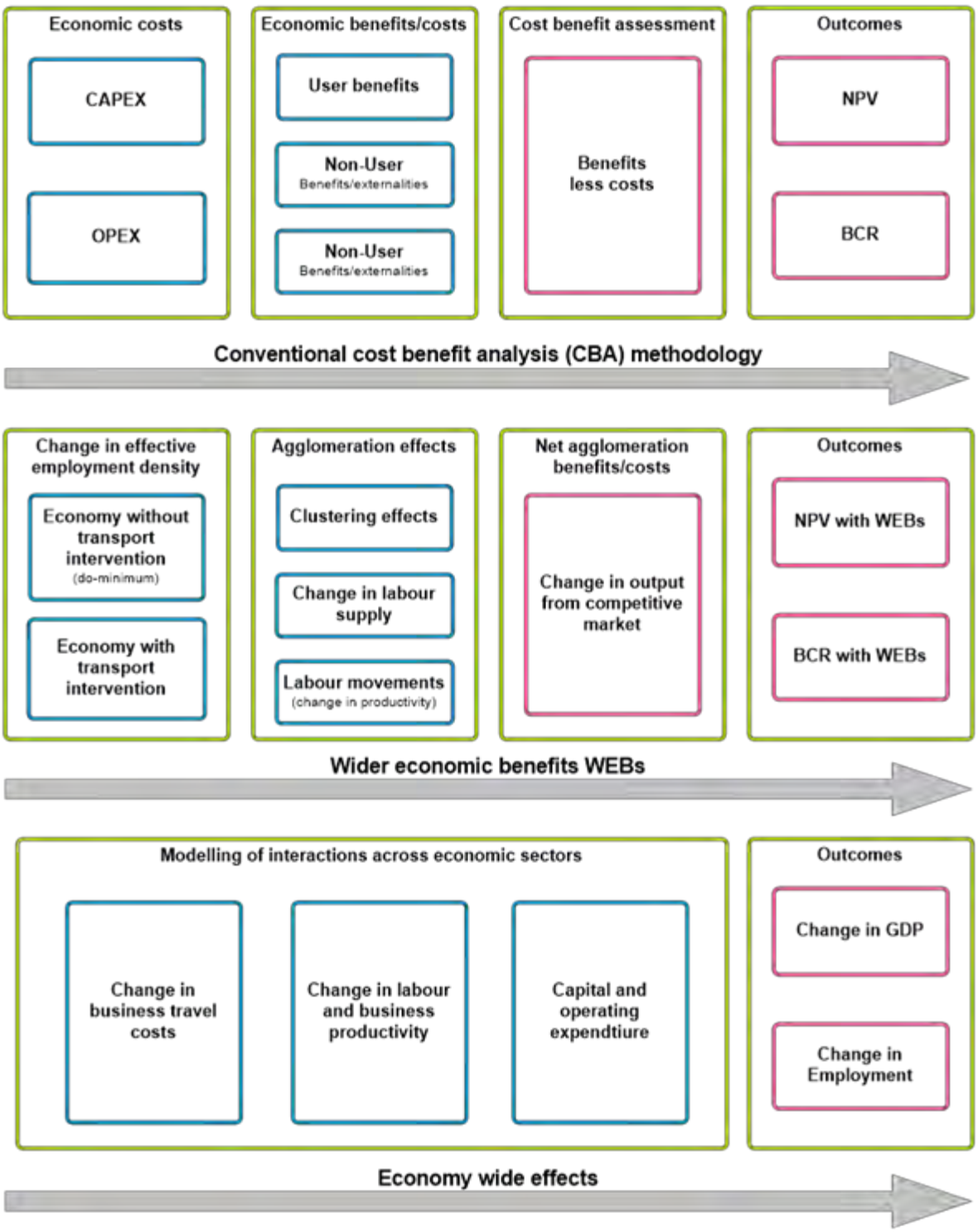
Transport interventions lead to time savings for the users (of rail and road), which decreases the cost of production of a range of goods and services. In addition to that, a transport intervention usually leads to agglomeration benefits as a result of firms locating near each other (Chèze and Nègre, 2017; Shefer and Aviram, 2005). This leads to:

- Better access to job opportunities for labour force participants, and therefore a shorter time spent in the job seeking phase.
- Greater sharing of knowledge and technology that improves industry specialisation
- Efficiency from sharing inputs and outputs of each economic sector increases.

These interactions lead to productive advantages (reflecting increased spatial concentration of economic activities). Maŕe and Graham (2009) estimated the strength of agglomeration effects of productivity in the New Zealand transport context based on New Zealand microdata. These estimates of agglomeration elasticities are used in the latest version of NZTA's EEM.

The economy-wide impacts of different projects are not proportionate. For example, a light rail project that connects two major economic hubs in a city with a smaller range of alternative transport modes, affects the other sectors of the economy more significantly compared to the same project in a city with a wider range of transport choices available or in the same city but at a location of lower significance to the regional economy. Arguably, the economy-wide effects are not captured in the WEBs, as there are potential multiplicative effects to the rest of the economy that are not captured in an estimation of productivity gains derived from agglomeration benefits.

Figure 2 Conventional CBA, WEBs and economy-wide effects of a transport intervention



Source: NZIER

There is a potential impact from clustering on the WEBs that are currently missing from the EEM framework. Transport interventions usually unlock previously commercially infeasible sites for development. For example, in the United Kingdom, the Docklands Light Railway is called the backbone to development in Docklands (Gleave & House, 2005;

Carter, 1991). Therefore, the economic benefits from an intervention may be captured in the land values (using a hedonic price method). Maré & Coleman (2011) study the patterns of business location in Auckland. They use granular firm-level data for 1999–2011 and robust regression analysis. Their results suggest that new entrants (firms) are attracted to areas with higher prices. They also identify that factors of accessibility significantly affect firms' choice of location (spatial sorting). The timeframe of their study does not include the recent significant changes in land prices in New Zealand. It is not clear if land values capture the benefits to society of a relocation of businesses or the relocation is simply a rent seeking behaviour – for further discussion on the information included in land values, see for example Torshizian (2017).

In terms of potential positive externalities, we first need to know the factors with most significance to New Zealand population and businesses. Maré, Coleman & Pinkerton (2011) identify residential sorting in Auckland based on qualification, income, and country of birth. They provide a static picture of the location of households. However, higher land values are likely to lead to a change in the residential location of some households. Torshizian & Chaplin (2019) studied **the features that New Zealanders value the most as the outcome of place-making programmes. This included an increase in walkability of their suburbs, safety (of roads and suburbs), quality of public transport services, accessibility, social cohesion and socioeconomic diversity and decrease in noise pollution**.

At a micro-level, the net gains to society depend on the weight of each of the preferred outcomes in the utility functions of different population groups and the size of the population groups in favour of and opposed to the changes in different outcomes. For example, as we will present in section 5, a change in the direction of the streets will be associated with gains to the food and beverage sector, and the professional services sector and potential losses to the health services sector. The food and beverage sector experiences a clustering in the two-way street, which will be associated with clustering of specific socioeconomic groups in that area and potential welfare gains for them. This comes at a cost to some other socioeconomic groups who do not benefit from the clustering of the food and beverage sector and who may therefore experience a lower sense of belongingness.[4]

Stroombergen, Bealing, Torshizian & Poot (2018) discuss the impact of socioeconomic changes on the New Zealand land transport system. As discussed in that report, clustering of households (and businesses) adds a layer of complexity to the estimated relationships between the improved features and the utility of households. Clustering acts as a third factor that affects both the improved features and the outcomes of interest, including land values and the wellbeing of residents. Torshizian (2017) studied the role of spatial factors in Aucklanders' choice of living environment, taking into account the endogeneity of spatial factors with respect to individuals' backgrounds. That study is the first applied solution that addresses the impact of clustering on welfare of households using spatial econometric techniques and accounts for endogeneity issues raised by individuals' choice of location. The results suggested a significant impact from clustering on the impact of access to amenities on residents' satisfaction with their living environment.

[4] The potential of a zero-sum game impact from clustering and the potential causality issues needs to be further evaluated.



4 Methodology

During this project, NZIER worked closely with the client team and the partners to identify the outcomes sought by the SFDT project (the outcomes). These include improvements in cultural, environmental, health, housing, income and consumption, safety, social connections, time use and subjective wellbeing of Dunedin residents.

As discussed in the background section, it is not clear if the value of these outcomes are reflected in land values (as discussed by Torshizian (2017)). Torshizian and Chaplin (2019) found the most relevant measures of the outcomes and then estimated their impact on life satisfaction of New Zealanders. In the preliminary business case, NZIER did not have access to IDI data and therefore could not estimate the impacts specific to the Dunedin population. For this work used the estimated values derived for the Auckland population from Torshizian and Chaplin (2019)

We suggest that the use of the Auckland data provides a reasonable proxy, and a level of granularity and confidence higher than that from using simpler methodologies. Clearly Dunedin has a different demographic make-up from Auckland, and thus residents may have different preferences, and may subjectively value aspects of wellbeing differently. We proposed to address this further in the Second Stage Business Case (SSBC) and update the values so that we gain a more granular set of data that reflects the preferences of the Dunedin population.

Technical note

To estimate the impact of socioeconomic and living factors, Torshizian and Chaplin (2019) estimated the following function:

$$\mathbf{LS_i} = \boldsymbol{\alpha} + \boldsymbol{\beta_j}\mathbf{F_{ij}} + \boldsymbol{\theta_k}\mathbf{C_{ik}} + \boldsymbol{\varepsilon_i}, \qquad \boldsymbol{\varepsilon_i} \sim \mathbf{N}(\mathbf{0}, \boldsymbol{\sigma_i^2})$$

Where, $\mathbf{LS_i}$ is the life satisfaction of individual i; $\boldsymbol{\alpha}$ is the constant; $\mathbf{F_{ij}}$ is the vector of j factors of living of individual i; $\mathbf{C_{ik}}$ is the vector of control variables (such as ethnicity, age, gender and partnership condition); $\boldsymbol{\varepsilon_i}$ is the random error term.

4.1 Estimating the impact of proposed changes on economic activities

To estimate the impact of the scenarios, we first estimate the impact of each proposed change on the composition of industries in the suburbs. Land demand is the combination of the likely growth of different industries across suburbs as well as the demand of different economic activities for different types of labour. We derive the demand of industries for a location from NZIER's Sub-Regional Industrial Growth Model (SIGM), and the demand for different types of labour from NZIER's Sub-regional Location Choice Model (SLCM). Our approach accounts for both the inflow and outflow of households by the movement of labour across suburbs in search of better job opportunities.

We adjust the labour force's decision for movement across regions by accounting for the importance of quality of life versus quality of business. This suggests that households with specific socioeconomic features (ethnicity, household composition and income level) are more likely to live in a region with better factors of quality of life, such as better access to tertiary education services, health services and retail services.

NZIER's SIGM provides information on economic activities (output and employment) for 14 economic sectors, including business categories, namely industrial, retail, office and other commercial, for the next 30 years, at the suburb (area unit) level.

We then used regression analysis to estimate the impact of the proposed changes for each scenario on the economic activities at the suburb level (provided from SIGM and SLCM models). We used the following data sources to measure the factors of change in each scenario:

- The direction and length of streets in New Zealand was from the Open Street Map.
- The proximity to and length of cycleways was from the Open Street Map.
- Walkability and use of public transport and active transport came from Census (2013) by Stats NZ.

In our estimation of the impact of proposed changes, we have sought to account for the most relevant features to the SFDT project, such as the proximity to hospitals and the direction of the roads around the hospital.

4.1.1 Estimated impact of proposed changes

To understand the impact of the proposed scenarios, we first estimate their impact on the activities of different economic sectors in the suburbs. We first describe the outcomes that are sought from some of the proposed changes and how they collectively change the shape of Dunedin.

The impact of 1-way and 2-way streets

The literature on the impact of 1-way and 2-way on economic growth and individuals' preferences are mixed. Particularly there has been not a clear impact on the number of job and the economic activity (as measure by GDP) – see for example, Riggs and Appleyard (2018). The literature does however suggest that the safety of roads is higher for 2-way streets.

The literature also suggests that 1-way streets are associated with positive liveability outcomes for residents if the population of commuters is higher than the population of residents in that area – which will be the case in Dunedin.

We estimated the impact of 1-way streets on different economic activities in New Zealand suburbs. Our results suggest that having a 1-way street is associated with:

- Higher share of professional services (0.7 percent), public sector services (0.5 percent), transport services (0.5 percent), wholesale activities (0.7 percent), finance services (1.3 percent) and other services (0.1 percent).
- Lower share of agricultural activities (-1.2 percent), education services (-0.4 percent), primary industry production (-0.8 percent), and health services (-0.4 percent).

While a 2-way street will be more supportive of a hospital's activities, by providing a better place for health activities, the 1-way street provides a better space for transport services. Hence, it all comes down to the number of users benefiting from each of these outcomes.[5]

The impact of cycleways

We also analysed the impact of the availability of cycleways on the activities in the suburbs. The availability of cycleways is associated with:

- Higher availability of food and beverage services (14.7 percent), professional services (8.4 percent), and other services (10.9 percent), construction activities (24.3 percent).
- Lower transport services (-8 percent).

We do not find a significant relationship between having cycleways and the provision health services, but it is likely that the emergence of cycleways will be associated with the appearance of more food and beverage activities in the city, which may positively benefit perceptions of 'liveability'.

In our models, we have not been able to separately identify the impacts of one-way versus two-way cycleways. For this stage of the analysis we have assumed that a two-way cycleway has the same level of functionality as having two one-way cycleways.[6]

The impact of road speed

Our analysis suggests that a 1 percent increase in road speed on a 1-way street is associated with:[7]

- Higher agricultural activities (3.1 percent).
- Lower food and beverage activities (-1.7 percent), public services (-2.2 percent).

And increases in speed on a 2-way street leads to:

- Higher manufacturing activities (3.1 percent), rental activities (4.4 percent), other services (4.3 percent).
- Lower agricultural activities (-3.5 percent), other production activities (-6.7 percent), construction activities (-5.1 percent), public services (-2.9 percent), health services (-4.4 percent).

Therefore, the impact of increases in speed on one-way streets on the composition of industries is different from the increase in speed on two-way streets.

[5] In our assessment of the association between having a 1-way street and the economic activities in the suburb, the causality is undetermined. This will be identified in the traffic model.

[6] We have not distinguished between the positive and negative effects of two-way versus one-way cycleways. For example, while there is clearly a transport benefit from the additional option to cyclists, this may have to be discounted to allow for lower speeds or hazards associated with two-way flow. For the purpose of this stage of the modelling we have fixed the value as providing two levels of cycleway functionality. This assumption may be relaxed at the next stage should it prove material.

[7] The potential impact on wellbeing of individuals will be estimated in a later stage.



4.2 Estimating the impact of economic activities on each outcome and the target populations

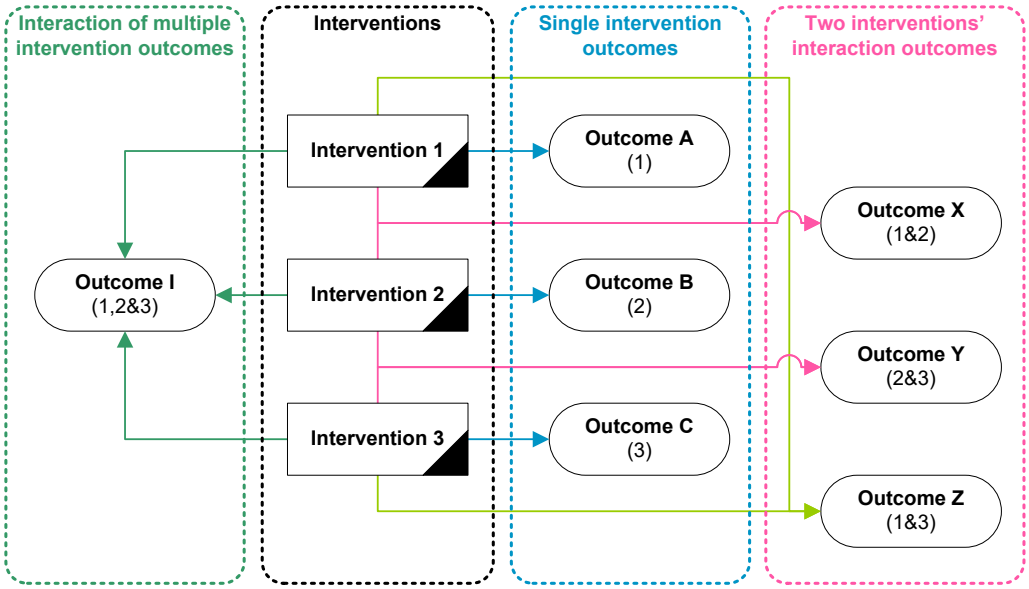
The changes in business activities in an area and its neighbouring suburbs will be associated with re-locating households in search for job opportunities and the features of neighbourhoods that are most likely desirable for them. This estimate is based on the tendency of a household with specific socioeconomic features (ethnicity, household composition and income level) to locate in or nearby a suburb with specific features.

Our SLCM model allows for relocation of households and changes in inward and outward migration from Dunedin. We use the likely changes in number of residents and the socioeconomic features of the population benefiting from the proposed changes to identify the target population of each outcome.

4.3 Our method to avoid double counting and define liveability

The RIT includes an optimisation model, which finds the best prediction for residents' life satisfaction (wellbeing). As shown in Figure 3, varying combinations of interventions can lead to a range of outcomes.

Figure 3 Inter-related outcomes leading to one ultimate outcome – life satisfaction



Source: NZIER

Obviously treating each intervention individually or assuming linear relationships does risk double counting or the risk of contradictory impacts.

A further methodological challenge is that the outcome of the mix of the interventions sums up to the adoption of different modes in a multi-modal transport network that ultimately improves the quality of the living environment. Different domains of wellbeing will be affected by each choice of intervention.

We note also that the literature tends not to provide an agreed single robust and excludable definition for each domain of wellbeing (different policy-makers' definitions of the domains often heavily overlap).

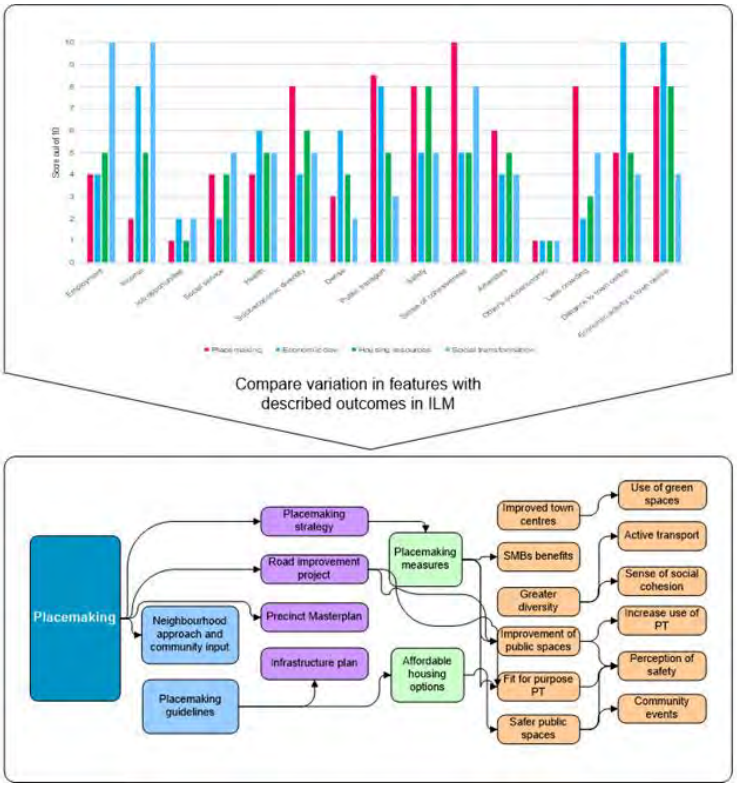
Torshizian and Chaplin (2019) used an innovative method, based on principal component analysis and intervention logic mapping, to identify the overlapping programmes/categories for a range of interventions, and to allow for them.

Using data available in the IDI, they investigated all the equilibria (i.e. combinations of different factors of the living environment) in the neighbourhoods that the outputs of the projects could possibly shape together. For example, one equilibrium would provide us with a picture of a suburb where the jobs factor and its relevant components exist most clearly. That equilibrium, therefore, can best describe the outcomes of the 'Jobs and Skills hub' intervention, based on our comparison between the emerged equilibrium and the description of the outcomes from intervention logic maps (ILMs) - as explained by Torshizian and Chaplin (2019). We have illustrated a schematic description of our methodology in Figure 4.

RIT defines the value of improvements in factors of the living space based on the priority that (Auckland) population puts on them and hence is not driven by perception of researchers and policy makers. Accordingly:

> *Liveability improves by improvements in socioeconomic diversity, good neighbourhood design, improved accessibility, quality public transport, higher safety (less crime) and improved sense of cohesiveness.*(Torshizian and Chaplin, 2019)

Figure 4 Definition of placemaking/liveability



Source: Torshizian and Chaplin (2019)

5 Results

We met with NZTA and provided a range of potential outcomes from SFDT. NZTA reviewed our list of potential outcomes and highlighted the outcomes most relevant to SFDT. We listed the identified outcomes in Table 5. The estimated impact of each scenario (Scenario 1, Scenario 2 and the similarities) and the population of the target population are shown in the table.

The impact on each outcome is a function of the population and the effect (e.g. if the estimated effect is significant but the target population is small, then the outcome does not change significantly).

After adding all outcomes together and accounting for overlapping effects, the total impact on wellbeing is reported in the bottom of the table. The total impact of the similarities, scenario 1 and scenario 2 is 0.6, 0.13 and 0.9 percent improvement in wellbeing of Dunedin residents, respectively. The minimum benefits from the proposed changes are as follows:

- $92 million for the similarities
- 19.9 million for scenario 1
- $138 million for scenario 2.

The value from each scenario in terms of liveability outcomes for Dunedin resident is $56.2 million for the similarities, $12 million for the scenario 1 and $84.5 million for scenario 2.

We describe the impact of the scenarios on each outcome below. Most of the value is generated through improved accessibility and the satisfaction of residents with their living environment.

Table 5 Estimated outcomes for each scenario

Comparison with the do-minimum

Wellbeing domain[8]	Outcome sought	Measure	Similarities		Scenario1 (exc. Sim)		Scenario2 (exc. Sim)	
			Effect (%)	Pop (1000)	Effect (%)	Pop (1000)	Effect (%)	Pop (1000)
2. Cultural Identity	More cultural identity	Value of households' ease of expressing their own identity	0.25	49.4	0	49.4	-0.25	49.4
2. Cultural Identity	Better sense of belonging	Households' belonging to NZ culture	0.3	0.46	0	Small	-0.4	0

[8] The outcomes are grouped within the 12 domains typically used to assess liveability. The numbers are consistent with The Treasury's numbering of 12 domains of wellbeing. We have included the domain numbers that were relevant to our assessment and excluded the rest.

Wellbeing domain[8]	Outcome sought	Measure	Similarities		Scenario1 (exc. Sim)		Scenario2 (exc. Sim)	
3. Environment	Households' SWB from clean environment	The impact of improved environmental outcomes on wellbeing	0.07	131	0	131	0.08	131
4. Health	Better mental health	Mental health for every 1-point change (improvement) (0-100 scale)	0.01	131	0	131	0.08	131
4. Health	Better physical health	Physical health for every 1-point change (improvement) (0-100 scale)	0.02	131	0	131	13.2	131
4. Health	Health intervening everyday life	If health problems intervene individuals' life	0	131	0	131	-11.2	131
5. Housing	Improved amenities and access to them	Value from locating next to a dense area with higher amenities	0.1	45.8	0.9	45.8	2.8	45.8
5. Housing	Satisfaction with housing and neighbourhood	Satisfaction of residents with their living environment	0.2	8	0.9	8	-0.9	8
5. Housing	Increases density levels	Population density	23.4	4.6	6.2	1.7	35	13.6
6. Income & consumption	Higher incomes	Household income	0	131	0	131	0.06	131
7. Jobs & earnings	Higher productivity	Productivity gains per density of workforce	0	131	0	130	0.01	131
9. Safety	Less crime	Satisfaction with safety in suburbs	-0.3	0	0	1.6	64	1.6
10. Social connections	Better social connections	Value from having a connection to people with similar socioeconomic status	0	131	0.3	131	0.4	131
10. Social connections	Improved public transport	Satisfaction with public transport	0.02	4.5	0.07	4.5	0.17	6.2



Wellbeing domain[8]	Outcome sought	Measure	Similarities		Scenario1 (exc. Sim)		Scenario2 (exc. Sim)	
12. Time use	Better access to public space	Satisfaction with access to facilities	0	8	0.01	4.5	0.17	6.2
12. Time use	Improved walkability	Value of improved walkability	3	131	10.4	13.5	4.6	7.5
Net impact Subjective wellbeing	Improved subject wellbeing	Life satisfaction	0.6	131	0.13	131	0.9	131
$millions benefit (minimum)	Total (minimum 95% confidence interval)		**$92**		**$19.9**		**$138**	
Liveability ($millions)	Total (average)		**$56.2**		**$12**		**$84.5**	

Source: NZIER

Cultural cohesion will be affected by the choice of scenario

According to our estimation of the relationship between changes in suburbs' economies and the increases in involvement of different ethnic groups in those suburbs, we expect no significant improvement in social cohesion as a result of scenario 1 outcomes and 0.25 percent worsening in social cohesion as a result of scenario 2 outcomes. This can be partly explained by further clustering of communities in scenario 2,[9] while scenario 1 has less of a population clustering effects. The similarities between the two scenarios improve social cohesion by 0.25 percent. The total population of Dunedin will be affected by the social cohesion outcomes.

Sense of belonging will be improved by the similar programme components

We do not capture any changes in sense of belongingness from the two scenarios. This is because of the combination of the population groups and the impacts. In case of scenario 1, the sense of belonging will not change significantly. In scenario 2, while we capture that the proposed changes will be associated with 0.4 percent decrease in the sense of belonging, the population groups affected by that are very small and therefore, the impact is insignificant. The similarities between the two scenarios are associated with 0.3 percent improvement in sense of belonging, benefiting a small population of 460 people.

Households' subjective wellbeing (SWB) from a cleaner environment is higher for scenario 2

Scenario 1 does not lead to significant changes to people's subjective wellbeing outcomes from a cleaner environment. Scenario 2 however will lead to improved professional services activities and public sector activities that will be associated with positive impact

[9] Our results suggested a higher concentration of specific businesses based on scenario 2 compared to scenario 1. This will shape further clustering of population groups that are more relevant to those industries and therefore decreases the interactions across ethnic groups.

on SWB from a cleaner environment. Accordingly, scenario 2 will improve SWB from a cleaner environment by 2.6 percent.[10]

Mental and physical health benefits the most from scenario 2

Our measurement of the impact of economic activities on mental health suggests that as a result of changes in compositions of activities in scenario 1, there will be no significant changes in mental health conditions. In scenario 2, the average mental health score improves by 0.08 percent for the Dunedin population.

The changes in composition of the economic activities will be likely to change the likelihood of physical health issues and also intervening the everyday life of people with health issues. For both outcomes, we don't identify any significant changes as a result of scenario 1.

The changes in composition of economic activities resulted from scenario 2 will lead to 13.2 percent improvement in people with health conditions, but at the same time, the increased activity of different sectors will be associated with a higher proportion of people experiencing health problems intervening with everyday life (by 11.3 percent).

Access to amenities will be highest in scenario 2

Access to amenities will be improved by 0.9 percent in scenario 1 and by 2.8 percent in scenario 2. Thirty-five percent of Dunedin's population will benefit from improved access to amenities. The impact is mainly due to improved transport services and partly due to an increase in the size of public services in the downtown precinct.

Satisfaction with housing and neighbourhood will be highest in scenario 1

The changes in features of suburbs as a result of scenario 1 will lead to 0.1 percent improvement in satisfaction of residents. Our results suggest a 0.9 percent decrease in overall satisfaction with neighbourhoods as a result of scenario 2. The changes in housing and neighbourhood features will affect 61 percent of the population.

Population density will be increased more significantly in scenario 2

The outcomes from scenario 1 will be associated with 6.2 percent decrease in population density, which will affect 1.3 percent of the population. Scenario 2 will lead to a 35 percent increase in population density and will affect 10.5 percent of the total population.

Household income will be affected significantly in scenario 2

The differences in the economic sectors affected by the two scenarios will affect population groups' income differently. Scenario 1 will lead to almost no change in the average income of the current population, while scenario 2 will increase the average household income by 0.6 percent.

Productivity will benefit the most from scenario 2

A 10 percent increase in employment accessibility in New Zealand raises productivity by 0.69 percent (Mare and Graham 2009). Our results suggest no change in overall productivity as a result of scenario 1 and a 0.01 percent increase in overall productivity from scenario 2.

[10] Shift to office work and away from construction and manufacturing work means less pollution.



Satisfaction with safety (less crime) will increase the most in scenario 2

Scenario 1 will not change the safety outcomes significantly. With improvements from scenario 2, the satisfaction with safety will improve by 64 percent for 1.2 percent of the population.

Social connections will improve the most in scenario 2

With an improvement in the composition of economic activities, clustering of businesses and households will change. As a result of scenario 1, overall social connection decreases by 0.3 percent and in scenario 2 overall social connection increases by 0.4 percent. The similarities between the two scenarios do not affect social connections significantly.

Satisfaction from improved access to facilities will improve the most in scenario 2

As a result of improved accessibility, satisfaction of Dunedin residents with public transport will improve by 0.01 percent in scenario 1, by 0.17 percent in scenario 2, and by 0.02 percent in the similarities.

Walkability will improve most in scenario 1

The outcomes from scenario 1 will lead to a 10.4 percent decrease in walkability and affect 4.5 percent of Dunedin's population. Scenario 2 leads to a 4.6 percent improvement in walkability for 5.8 percent of the population.

In terms of the wellbeing impact of walkability, our database of New Zealanders suggest that for each 1 percent improvement in walkability, life satisfaction increases by 1.11 percent. However, after accounting for the rest of the improvements that we have captured, we concluded that counting walkability as an additional advantage will be double counting (i.e. the impact of that is already captured through other improvements mentioned above).[11]

[11] This is likely to be because we have already captured the health outcomes and therefore the additional associated value of walkability is already included.

6 Caveats of our estimations and the modelling approach

We are confident that the modelling approach we have applied is a robust framework to assess the wellbeing impacts of interventions on and in communities. Our approach is also one of the very few that makes use of New Zealand data (most extrapolate from large European metros).

There are also some limitations associated with the modelling, where we have frozen certain assumptions for the purpose of developing information that can assist decision-makers at this stage of the project.

As the project moves to stage 2, we suggest relaxing some of these assumptions – for example, it may be useful to commission IDI data research to ensure that we have Dunedin specific data, rather than using Auckland data as a proxy. We could also look to assess some of the trade-offs between choices with a higher degree of granularity (e.g. Do two-way cycleways deliver the same benefit as two separated one-way cycleways? And does this change if you account for the possible alternative use of road-space?).

We should also note that this study has been undertaken in a pre-COVID world. At this stage we have not sought to anticipate or account for the role of working from home, changes in parking capacity or other potential impacts of COVID-19 on households' future choices of location, transport, study or employment.

The literature on the theoretical and applied impacts of transport interventions is constantly developing. In particular, the literature on the impact of the location choice of businesses and households and their impact on WEBs and the economy-wide effects of transport interventions is at exploratory stages. Our techniques for estimating these impacts are based on correlations between economic activities and the location of households with different socioeconomic features. This however needs to be further investigated in future studies.



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Appendix K Place Quality Report

Shaping Future Dunedin Transport

Dunedin City Centre : Place Value

May 2021

Boffa Miskell

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1. Introduction

Dunedin city centre is at an exciting point in its development history because there are influential projects in the planning and design process at the same time that together can be shaped to deliver a better quality place. This in turn will generate positive benefits across Dunedin for its people and visitors alike.

These influential projects include the new Dunedin Hospital, University of Otago campus development. There are design processes underway for George Street and other key city centre streets to make them better quality places for people to spend time.

The confluence of these projects provides an opportunity to look at their interactions and to leverage the benefits from them in an integrated way. An important aspect of this integration is the way in which the Dunedin city transport network operates. The network of streets and modes of movement these facilitate are integral to the connectivity of people to, within and through the city. The benefits of these projects can be enhanced by considering them together and all are affected to some extent by the configuration of the arterial and local street network.

Given this opportunity the Shaping Future Transport for Dunedin (SFTD) Business Case process has been promulgated to work with key stakeholders and technical experts to identify the case for change for the street network, confirm problems, benefits, opportunities and investment objectives, reflecting transport and wider city liveability aims. The investment objectives that have been established through the Business Case process to date are (summarised):

- reduce deaths and serious injuries within the city centre
- increase use of active modes and public transport to city centre
- Improve place quality in city centre
- make Dunedin a more liveable city
- reduce traffic speeds/volumes and increase pedestrian levels of service on city streets
- maintain reliable journey times on routes with major vehicular movement functions
- reduce carbon emissions from transport in study area

Waka Kotahi NZ Transport Agency, Dunedin City Council and Otago Regional Council are leading this work Business Case. Mana whenua, the new Dunedin Hospital team, University of Otago and KiwiRail are also involved. In tune with the objectives noted above, this report articulates benefits for Dunedin's city centre 'place' quality from the two scenarios currently being considered for the movement network. The options are described on the following pages.

2. Place Quality

There are multiple attributes that make a great place (refer Figure 1). Dunedin City Council has been committed to improving the place quality of the city centre and investments continue to be made to this end. The Dunedin Central City Plan sets the scene for these improvements. Council has considered city centre streets in terms of their dual role for movement and as places for spending time. Figure 2 is from a working draft of a Dunedin Central City Place Movement Framework that reflects that all streets have a measure of both place and movement function - no street is just for movement or just a place. The streets with higher place quality typically have lower and slower volumes of movements. However, even higher volume movement streets, like the arterial network being considered in this Business Case, are accorded some level of place quality. All streets in any city centre should recognise that a level of place is needed to make the city accessible and enjoyable for everybody.

There is also a dollar value that can be ascribed to the investment made in the quality of places in the city. Attracting people to spend time is good for business, for social connectedness and well-being. A dollar value can be ascribed to improved place quality and section 10 of this report describes the use of a method called "Valuing Public Realm Tool-kit" (VURT) to generate a value for the two scenarios being considered in this stage of the Business Case process.

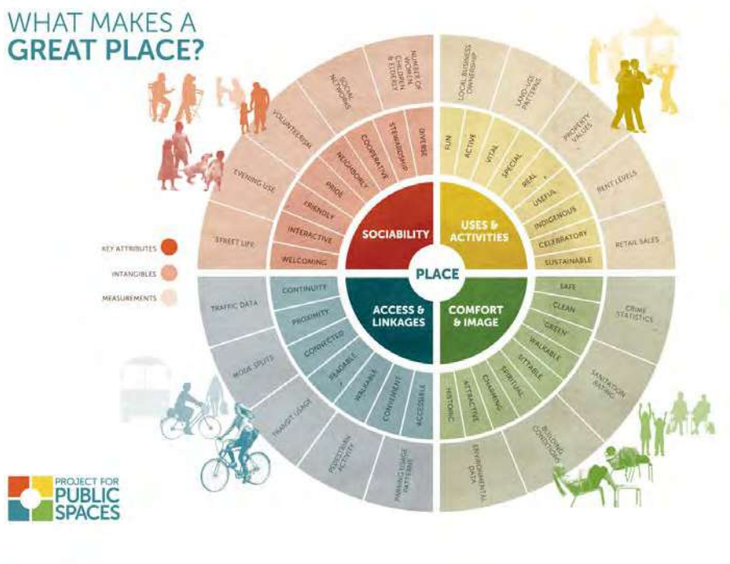


Figure 1. Project for Public Spaces Diagram



Figure 2. Place Movement Framework Diagram

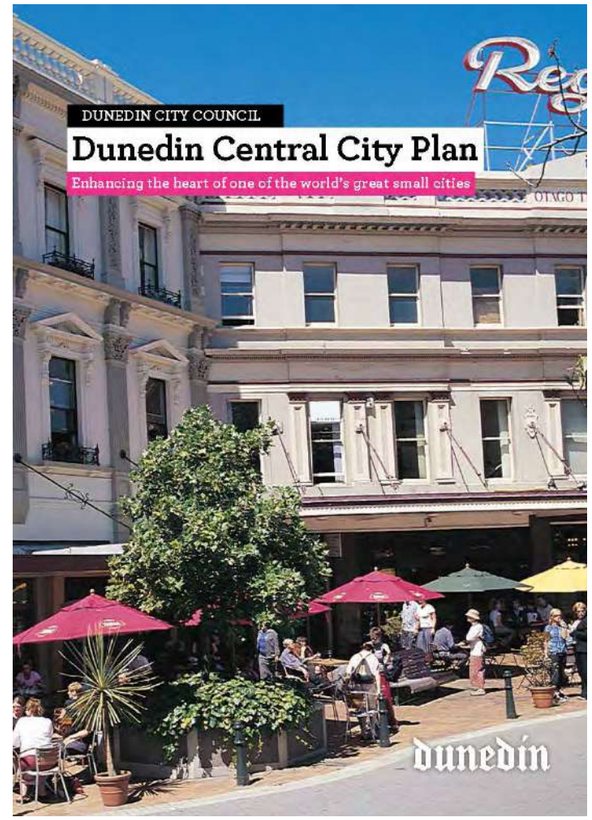


Figure 3. Dunedin Central City Plan, Dunedin City Council

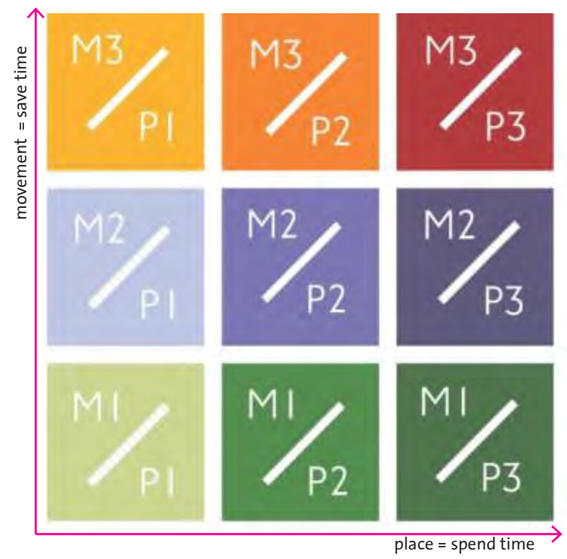


Figure 4. Street Movement Framework Diagram

3. Spatial Approach

Within this report Dunedin city centre is considered as a series of precincts, each with particular attributes.

The precincts are spatial and described on the diagram beside. The SFDT project is focused to the arterial network as well as to modal options (eg bus, car, cycle, walking) by which to access to and within the city centre.

The influences of these arterials to the wider city street network is recognised. However, for the purposes of this report three focus areas have been used to represent the options and how these perform in terms of contribution to place quality.

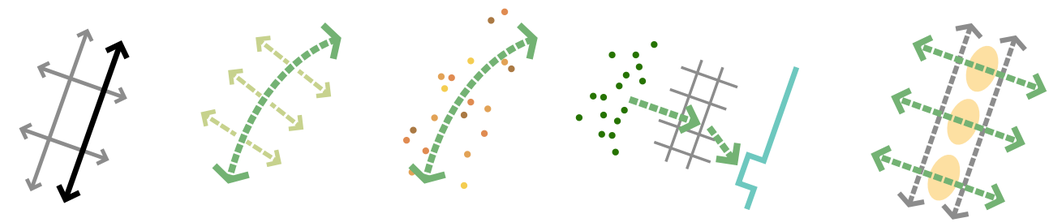
There are 'connecting' objectives that sit together with the precincts as set out below. These connections are also applied within the diagram beside. The connections and place qualities are reflected in this report in the scenarios and the way these have been valued in the latter part of the report.

The Precincts

The diagram (refer Figure 5) identifies precincts within Dunedin's city centre (as referenced in the Dunedin Central City Plan). These are not discrete and include a mix of activities as well:

- **Tertiary Precinct** University of Otago and Otago Polytechnic - both are implementing campus plans.
- **Retail Precinct** George Street, the main retail hub of Dunedin where initiatives are planned to improve place quality.
- **Cultural and Entertainment Precinct** Octagon, Railway Station and Toitu Museum which are key city destination anchors.
- **Warehouse Precinct** Queens Garden and Rattray Street where initiatives have been implemented to improve place quality.
- **Waterfront Precinct** to which connections can be made from the city.

There are five objectives for the Dunedin city centre with a 'connecting' intent which can also be overlain to the diagram to the right (Figure 5). These are relevant to the business case opportunities as well as wider city centre planning initiatives underway:



North South connectivity | East West connectivity | Joining the Dots | Linking green to blue | Connect with Investment partners

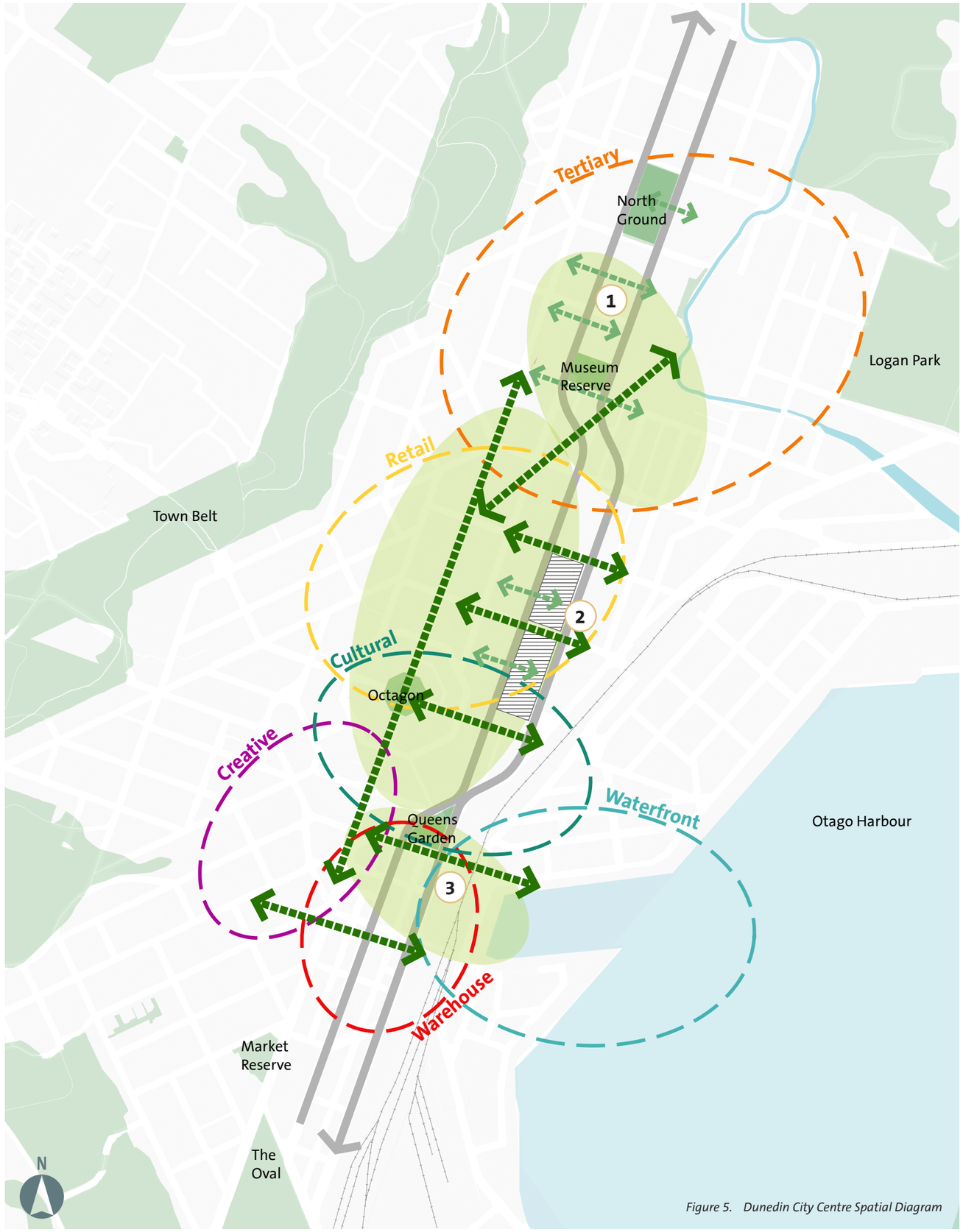


Figure 5. Dunedin City Centre Spatial Diagram

Focus Areas

There are three focus areas highlighted within the precincts (refer to Figure 5). These areas are identified because they leverage mutual benefits for the city and partner project investments being planned.

1. North Area focuses on the development plans of University of Otago and Otago Polytechnic.

2. Central Area focuses on the new Dunedin Hospital development areas, the Octagon and George Street.

3. South Area focuses on Queens Garden and its relationship to Toitu Museum, the warehouse precinct and the area's habour connections.

Identifying these areas (and discussion on next pages) serves two purposes within the context of the business case:

- They may be where more investment in changes to streetscape in the network is made for staging or prioritising changes
- They may lend weight to the business case as co-investments are leveraged from changes to the network

Scenarios

At this stage of the Business Case process there are two primary scenarios that have been developed to give effect to the project objectives.

The scenarios have been developed through two rounds of stakeholder workshops and technical work.

The scenarios are representations of what could be done within the movement network and mode provision to assist the objectives for the city centre.

The scenarios are not designs, but give enough definition to allow traffic modelling, stakeholder and community feedback and other technical assessments to be undertaken. There will be multiple variations possible within the scenarios, but they are deliberately distinctive from each other to allow the responses to the project objectives to be understood.

Following feedback from engagement process, further work was done on the secenrios and a shortlisting process was undertaken.

Shortlising process

During the shortlisting process, the two primary scenarios (and subsequent iterations) were assessed in detail. The most significant difference between each programme (scenario) was the configuration of SH1 through central Dunedin. The four programmes were as follows:

Programme (Scenario)	One way	Two way	Description
P1	√		Two, one-way arterials with two through lanes
P2		√	Two lane local road and arterial with two through lanes
P2v2		√	Two lane local road and arterial with four through lanes
P2v3		√	Two lane local road and arterial with following configuration: • Two through lanes north of Albany Street • Three through lanes (two southbound and one northbound) between Albany Street and Queens Gardens (in line with Burlington Street) • Four through lanes south of Queens Gardens

P1, P2 and P2v2 were assessed with P2 going through a number of iterations. Modelling and fatal flaws analyses were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width.

Through this process, P2v3 was identified as the preferred layout for a two-way option. This place report evaluates only P1 and P2v3.



Stakeholder Workshop images

4. Current Network

One-Way System North and South



Figure 6. Existing Vehicular Movements

The diagrams on this page show how the current city centre network is configured:

- The highway network (effectively arterials) runs as a parallel one way traffic north and south 'pair'. At the time this system was established (1968) bends were introduced to and changes made at some intersections to enable this one way system.
- Highway 88 also connects the one way pairs to the port via St Andrew Street.
- Provision has been made within the system for cycles with lane separation markings and devices in some sections.
- The bus routes come together at Great King Street and connect to Princes and George Street from suburban locations.
- Pedestrian footpaths are provided across the city centre but there are some key routes marked on the diagram below.
- The speed environment is set at 50kmh on the highway arterials.
- Currently 80% of movements are made by car to the city centre. The remainder are walking, cycles, bus movements.
- Daily into the city centre there are 15,400 vehicle movements north bound on city streets (65% of this is aiming for the centre) + 13,700 on Wharf Street (30% is aiming for the centre) and 11,800 southbound (30% of this is aiming for the centre)
- There is a relatively high (5th highest in NZ) crash rate particularly at intersections - vulnerable users are at risk.
- The volumes of heavy vehicle movements and other vehicles on arterial streets is a significant influence to the quality of place in these areas.

Cycle Route Connections

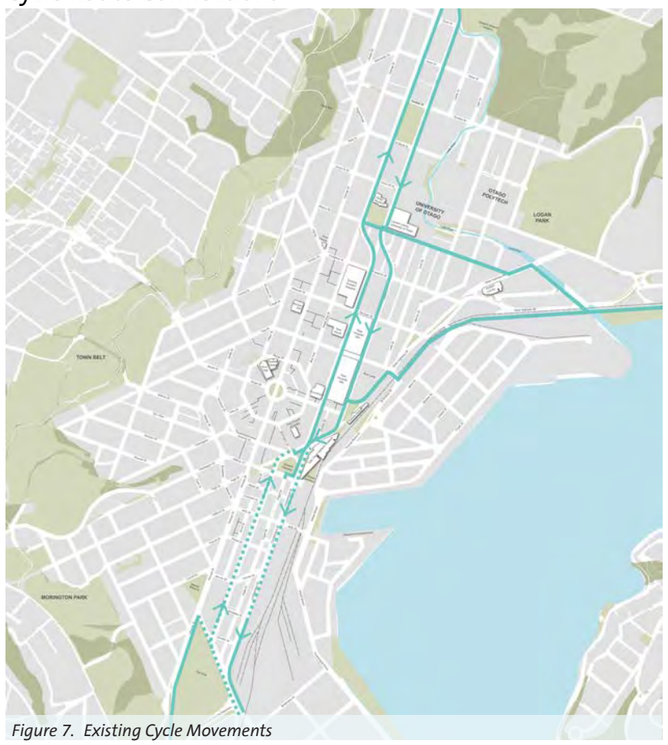


Figure 7. Existing Cycle Movements

Bus Route Connections



Figure 8. Existing Bus Movements

Pedestrian Connections

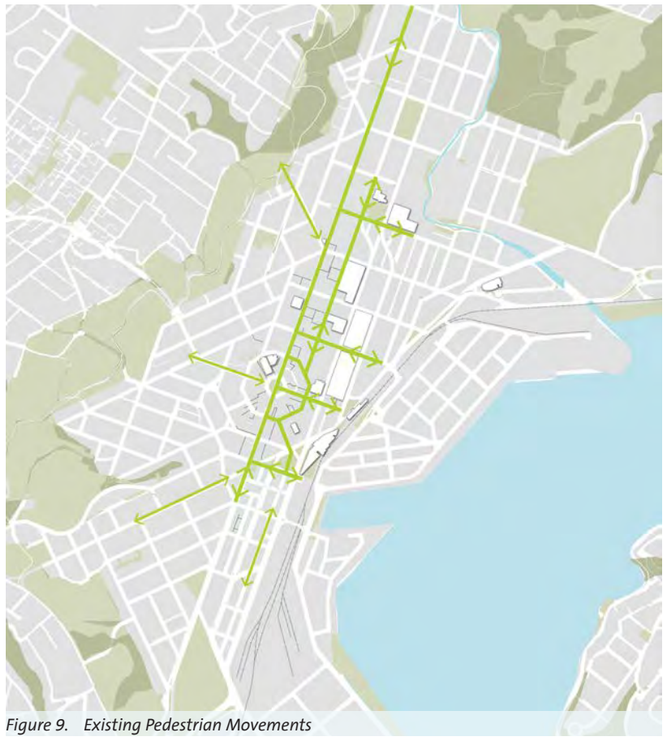
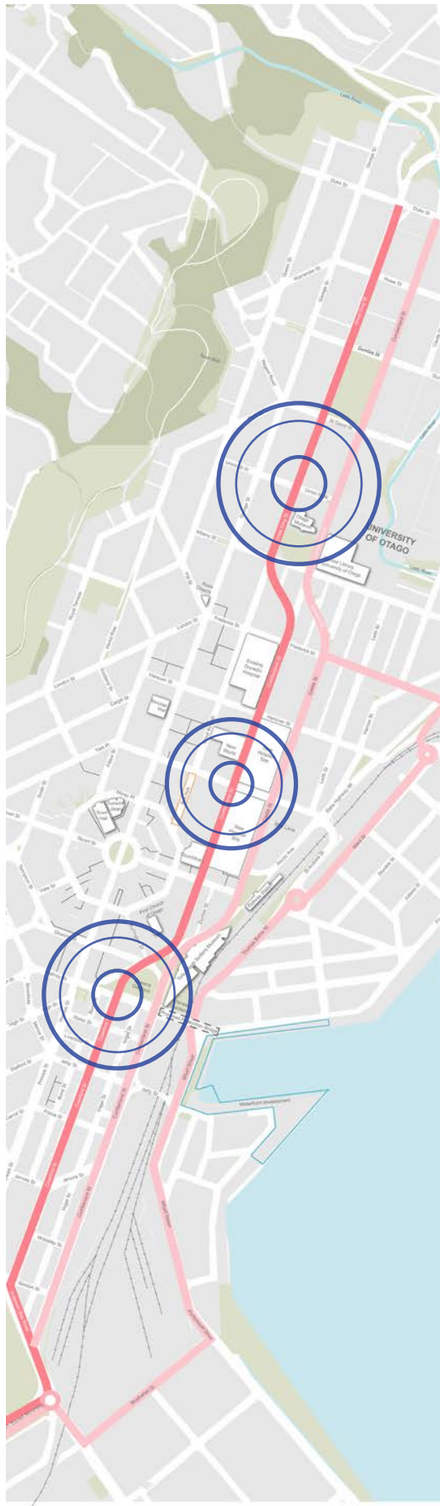


Figure 9. Existing Pedestrian Movements

Location Map



Great King Street - Museum Reserve



Cumberland Street - At new Hospital



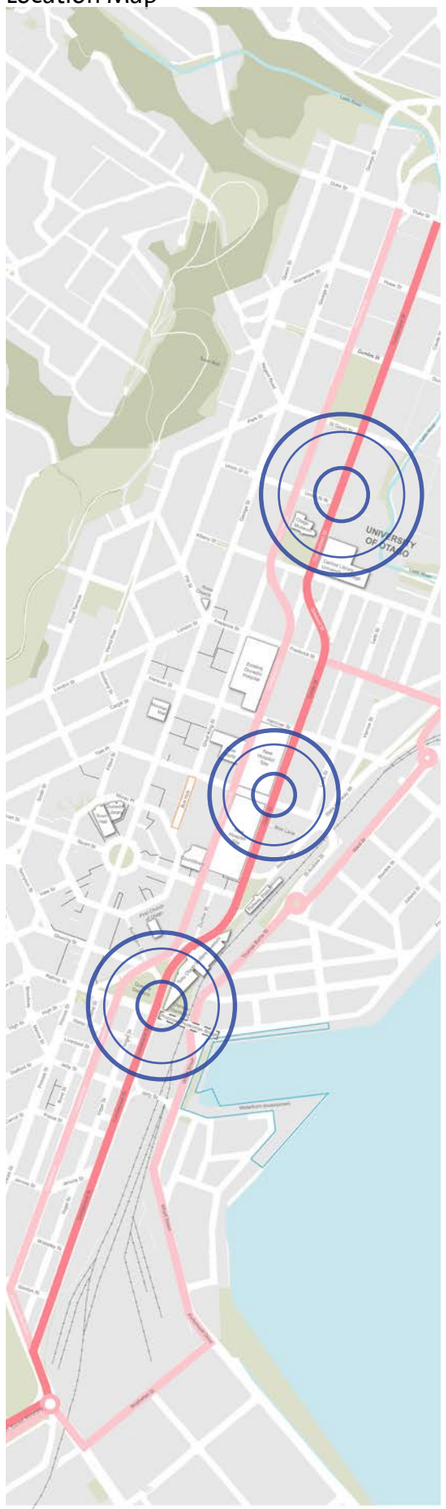
Crawford Street - Queens Garden



Crawford Street - Warehouse Precinct



Location Map



Cumberland Street - University Library



Castle Street - At new Hospital



Cumberland Street - Toitu Otago Settlers Museum



Cumberland Street - Warehouse Precinct



5. Scenario 1

Retain One-Way System Enhance Street Environment



Figure 10. Scenario One Vecihular Movements

These diagrams show the option that keeps the current one way State Highway system. It also introduces some other ideas:

- One-way pair as existing with through traffic able to use SH1 and harbour arterial.
- Slower speed zone in core on both SH1 routes.
- SH88 redirected to Frederick Street
- Targeted amenity improvements.
- Separated cycleway likely to remain on both SH1 routes and extends to Oval
- Barnes Dances on SH1 at key intersections only
- On-street parking mostly unaffected

Cycle Route Connections



Figure 11. Scenario One Cycle Movements

Bus Route Connections



Figure 12. Scenario One Bus Movements

Pedestrian Connections

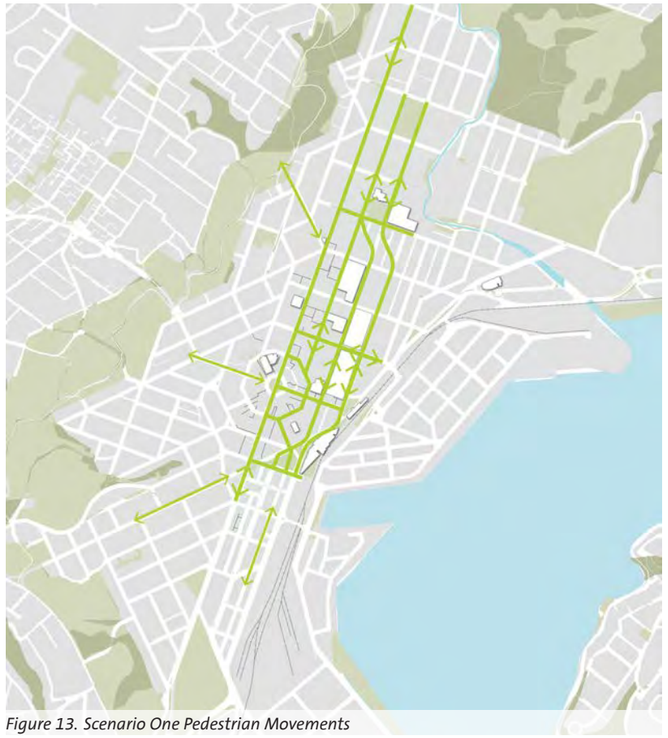
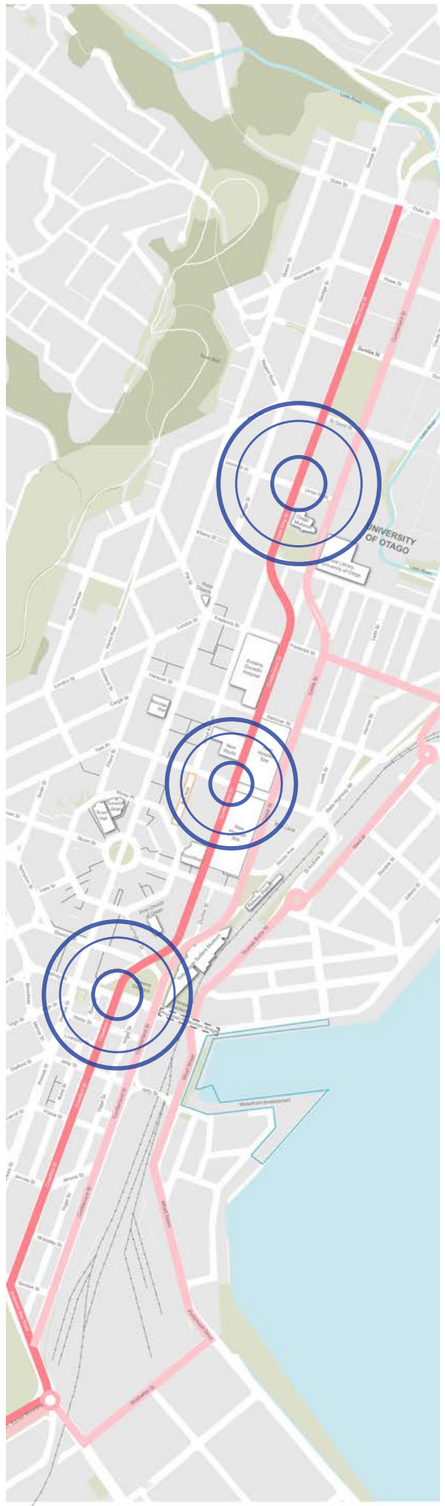


Figure 13. Scenario One Pedestrian Movements

Location Map



Great King Street - Museum Reserve



Cumberland Street - At new Hospital



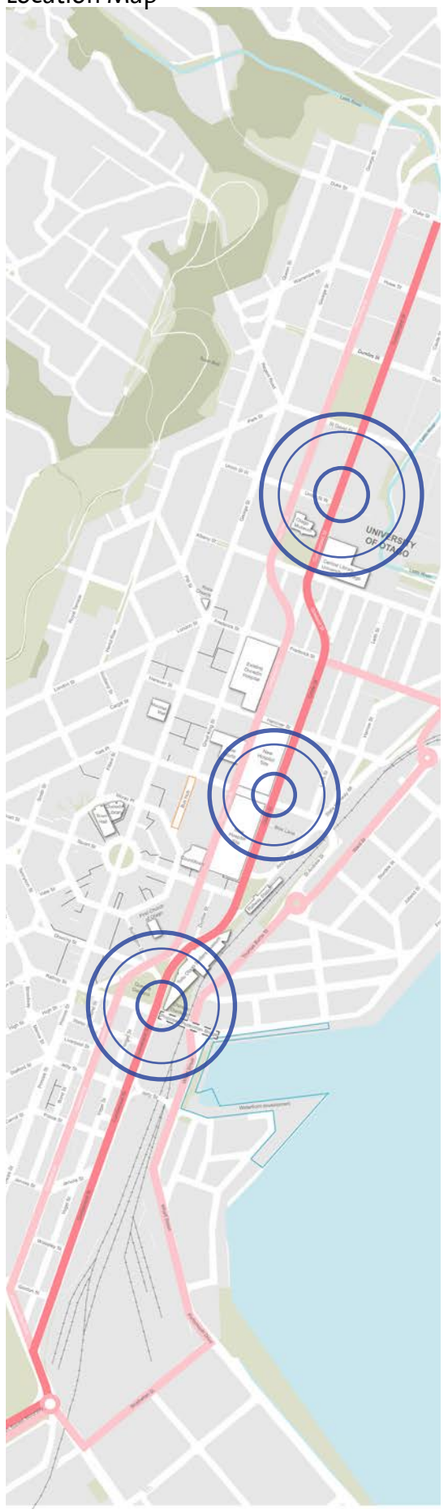
Crawford Street - Queens Garden



Crawford Street - Warehouse Precinct



Location Map



Cumberland Street - University Library



Castle Street - At new Hospital



Cumberland Street - Toitu Otago Settlers Museum



Cumberland Street - Warehouse Precinct



6. Scenario 2 v3

Introduce Two-Way System



Figure 14. Scenario Two Vehicular Movements

These diagrams show the option that changes the current one-way system through Dunedin to a two-way system. Key features of this option include:

- Introduces a two-way system
- Main arterial through route behind the new hospital (see cross sections) –50km/h, minimal on-street parking, no cycling facilities, with
  - 2 through lanes north of Albany Street
  - 3 through lanes (two southbound, one northbound) between Albany Street and Queens Gardens
  - 4 through lanes south of Queens Gardens
- City Street (local road) on the current northbound SH1 road – providing a two-way separated cycleway for the full route from the Oval to the Botanic Gardens, retain /increase on-street parking, Barnes Dance at all signals, more mid-block crossings
- Targeted amenity improvements, focused on local road environment in the core, planted median on arterial
- Slower speed zone and increased place value on local road

Cycle Route Connections



Figure 15. Scenario Two Cycle Movements

Bus Route Connections

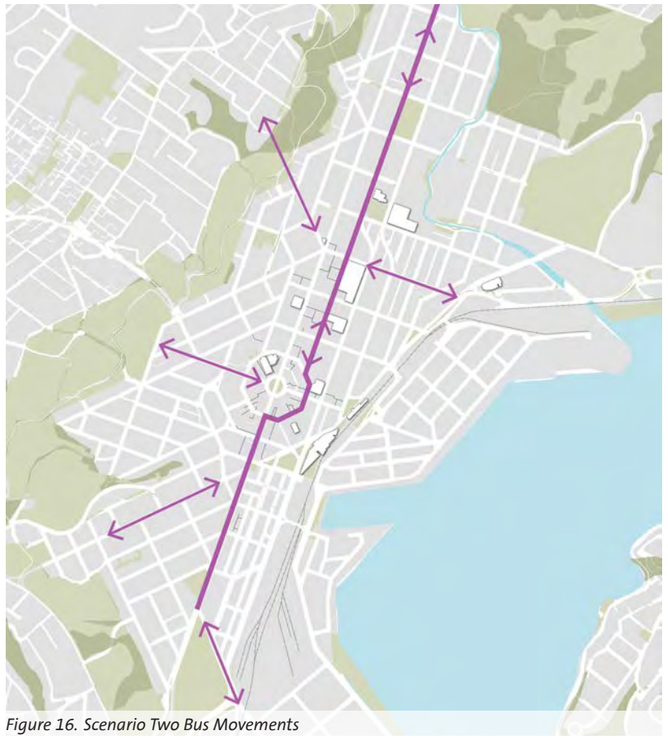


Figure 16. Scenario Two Bus Movements

Pedestrian Connections

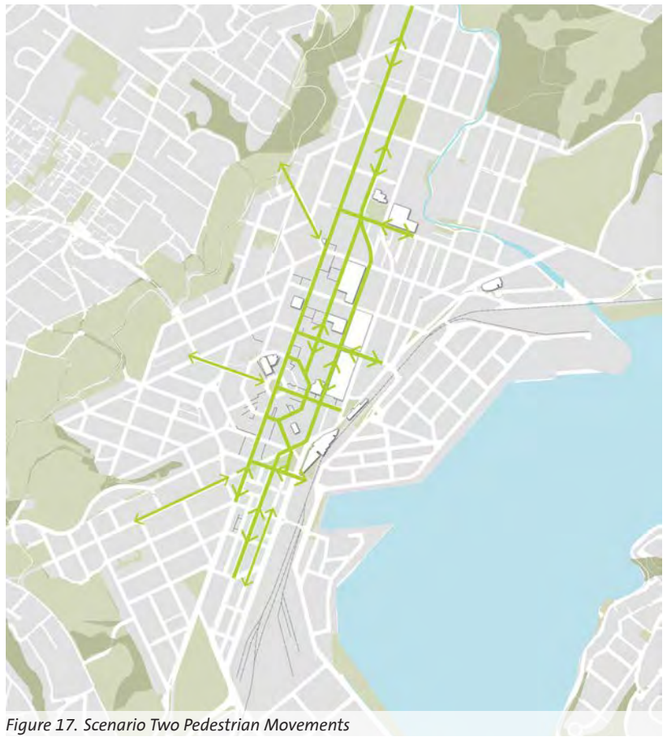
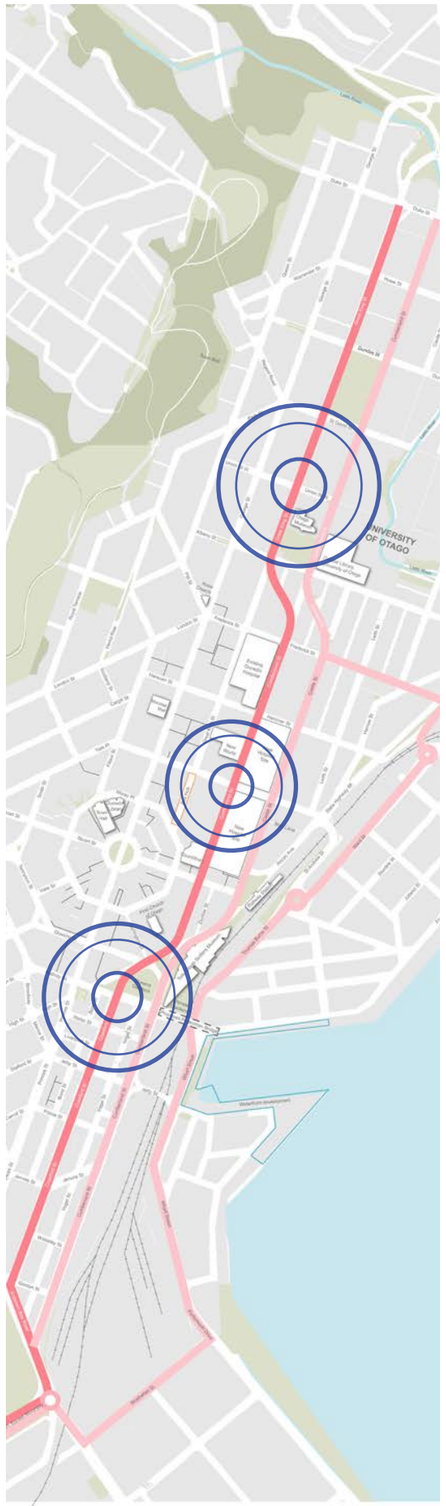


Figure 17. Scenario Two Pedestrian Movements

Location Map



Great King Street - Museum Reserve



Cumberland Street - At new Hospital



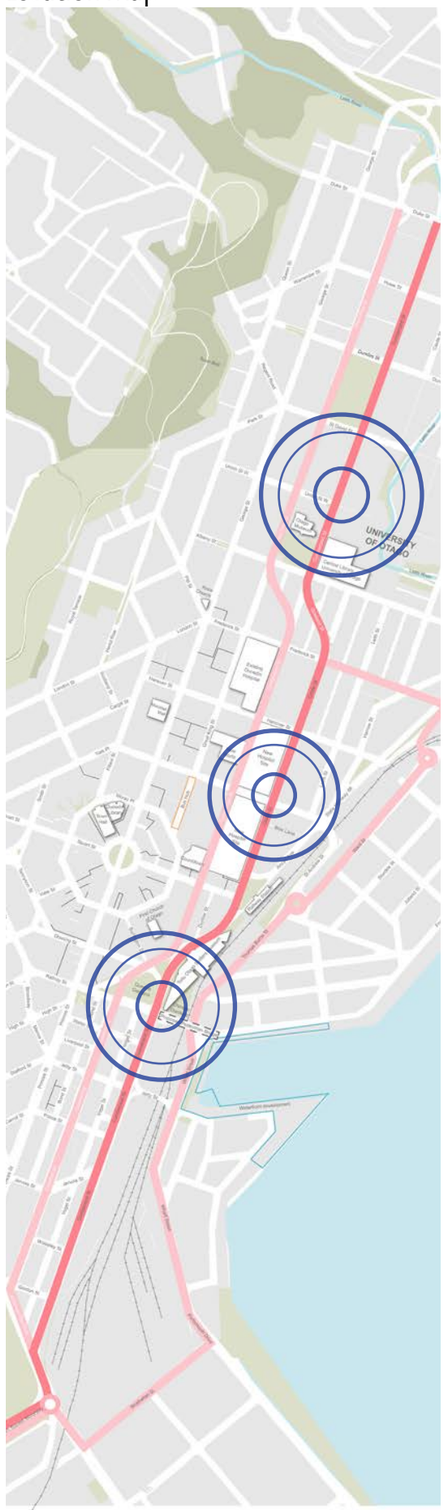
Crawford Street - Queens Garden



Crawford Street - Warehouse Precinct



Location Map



Cumberland Street - University Library



Castle Street - at new Hospital



Cumberland Street - Toitu Otago Settlers Museum



Cumberland Street - Warehouse Precinct



7. University - North Focus Area Place Opportunities

Scenario One | Opportunity Diagram



- Scenario One retains a one-way arterial pair with a lower speed limit on both Cumberland and Castle Streets. Pedestrian permeability is provided for by proposing Albany Street as a slower movement street. Potential green spaces on either side of Albany Street create a 'green gateway' to the northern entrance of the city centre.

Figure 18. North - Scenario One Opportunity Diagram

Scenario Two | Opportunity Diagram



- Scenario Two provides a two-way arterial street network with a lower speed limit on Cumberland Street and maintaining the existing speed limit on Castle Street. Pedestrian permeability is provided by proposing Albany Street as having a slow street environment. Development opportunities are available if the 'S' bends are removed in the future. Potential green spaces on either side of Albany Street create a 'green gateway' to the northern entrance of the city centre.

Figure 19. North - Scenario Two Opportunity Diagram

Ideal Scenario | Opportunity Diagram



- The Museum Reserve and its surrounds are at the heart of the Tertiary Precinct and the University of Otago campus.
- Removing the 'S' bends enhances pedestrian permeability across Cumberland and Great King Street to the campus and reconnects the campus to the city (both visually and physically)
- Extending green space across Albany Street (a slower street) and weaving green through neighbouring streets provides a green framework to the northern gateway of Dunedin's central city.
- Development opportunities exists to the south of the reserve and library by reinstating street layout original form.
- Improves pedestrian connectivity to the Leith Walk and Leith River and into the wider tertiary precinct.

Figure 20. North - Ideal Scenario Diagram

- Green space opportunities
- Potential development opportunities
- Key vehicle movement routes
- One way SH network
- Two way SH network
- Slow vehicle areas
- Pedestrian connectivity desire lines

University of Otago Plan

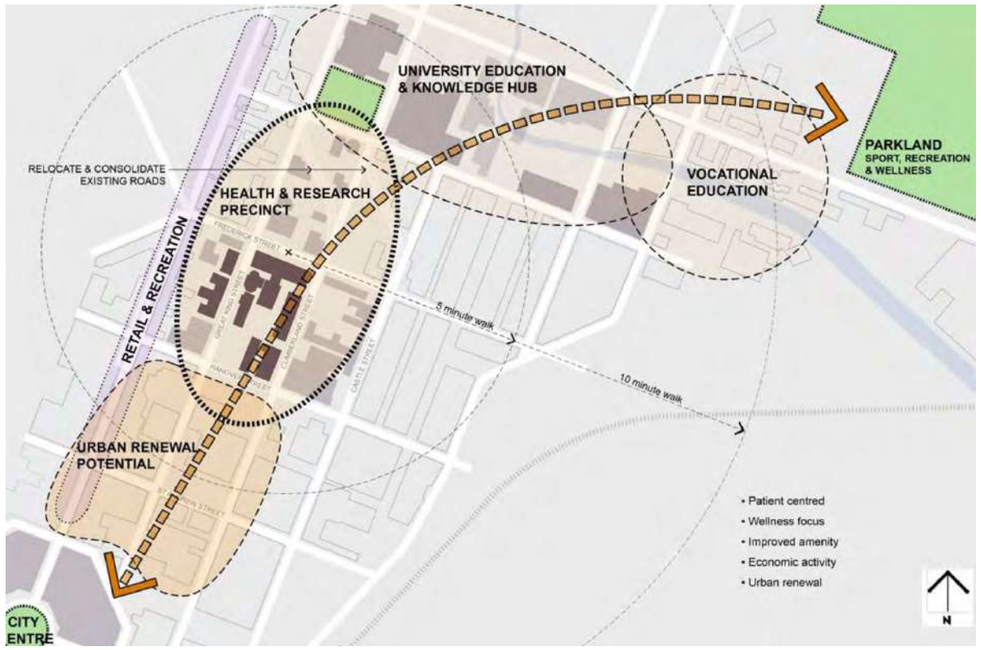


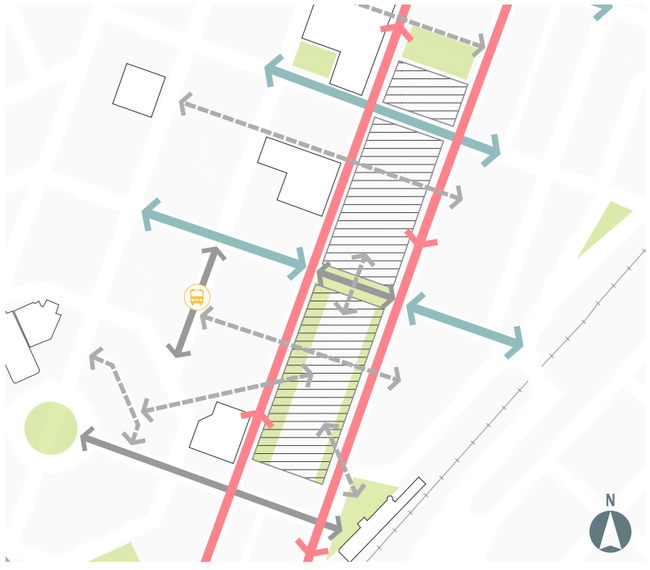
Figure 21. University of Otago Spatial Diagram

The diagram (from University of Otago Campus planning) above reflects Otago University aspirations. The strategic objectives of the University are listed below:

- Creating a strong physical connection across campus, city and beyond; a corridor that links the city centre, Hospital, Health Research, Teaching, Green Spaces, Polytech and wellness precinct near the Stadium and Logan Park.
- Creating strong physical connection for Health Sciences teaching and research; including connection with Hospital
- Creating strong linkages for teaching and Research in the Science Precinct; food sciences, nutrition, physical education
- Enabling opportunities; for easy access and shared infrastructure with other city 'stakeholders'
- Provide for rest of University teaching and research; wider transport / access
- Outstanding Campus Environments
- Sustainability, including transport carbon footprint

8. New Hospital - Central Focus Area Place Opportunities

Scenario One | Opportunity Diagram



- Scenario one retains a one-way State Highway pair with a lower speed limit on both Cumberland and Castle Streets. Pedestrian permeability is provided between the hospital campus by proposing St Andrew Street as a low speed traffic space. Potential new open spaces and through block connectivity within the hospital site can improve permeability further and potentially increase the available green space in this part of the city centre.

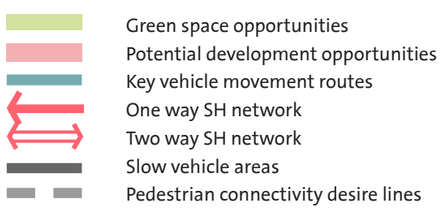
Figure 22. Hospital - Scenario One Opportunity Diagram

Scenario Two| Opportunity Diagram



- Scenario Two provides a two-way State Highway network with a lower speed limit on Cumberland Street. Castle Street will assume a larger traffic flow. Pedestrian permeability is enhanced by reduced traffic and speed on Cumberland Street. As with Scenario One, St Andrew Street is a low speed traffic space. Potential new open spaces and through block connectivity within the hospital site can improve permeability further and potentially increase the available green space in this part of the city centre.

Figure 23. Hospital - Scenario Two Opportunity Diagram



Southern District Health Board



Figure 24. New Hospital Site Spatial Diagram

The diagram (provided by Hospital Planners) above reflects a notional study of the new hospital layout.

The strategic objectives provided by the new hospital designers are listed below:

- promote a positive patient, visitor and staff experience
- provide equitable access to care
- promote sustainability and flexible, future-focussed development strategy
- a precinct that will celebrate the urban built environment
- two-way roads would improve accessibility and safety

Considerations for the new hospital are listed below:

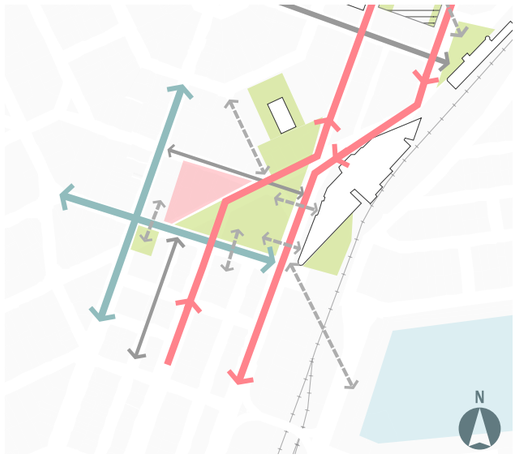
- Shared space concept on St Andrew Street would improve connectivity across the hospital campus
- Safe and easy access for pedestrians
- Connectivity with public transport at Great King Street
- Separation of public, emergency and service traffic
- Minimise impact on neighbours (traffic volume, noise)
- Availability and location of parking
- Integration of hospital with city
- Potential health precinct

- Opportunity to integrate with the central city and allow for safe pedestrian permeability across the two way street network both formal and informal crossing opportunities can be provided for.
- Cumberland Street as a slower speed and reduced volume traffic street increases the opportunities to improve the quality of the street space amenity for hospital users.
- Two way traffic on both Cumberland (along with slower speeds) and Castle Street presents opportunities for different street fronting land use developments.
- Easy pedestrian connectivity to the new bus hub, George Street via Albion Place and the Railway Station can be provided for through a green framework along the new hospital boundaries.

- A slow street or shared spaced treatment on St Andrews Street between the hospital blocks creates enhanced connections between the hospital blocks for hospital functionality.
- A two-way street network allows for efficient access to the hospital for emergency vehicles and separation of the public and service traffic.
- The introduction of changes to the network to enable hospital construction presents an opportunity to change perceptions of the network flexibility.

9. Warehouse | Queens Gardens - South Focus Area Place Opportunities

Scenario One | Connection Diagram

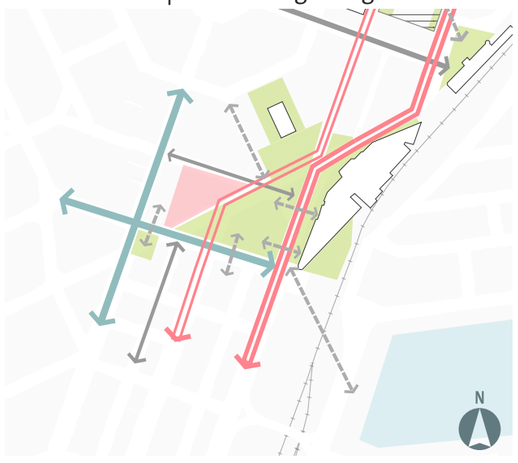


Scenario 1 retains a one-way State Highway pair with a lower speed limit on both Cumberland and Castle Streets. Pedestrian permeability is limited by the severance caused from the one-way SH pair.

Development opportunities are available in carparks surrounding Queens Garden.

Figure 25. South - Scenario One Opportunity Diagram

Scenario Two | Urban Design Diagram



Scenario 2 provides a two-way State Highway network with a lower speed limit on Cumberland Street.

Castle Street will assume the larger traffic volumes. Pedestrian permeability is provided for by Cumberland Street reduced volumes movements and reduced speed and streetscape improvements. Potential new green spaces surrounding Queens Garden could spill over the surrounding road network creating a 'green gateway' to the southern entrance of the city centre. Development opportunities are available in carparks surrounding Queens Garden.

Figure 26. South - Scenario Two Opportunity Diagram

Dunedin City Council



Figure 28. Warehouse Precinct Image

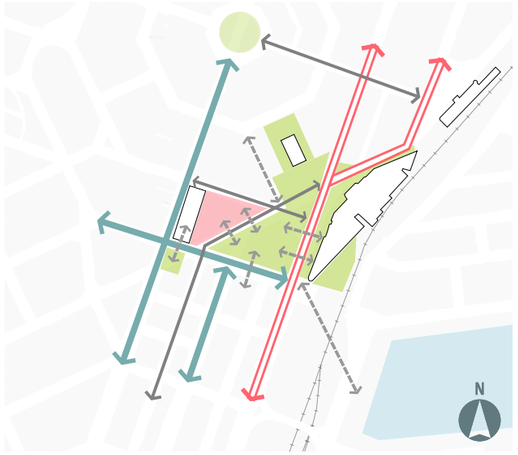


Figure 29. Queens Garden Image

The strategic objectives of the DCC are listed below:

- Compact city with vibrant centre
- Alliances for innovation + a compelling destination
- Creative places with identity
- Low-carbon and enhancing biodiversity
- Open with green spaces
- Connected, safe and accessible for communities
- Efficient movement of people and goods
- High levels of accessibility to key destinations (such as healthcare)

Ideal Scenario | Long Term Outcomes



- Queen's Garden and Exchange Square are special places with strong cultural value and pre-1840 history.
- Opportunity to create a 'front lawn/plaza' experience for Toitu Museum and reconnect Queens Garden to the city (both visually and physically).
- Opportunity to reinforce the grid and diagonal street pattern of Kettle's street plan.
- Opportunity to close Crawford Street at Rattray Street which bisects the Queens Garden, which can reconnect open, green space close to the centre of the city.
- Several iconic Dunedin landmarks are in close proximity to the Queens Garden - connecting these with safe, controlled pedestrian crossings, especially across Rattray and Cumberland Streets is an opportunity.
- Burlington Street could be developed into a pedestrian only area or a shared space to allow vehicles to gain access.
- Development opportunities exist to the north, south and west of the gardens notably the DCC carpark land and along Crawford Street which would be enhanced by addressing the street hierarchy differently.
- Connectivity to the Warehouse Precinct and the harbour area could be made easier and more accessible by spreading the vehicle movements across the transport network and enhancing linkages back into the city.

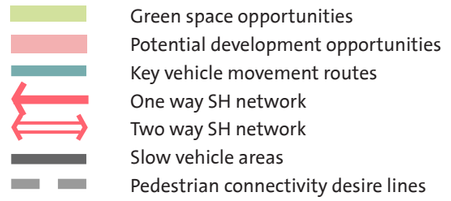


Figure 27. South - Ideal Scenario Diagram

10. Valuing Place Quality

Valuing Urban Realm Toolkit

The use of streets and public spaces (urban or public realm) by people as pedestrians has a value in both social and economic exchange. To value the potential investment in the quality of Dunedin's city centre streets as part of SFDT the Valuing Urban Realm Toolkit (VURT) methodology[1] has been used.

By putting a monetary value on those hard-to-quantify benefits of investing in better streets and spaces, VURT allows them to be considered alongside conventional time-saving, safety and other benefits, both in assessing options for future proposals and building businesses cases for their implementation[2] . We note that this VURT assessment is preliminary which reflects two factors. The first is that the expectations for future pedestrian numbers associated with the new hospital are still being resolved. The second is that the pedestrian baseline data used also has assumptions that can be removed by undertaking new counts. At this time (post COVID 19 effects on pedestrian movements) contemporary counts are not practicable. These data can be updated in due course but the assessment remains a useful guide at this time to the value of investment in place quality. In summary, the VURT process has been:

- Assess the existing streetscape quality using Pedestrian Environment Review System (PERS) on-site audit tool (see below)
- Assess the future streetscape quality arising from the proposed scenarios (plan-based PERS assessment)
- Evaluate the change in streetscape quality between the existing (baseline) situation and the future scenario
- Assess how many people will experience that change in quality
- Assess how long these people will experience the change for, while passing through or staying in the street / space
- Monetise all user benefits by applying Willingness-to-Pay values to the total number of people using the space
- Calculate user benefits for a single year
- Calculate user benefits over the specified lifetime of the project (the period of time can vary with the project)

The PERS audit is a standardised approach to evaluating the attributes that combine to shape the quality of a street or place. If the attributes are not present, or are in poor condition then the street or place will not be a good place for pedestrians and they will avoid or only go there if they have no choice. The opposite is that if the attributes are present and in good condition the street or place will be attractive to pedestrians and people will choose to go there, which both benefits social and economic outcomes for those people and at that place. The attributes in the PERS are in two parts – link attributes and space attributes as set out below.

Each attribute is scored (+3 to -3) for each of the selected Dunedin focus areas and streets in the scenarios described earlier in this report. The assessments were undertaken by technical specialists in urban design, transport planning and included client and consultant team members to test the approach.

As noted above this score is combined with current and future pedestrian volumes to calculate (using inbuilt model willingness to pay values) the user benefits of each scenario.

The PERS attributes scored are:

LINK ATTRIBUTES	SPACE ATTRIBUTES
Effective width	Moving in the space
Dropped kerbs	Interpreting the space
Obstructions	Personal safety
Permeability	Feeling comfortable
Legibility	Sense of place
Lighting	Opportunity of activity
Personal security	
Surface quality	
User conflict	
Quality of environment	
Maintenance	

The PERS assessments were undertaken in two periods mid October 2019 and then in mid May 2020 with the second period reflecting the extended range of the scenarios being considered in the Business Case. A review and subsequent minor updates were completed in March 2021 to refelct alterations to the scenarios.

Figure 30 describes the street sections within the three focus areas where the assessments were undertaken - these align with the scenarios. It is noted that although three areas within the city have been selected for the application of the VURT, any investment in the streets within these areas will be rolled out along the whole route in various forms as it traverses the city centre - a distance of some 3km. Estimates for the unscored street sections were applied according to the method described below (see Assumptions).

Customising VURT to Waka Kotahi Research

Recent research conducted for Waka Kotahi, conducted across a wide set of international evidence, points to methods that, while similar to VURT, measure street attributes in different ways. An exercise was undertaken in cooperation with Waka Kotahi to consider how VURT results differed from an emerging methodology it was considering.

The extreme changes in PERS scores were compared with discrete changes in a series of attributes. The results for any one attribute showed large variations from VURT values but taken across all attributes the difference between the emerging methods values and the VURT values was around fourfold. The conclusion reached was that multiplying the VURT-derived results by 4 would provide a reasonable approximation of results from the alternative, emerging Waka Kotahi method (still in development) subject to closer examination of two attributes, namely effective street width and traffic reduction. The analysis followed in this Dunedin situation and for the Business Case is to multiply all VURT-derived values by 4. This has been done within the results as set out below.

Data supplied by DCC has been used to determine the current pedestrian counts (combinations of 2017/2018 counts) for the streets that the scenarios have been assessed in. Across the network of the streets in the area being considered the peak hour of 11.45am to 12.45pm has been consistently used to ascertain a reference point for the use within the VURT calculations of benefits. It is noted that some streets experience different peak times.

Forecasts of pedestrian volumes are required to enable the future benefits of investments in streets to be calculated. Essentially with more pedestrians present more people will benefit. The approach with forecasts has been to apply an increase in the percentages of pedestrians based on Dunedin projected population to all current pedestrian counts and overlay this with the localised changes coming from hospital redevelopment and the university development. Forecasts have been considered as follows.

New Hospital pedestrian count
The new hospital is projected to employ 1000 people during construction on site. The current hospital working population is 1300 to 1400. With a split of services between the current and future hospital site the street level pedestrian movement of both staff and patients can be expected to increase significantly. There is an extended 'health precinct' concept which includes the Otago University campus facilities which can be expected to further extend street level movements between the new, current and university areas. We understand that hospital car parking will be limited (250 are noted to be provided)[4] on the site. There can consequently be expected to be pedestrian movements to and from the hospital as well to the bus hub (at Great King Street) and to parking areas in the vicinity in combination with dropping off near the front (which is expected to be Cumberland Street). The current movements around the frontages to the current hospital can only be estimated from pedestrian counts at street intersections. There have been no counts taken from the hospital entrances themselves.

At the same general peak time hour (11.45am 12.45pm) Great King Street 156 people headed north (towards the main hospital entrance), at Frederick Street 342 people headed west (towards that Maternity entrance) Cumberland Streets 172 people recorded. The total hour midday peak is at 670 people. A total of 600 pedestrians between 11:45-12:45 was assumed as the starting pedestrian count near the new main entrance, assumed to be spread across two blocks of Cumberland Street, between Stuart and Hanover Streets.

Growth influences
The estimated resident population figure has Dunedin's population at 130,700 in the year to June 2018. This is an increase of 7200 people since 2013 (or 1440 per year on average over 5 years) or a rate of 1.14% p.a.

The growth (20 years – to 2036) the Dunedin campus would be required to accommodate would be an additional 6,900 student EFTS and 500 staff FTE in the academic division[5]. The current university population is some 21,000 students and some 4,000[6] staff, thus the expected student growth rate is 1.43% p.a. There can be a reasonable assumption that is this growth is realised that many of the faculty and students will be pedestrians in the area including those streets being considered in the two scenarios.

1. VURT is a methodology developed by Transport for London (TfL) and has been adapted for use in NZ
2. Case Study Research into Applying the Transport For London VURT Methodology in Auckland, New Zealand (2017) Boffa Miskell in collaboration with Auckland Council
3. Contract 2019209
4. New Dunedin Hospital Preliminary Site Master Plan Report (2019)
5. Otago University Campus Master Plan (2016)
6. Otago at a Glance, University of Otago (2019)

Valuation Assumptions

The results from the VURT are provided in present value terms, based on the following core assumptions:

- Base year is 2020
- First year benefits occur in 2023
- Pedestrians are assumed to walk 100% of the four street sections next to the hospital, 50% for the other four scored sections and 100m each for the four unscored sections that complete the current Queens Garden to University state highway corridor.
- Daily pedestrian counts are assumed to be 6.5 times the 11:45-12:45 count (consistent with measured data sighted)
- Annual pedestrian counts are assumed to be 332 times the daily account (a standard assumption taking account of reduced flows on holidays)
- The growth rate of pedestrians will be 1.3% p.a., being the average of recent population growth and expected student growth (sensitivity tests are also provided for annual growth rates of 0.8% p.a. and 1.8% p.a.)
- The street assets have a life of 30 years (i.e. 2023 to 2052). There is likely to be some residual value in the street assets in 2052 but this has been ignored in this analysis based on the assumption that substantial costs will be incurred at the time to realise this value. This assumption is judged to be conservative.
- A real discount rate of 4% is appropriate, based on the Waka Kotahi expected move to this discount rate in July 2020.
- Values per PERS derived in the UK were converted to NZ dollars at an exchange rate of 0.5 NZ dollars per British pound.

Two further adjustments were made to the figures provided by the VURT.

First, not all streets to be improved were scored. An estimate of the missing sections was made by (a) assuming PERS and pedestrian counts are the same as for adjacent sections; and (b) further assuming that pedestrians only walked 100m of each section on average, given these sections were long sections away from the university and hospital.

Second, recent research conducted for Waka Kotahi across a wide set of international evidence points to methods which, while similar to VURT, measure street attributes in different ways. An exercise was undertaken in cooperation with Waka Kotahi to consider how VURT results differed from an emerging methodology being considered. The extreme changes in PERS scores were compared with discrete changes in a series of attributes. The results for any one attribute show large variation from VURT values but taken across all attributes the difference between the emerging Waka Kotahi values and the VURT values was around fourfold. The conclusion reached was that multiplying the VURT-derived results by 4 would provide a reasonable approximation of results from the alternative, emerging Waka Kotahi method subject to closer examination of two attributes, namely effective street width and traffic reduction.

The analysis followed in this business case is to:

- Multiply all VURT-derived values by 4
- Accept the VURT-derived values for effective width, on the judgement that this attribute was not of major significance in this business case
- Explicitly analyse traffic change effects using the emerging Waka Kotahi method for Scenario 2 versus Scenario 1 (i.e. less traffic on Cumberland but more on Castle) – this work is yet to come.

The improved street attributes are estimated to provide benefits to pedestrians over the next 30 years of $17 million for Scenario 1 and $22m for Scenario 2, both in present value terms. The effect is largest on the Cumberland Street section expected to front the hospital main entrance. With further data on this future pedestrian population the values can be expected to be further refined.



Figure 30. VURT Assessment Locations



11. Programme Performance

Outcome of VURT assessment for both Programme 1 and Programme 2v3

The table below summaries the outcome of the VURT assessment for each programme. The improved street attributes are estimated to provide benefits to pedestrians over the next 30 years of $16 million for Programme 1 and $19.9m for Programme 2, both in present value terms.

Present value of pedestrian benefits relative to Status Quo ($0m) – Refer to Attachments for locations		
Street Section (refer to Appendices for locations)	**Scenario 1**	**Scenario 2 v3**
Castle Street (CA1)	$0.5	$0.3
Castle Street (CA2)	$1.0	$0.5
Cumberland Street (C1)	$9.8	$11.2
Cumberland Street (C2)	$3.8	$4.5
Cumberland Street (C5)	$0.4	$1.0
Great King Street (GK5)	$0.2	$1.7
Queens Gardens North (QN)	$0.2	$0.5
Queens Gardens South (QS)	$0.1	$0.2
Sub-total	**$16m**	**$19.9m**

Further commentary about the performance of each programme, particurly in relation to the PERS place quality attributes is set out below.

Performance of Programme 1

The improvements to place quality resulting from Programme 1 is estimated to provide benefits to pedestrians over the next 30 years of $16 million. The effect is greatest on the Cumberland Street section outside the new Dunedin hospital, with an estimated value of pedestrian benefits totalling $9.8 million.

Multiple factors including high pedestrian numbers associated with the new hospital contribute to the Cumberland Street effect. Pedestrian permeability is provided between the hospital campus by proposing St Andrew Street as a low speed traffic space. Potential new open spaces and through block connectivity within the hospital site will also improve permeability further and potentially increase the available green space in this part of the city centre. The most influential of the PERS attributes which contribute to the Cumberland Street effect are from the proposed improvements in amenity through planting and kerb build outs and increased feelings of comfort and safety resulting from the separation of the footpath provided by either parking bays and/or cycleways from the one-way traffic lanes.
The slow speed zone also provides benefit to the pedestrian and when coupled with the above attributes helps to improve place quality.

It should be noted that a key component of the pedestrian benefits on Cumberland Street outside the new hospital is the separated footpath. If this separation is not provided i.e. a footpath is directly adjacent to two one-way traffic lanes this will impact on the benefits to pedestrians as valued by VURT and in turn place quality.

The value of pedestrian benefits on Castle Street behind the new hospital, whilst also positive compared to the status-quo is much lower than on Cumberland Street. This is primarily due to less opportunity for improving pedestrian permeability and amenity, which impact of feelings of comfort and safety, coupled with lower pedestrian numbers.

There is a slight increase in value of pedestrian benefits around the University under Programme 1. This is primarily related to some slight increase in feelings of comfort and safety due to introduction of a lower speed limit on both Cumberland and Castle Streets. Some improvement in pedestrian permeability is also provided by proposing Albany Street as a slower speed street.

The lowest value of pedestrian benefits is at Queens Garden (southbound). This is primarily due to pedestrian permeability continuing to be limited by the severance caused from the one-way system. The slight increase in benefits acknowledges that there may be a reduction in traffic volume as some of the existing traffic may move to the harbour arterial and providing some separation (planting, parking and/or cycleway) between footpath and two lanes of one way traffic improves feeling of comfort and safety.

Performance of Programme 2v3

The improvements to place quality resulting from Programme 2v3 is estimated to provide benefits to pedestrians over the next 30 years of $19.9 million.

As per Programme 1, the effect is greatest on the Cumberland Street section around the new Dunedin hospital. The estimated value of pedestrian benefits on Cumberland Street outside the hospital under Programme 2v3 totals $11.2 million. Again, multiple factors including high pedestrian numbers associated with the new hospital contribute to this value. The most influential of the PERS attributes are the proposed improvements in pedestrian permeability, through the introduction of a two-way local road and mid-block crossings, improved amenity through addition of planting and kerb build outs and increased feelings of comfort and personal safety and environmental quality due to reduced traffic volumes, introduction of sow speed zone and less heavy traffic as more traffic use the arterials (Harbour Arterial and SH1).
It should be noted that under Programme 2v3, the value of pedestrian benefits on Castle Street behind the new hospital, is now significantly lower than the value of pedestrian benefits on Cumberland Street. Whilst Programme 2v3 still provides a positive (although minimal) effect compared to the status-quo, that benefits to pedestrians is now lower than Programme 1 benefits despite working to same predicated pedestrian numbers. This is primarily due to the proposed three through lanes between Albany Street and Queens Garden. Because of spatial constraints within the road corridor, the additional traffic lanes results in no ability to provide for general amenity planting nor separate the footpath from the traffic lanes (either with cycleway, parking or planting). This has a significant impact on the PERS attributes of feelings of comfort and personal safety, quality of environment and pedestrian permeability.

Under Programme 2v3 there is an increase in value of pedestrian benefits around the University. Again, this is primarily related to increases in feelings of comfort and safety due to introduction of a lower speed limit on both Cumberland and Castle Streets, and the introduction of a two-way local road replacing the current one way system, which will increase feelings of comfort and personal safety, provide more pedestrian permeability and opportunities for activation.

Again, the lowest effect overall is at Queens Garden (southbound) where there is $0.2m value of pedestrian benefits above the status quo (do minimum). This is mainly due to pedestrian permeability continuing to be limited by the severance and impacts on feelings of comfort, personal safety and pedestrian permeability caused from the proposed three through lanes of traffic. The slight increase in benefits acknowledges that there may be a reduction in traffic volume as some of the existing traffic may move to the harbour arterial which improves comfort to some extent.

South of Queens Garden due to the introduction of a two-way local road on Crawford Street, there will be increased pedestrian benefits resulting from improved feelings of safety and comfort and increased permeability to the Warehouse Precinct. Furthermore, on Cumberland Street, whilst there is four through lanes of two way traffic, the introduction of a footpath which is separated from the traffic lanes (by cycleways, parking and amenity) helps to improve the PERS attributes of comfort and safety and in turn improve place quality.

12. Programme Scores

Scoring system

A seven-point scoring system was used:

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernable or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

Programme 1 and Programme 2v3 Scores

The table presents the scores for each programme, for place quality. The scoring for the two programmes reflects how well each programme performs against the criteria, compared to the Do Minimum. The Do Minimum consists of the transport network as it currently exists with the addition of the following committed interventions:

- Permanent Barnes Dance at both Albany Street/SH1 intersections (currently a trial)
- George Street – 10 km/h for four blocks - Albany to Moray Place
- Tertiary – 30km/h speeds on Union Street, Harbour Terrace, Clyde Street and Forth Street.

Programme	Score	Summary Rationale for score
Do Minimum	0	• Whilst slower speeds will help with people being able to cross the road more safely and slightly improve feelings of comfort when walking along footpaths without being combined with other attributes such as improved amenity these will have no discernible impact on place quality.
Programme 1	+1	• Includes improvement in place from a repositioning of traffic volumes -some to the harbour arterial which when coupled with slow speed zone will improve comfort to some extent. • The proposed additional streetscape improvements will contribute to the legibility of the street network and with some amenity improvement to arterials. • User conflicts in terms of better cycle amenity and footpath widths and separation form traffic lanes in places is also positive. • There is some improvement in the opportunity for activation and amenity in some locations particularly outside the new hospital. • The retention of the two-way system, however, will continue to have an impact on pedestrian permeability and feelings of comfort and personal safety and in turn place quality.
Programme 2v3	+2	• Reallocating larger volumes of traffic across to the east side of the new hospital enables a more city street quality environment graduating back towards the city centre. • The slowing of traffic and reduced volumes also adds to the permeability of the street to crossing in combinations with new mid-block crossings. • The legibility of the street network is also enhanced as is the users experience with the two-way system. • Local identity can also be more easily understood and stopping options are increased in terms of business visibility which enhanced opportunities for new activities. • The quieter street environments will also encourage people to spend time in the place which assist the activation. • Whilst the proposed three through lanes between Albany Street and Queens Garden, presents a reduction in pedestrian benefits and place quality behind the hospital when compared to Programme 1, the benefit of improvements to Cumberland Street, Great King and Crawford Street resulting from the introduction on a two way local road, will provide a more positive impact to place quality than Programme 1.



Appendix L Health Impact Assessment

Shaping Future Dunedin Transport Project:

Health impact assessment

For the Local Advisory Group

Robert Quigley

Quigley and Watts Ltd.

20 April 2021



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1. Introduction

Shaping Future Dunedin Transport is a collaborative partnership between Waka Kotahi NZ Transport Agency, Dunedin City Council and Otago Regional Council. The Local Advisory Group has a wider membership, including Southern Partnership Group, Ministry of Health, Southern DHB, University of Otago, Otago Polytechnic, Otago Regional Council, Te Rūnanga o Ōtākou, Otago Mayoral Forum and the Workforce Group (MBIE).

The Local Advisory Group asked for a health impact assessment (HIA) on the Shaping Future Dunedin Transport project (hereafter project).

The project is a review of Dunedin's central city transport system. The project is in response to the new Dunedin Hospital (NDH) development which is being built between two State Highway 1 roads. The project is about re-thinking the future of Dunedin's central transport system to see if it can be used to support major developments, such as the NDH and better enhance the central city for everyone.

The HIA assessed three roading scenarios: Do Minimum, Programme 1, and Programmme 2v3. The three roading scenarios are presented in more detail in Section 1.2 below. Additional project details can be found on the Waka Kotahi NZTA website.

1.1 Purpose and objectives

The purpose of this assessment is to judge the potential health effects of the two proposed road scenarios against the Do Minimum scenario, including both potential positive and negative effects. The assessment suggests ways to minimise potential negative effects and maximise the uptake of potential health benefits.

The objectives are to:

- Draw from and build upon the outputs of the regulatory planning and assessment process (e.g. other assessments) and collect bespoke data from stakeholders
- Identify and describe any potential health effects (positive or negative) from the scenarios
- Make evidence-based suggestions to maximise positive effects and minimise negative effects.

1.2 The three scenarios being assessed

Table 1 (below) outlines the characteristics of the three scenarios.

Table 1. Programme characteristics

Do minimum characteristics	Programme 1 (P1) characteristics	Programme 2v3 (P2v3) characteristics
• Permanent Barnes Dance crossings at Albany/SH1 intersections. • George Street 10km/h for four blocks (Albany Street to Moray Place). • Tertiary area 30km/h on side streets (Union, Clyde and Forth Streets and Harbour Terrace)	Do minimum plus: • Harbour Arterial upgrade (peak travel time is similar to the Do Minimum paired SH1 route) • Parking management will prioritise shoppers and hospital users over long term parking • More frequent and more direct bus services with a low flat fare • Two park and ride sites (Burnside and Mosgiel) • Cycle and pedestrian network gaps improved • SH88 relocated from St Andrew Street to Frederick Street to allow a pedestrian focus on St Andrew Street • Pedestrian priority at signals on hospital frontage • Provision of additional cycle routes connections on Albany Street and St Andrew Street	• Same as Option 1
No change to existing: Pair of SH1 one-way arterials retained at 50km/h	Pair of SH1 one-way arterials retained, but at 40km/h. 1. Northbound arterial stays one way and two lane. This road is the front door to the hospital, and the western-most SH1 arterial ie. closest to the city centre. 2. Southbound arterial stays one way and two-lane. This road is at the back of the hospital, and the eastern-most SH1 arterial. The SH1 one-way arterials will have slightly improved amenity for pedestrians (e.g. Barnes Dance crossings at intersections, amenity planting, greater separation from traffic), improving north-south and east-west pedestrian movements	Pair of SH1 one-way arterials changed: 1. Northbound arterial changes to a two way local road at 30km/h. Not a State Highway. This road is the 'front door' to the new hospital. 2. Southbound arterial changes to a two-way State Highway Arterial at 50km/h (now only one road is a State Highway instead of two) The local road will have a significantly improved level of amenity, people-friendly, pedestrian focus, cycle friendly and safe for people of all abilities. It will be a spine for all north-south movement of pedestrians, bus users and people who cycle. It will also support accessible routes east-west better than Programme 1. The two-way State Highway Arterial will have few improvements to amenity, be a primary vehicle route, have no cycle facilities and will not have mid-block crossing for pedestrians, but will have improved pedestrian safety at intersections (Barnes Dance crossings).

•

Do minimum characteristics	Programme 1 (P1) characteristics	Programme 2v3 (P2v3) characteristics
No change to existing: The authority to make decisions about allowable land uses on the existing SH1 pair sits with multiple agencies (e.g. Council, NZ Transport Agency) due to it being a State Highway	The authority to make decisions about allowable land uses on the existing SH1 pair sits with multiple agencies due to it being a State Highway	The local road allows a greater proportion of the central area of Dunedin to be under Council authority: This significantly increases opportunities for residential living and supportive business environments all the way back to the city core.
No change to existing: Number of on-street parks unaffected. Commercial parking buildings to support new hospital are expected.	Number of on-street parks reduced slightly to accommodate amenity improvements. Commercial parking buildings to support new hospital are expected.	Parking removed from the new SH1 arterial to accommodate extra vehicle lane. Parking on local road retained and where possible expanded. Commercial parking buildings to support new hospital are expected.
Vehicle speed limits retained at current levels except for George Street and Tertiary area side-streets (as above).	Vehicle slow zone of 30 to 40km/h from Jetty Street (in the south; warehouse precinct) to St David Street (in the north; tertiary precinct), including existing pair of SH1 arterials (40km/h)	The new SH1 arterial is 50km/h. A vehicle slow zone of 30km/h from Jetty Street (in the south; warehouse precinct) to St David Street (in the north; tertiary precinct)
No change to existing: Dedicated cycleways on the existing paired SH1 arterial retained, supporting confident cyclists.	Dedicated cycleways on existing paired SH1 Arterial retained and extended; supporting confident cyclists.	The new two-way SH1 Arterial will have no dedicated cycling facilities, but similar amenity value to the Programme 1 SH1 arterial. The cycling spine will shift to the local road and will support two-way travel and less confident people who would like to cycle.
No change: Pedestrian connection between bus hub and new hospital is retained in its current state.	Pedestrian connection between bus hub and new hospital is improved via Barnes Dance crossings, is indirect, but supports all types of abilities.	Pedestrian connection between bus hub and new hospital is greatly improved via Barnes Dance crossings and signalised mid-block crossings, is direct and supports all types of abilities.

•

2. Approach and methodology

2.1 Conceptual framework

Health impact assessment (HIA) is the most common framework used in New Zealand and internationally to analyse, monitor and manage the health consequences of development. HIA can inform the choice of options and design of projects/programmes.

The International Association of Impact Assessment (2006) describes how interventions (such as a proposed change to a road) might affect health through intermediaries, or what are described as the determinants of health. These include:

- Individual determinants (genetic; biological; sex; dietary intake; personal safety; tobacco use; activity; employment status; housing status; personal income; educational status; etc)
- Social and environmental (Access to health services, education, employment and other social services; Quality of air, water and soil; Distribution of wealth; Community norms and attitudes; Urban design; Local transport options available, etc.)
- Institutional factors (capacity, capability and jurisdiction of Government, Local Government and NGOs to provide frameworks for action, services and infrastructure).

However, HIA cannot start with a checklist of potential impacts but must identify what to assess from an awareness of the project and an understanding of how the project might affect what is important to the project's stakeholders. Fortunately, contextual information is available regarding the roading options and data is available about the local communities. Also, site and stakeholder specific information was considered to further understand the proposals and what might be important to stakeholders via:

- Discussions with Local Governance Group
- Discussions with project team
- Alignment with assessment criteria for Strengthening Future Dunedin Transport's Multi Criteria Analysis
- Site visits
- Maps of the region.

Taken together, the above information was used to provide a conceptual basis for this assessment, by answering the key question - Whether there may be any health effects:

1) Arising from the two roading scenarios versus the Do Minimum
2) On access to health services, safety, pollution, activity (via mode shift), connectivity within the CBD, and sense of place
3) Arising from being an older person (Dunedin and/or outer center such as Oamaru); a hospital staff member; a university student; or person with disabilities?

2.2 Geographic study area

Given this is a transport project, a study area had previously been defined by Waka Kotahi. This area encompasses the roads proposed to be changed and the communities around them (see Figure 1 for Study Area). The study area encompasses the area between the Oval (in the south) and Botanic Gardens (in the north) and several blocks east of Princess Street, the Octagon and George Street. These areas happen to match two Statistic New Zealand Census Area Units (Campus South and Dunedin Central-Harbourside).

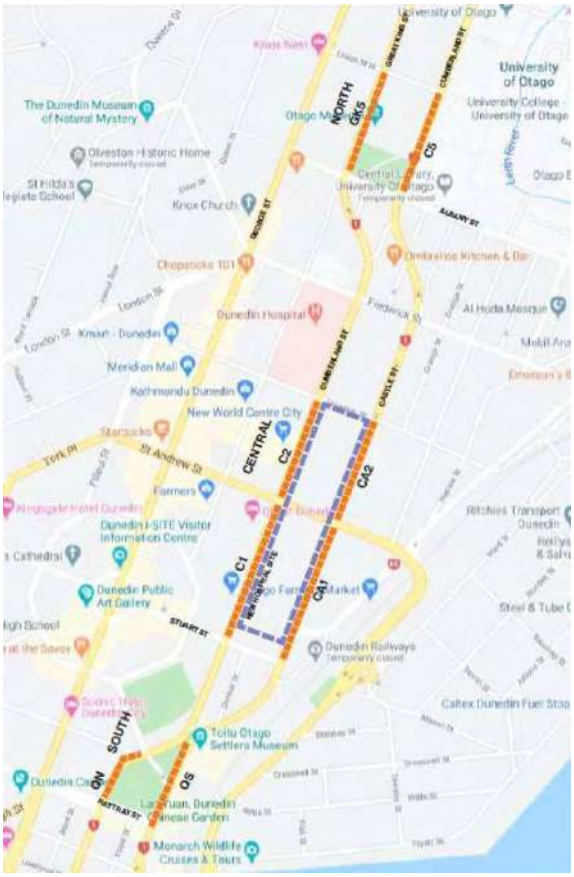


Figure 1. Study area

2.3 Data collected and considered

Beyond the information sources listed in Section 2.1 above, the methods of gathering information about the existing situation and potential health effects were:

Undertake scans of the literature to understand the empirical evidence about how these topics might impact on health outcomes. Literature reviews are available from the author for:

- Access to health services
- Safety
- Mode of travel and connectivity
- Sense of place
- Pollution.

Engage those with most experience in such matters, such as topic experts from stakeholder agencies; or those who will experience the intervention, such as community members from within the study area. Using predominantly telephone interviews and focus groups, 66 people/organisations were engaged by the health assessor:

- People with disabilities and advocates (18)
- Students (11)
- Hospital staff (12)
- Older people and advocates - North Otago and Oamaru (18)
- Shaping Future Dunedin Transport team and multi criteria analysis authors (6)
- New Dunedin Hospital (1).

Review existing reports, including the Multi Criteria Assessments, the Public Engagement summary and the online social pinpoint analysis.

-

2.4 Assessment and scoring method

Data were considered by the assessor to determine whether a health effect had the potential to occur or not. Both positive, negative and neutral effects were considered. Where effects were concluded to potentially occur, the effect was scored using the same scale as the Multi Criteria Analysis (See Figure 2.)

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernable or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

Figure 2. Assessment scoring matrix

3. Community profile

As described above, the study area matches closely to three statistical areas: Campus South; Dunedin Central; and Harbourside. Data for these areas are described below. Maps are presented in Appendix 1.

3.1 Introduction

Dunedin City sits within the Otago Region on the east coast of the South Island of New Zealand. Dunedin City is a harbour city but also has a large geographical area to the south, west and north totalling over 3,300 km^2 (See Figure 3).

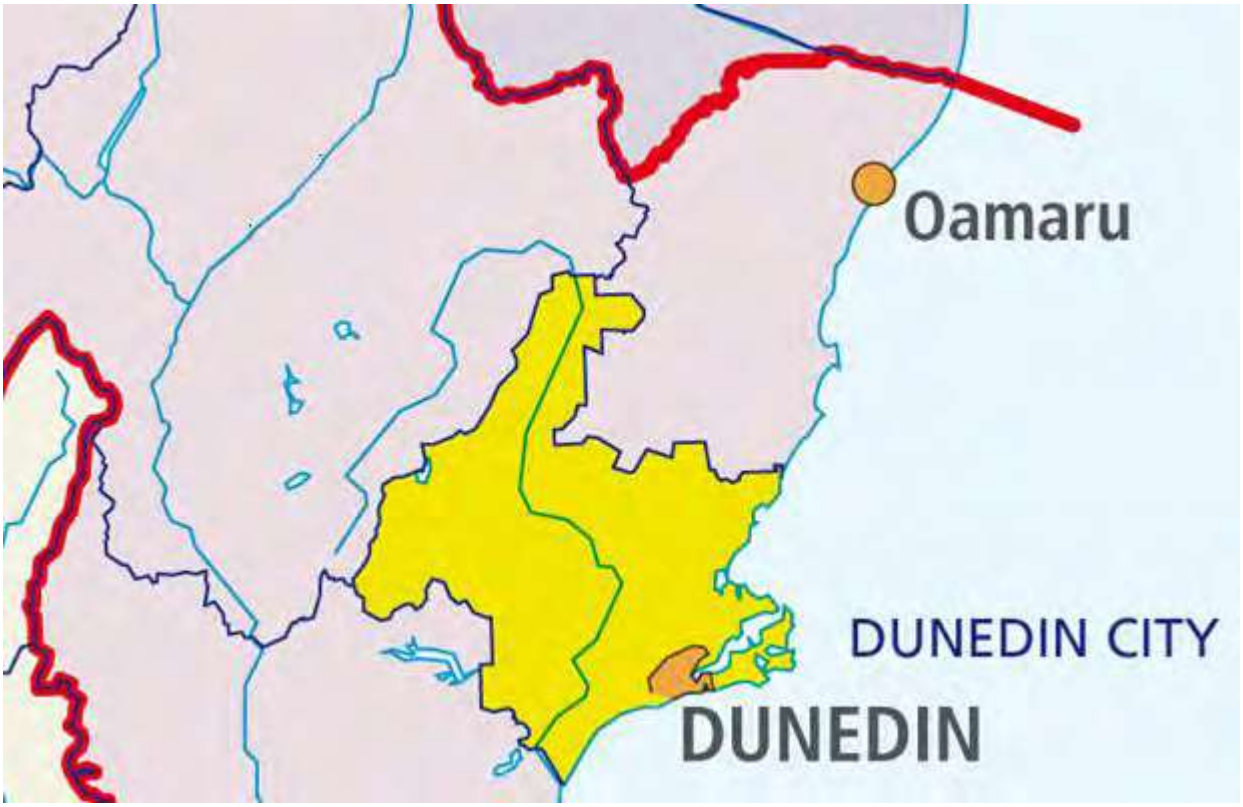


Figure 3. Map of Dunedin City (yellow)

Within the urban centre, Dunedin City boasts retail, hospitality destinations and access to high quality services, be that education, health or arts, etc.

The rural areas within Dunedin City boundaries are those that can be experienced all over New Zealand. Lightly populated, zoned rural, and a predominant agricultural land use.

3.2 Population

The 2018 Census showed Dunedin City had a resident population of 126,255, with population growth of 6.4 percent from the 2006 Census. The 2020 estimated population is 134,100 (a further 6.2 percent increase in just two years) (see Table 2).

Harbourside has a very small and declining resident population (45 in 2018), reflecting the industrial nature of the area.

The population in Campus South has decreased by 7 percent to 2,031 in 2018. In contrast, the Dunedin Central population has increased by 2.3 percent over the same time, but this is about one-third of the increase experienced by Dunedin City as a whole (see Table 2).

Table 2 – Population data (*Statistics NZ, 2021*)

	Population by Census			Population per cent change
	2006	2013	2018	2006 to 2018
Campus South SA2	2,184	2,046	2,031	-7.0%
Dunedin Central SA2	1,902	1,914	1,962	+2.3%
Harbourside SA2	60	48	45	-25.0%
Dunedin City	118,683	120,249	126,255	+6.4%

3.3 Demographics

Table 3 continues to show the differences between Campus South and Dunedin Central compared with Dunedin City. Campus South and Dunedin Central have very low proportions compared with Dunedin City for those aged 65+ years, income and house ownership. Campus South and Dunedin Central also reflect a more diverse ethnic population, where Dunedin City has 13 percent non-European, compared with more than double that in Campus South (31 percent) and Dunedin Central (30 percent). These data reflect classic student and inner city populations and demonstrates these populations are quite different from 'typical' Dunedin City residents.

The average population per household varied, with Dunedin City at 2.40, Dunedin Central at 2.33, and Campus South at 3.92 people per household. The higher Campus South average reflects the student population in the area who are, nearly all, flatting (house ownership of 2%).

The very small sample size of Harbourside makes the presentation of demographics prone to error, so it is not reported from this section forward.

Table 3 – 2018 Census demographics (Statistics NZ, 2021; Massey University, 2021)

Area	Aged 65+ (per cent)	Median income	Per cent Maori/European[1]	House ownership[2] (per cent)	Average population per household	NZ Deprivation Index[3]
Campus South	0.3	$6,900	12/69	2	3.92	9
Dunedin Central	3.0	$17,400	9/70	16	2.33	8
Dunedin City	15.9	$25,500	9/87	67	2.40	N/A

[1] People can self-identify with more than one ethnic group and not all ethnic groups are shown, so totals do not sum to 100

2 Owned, partly owned or held in a family trust

3 The NZ Deprivation Index combines census data relating to income, home ownership, employment, qualifications, family structure, housing, access to transport and communications. Meshblocks (the smallest geographic area from census data) are grouped into deciles, where 1 represents the areas least deprived and 10 the areas most deprived.

3.4 Transport data

Table 4 continues to show the diversity in the two statistical areas compared with Dunedin City, with:

- High (80.5% in Dunedin Central) or very high (96.6% in Campus South) proportions walking or cycling as their main way to travel to education
- Campus South and Dunedin Central have a four to five times the proportion of people walking or cycling as main means to travel to work when compared to Dunedin City
- About one-third of people use a vehicle as main means to travel to work (in Campus South and Dunedin Central) compared with nearly three-quarters in Dunedin City.

Again, demonstrating these populations are quite different from 'typical' Dunedin City residents. Simply, the vast majority of these residents do not rely on vehicles to travel to work or education and instead use walking (predominantly) and cycling. Public transport usage remains relatively low, as per the rest of Dunedin City.

Table 4 – Transport related Census demographics (Statistics NZ, 2021)

Area	Vehicle as main mean to travel to work (percent)	Walk or cycle as main means to travel to work (percent)	Bus or train as main means to travel to work (percent)	Walk or cycle as main way of travel to education (percent)	Car, truck or van as main way of travel to education (percent)
Campus South	37.1	48.1	2.8	96.6	0.2
Dunedin Central	31.0	57.7	4.4	80.5	12.0
Dunedin City	73.4	12.0	3.4	43.3	43.6

3.5 Population groups of focus for this assessment

Additional data about the five groups of focus is presented below.

3.5.1 Older people

Older people are one-quarter of Dunedin's population, but as seen in the Census data above, proportionally, very few live in the CBD. Therefore, most older people travel to the city centre to engage with it. Focus group and interviews identified older residents of Dunedin use their gold card on buses, catch a lift with a friend or drive a private vehicle to travel to the city centre Taxis are rarely used due to cost.

Older people have strong desire to travel to the city centre to meet their friends, volunteer and do daily tasks. When in the city, older people from Dunedin usually do several things each time they come into the city, rather than just coming in for one reason and then leaving again. This provides a solid connection to the city centre for these older people. Older people from Dunedin regularly move about the city (several blocks) on foot. This is confirmed by the NZ Travel Survey which shows that older people are walkers - they walk for more minutes than at any other stage/age in their life.

Older people do travel to the city centre for hospital appointments and the literature is clear that older people have a higher need than average for access to hospital-level/outpatient health services. Transport is their number one barrier for accessing services.

For those who drive, the focus groups and interviews identified that they do not like driving on the one-way system, finding the heavy vehicles and speed intimidating, and rarely venture onto the one-way system on foot. They say the State Highway intersections are dangerous due to vehicle speed and turning

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traffic. This is confirmed via Waka Kotahi's Community at Risk Rating system, where Dunedin City has the highest risk rating, nationwide, for intersections, and third highest risk rating for older road users.

When North Otago older people must come for a hospital appointment, they either get a lift, come in by shuttle or bring a private vehicle. A medical appointment is an in-out appointment, meaning they only come for that reason, and then leave again. Parking is a common concern for medical appointments, especially as appointments sometimes take several hours (beyond parking restrictions); parking is sometimes quite a distance for these older people to walk; and the drop-off zones mean the driver must leave a (typically) unwell person alone while the driver attempts to find a suitable park. Park and ride options for people arriving from the North were seen as one potential solution to this parking dilemma.

In contrast, when older people from North Otago choose to come to Dunedin City for other reasons, such as visiting friends, family, shopping or window-shopping, entertainment, they've planned their day. They usually arrive by vehicle, and move about within the city, mostly by vehicle. People from Oamaru had a higher expectation of being able to park at a venue, and as such typically chose places to visit that were not available in Oamaru, had attached parking and typically these venues were on the fringe of the city. Unlike older people from Dunedin, they seldom parked in the city and walked throughout the CBD.

According to interviewee's (advocates for older people), the experiences of older people from North Otago are similar to those of older people from Central Otago (Wanaka, Cromwell, Queenstown) who also arrive from the north for medical appointments. These travellers often take State Highway85 (via Ranfurly/Palmerston) over State Highway8 (via Roxburgh/Milton).

3.5.2 People with disabilities

People with disabilities are one-fifth of population, and according to interviewee's and focus group participants the proportion living in the CBD is low. This is said to be due to the relatively inaccessible nature of inner city residential buildings, and cost. Popular suburbs for people with disabilities are instead, for example, South Dunedin which is flat, close to the city and more affordable.

Therefore, most people with disabilities travel to the city centre to engage with it. Focus groups and interviewees identified that people with disabilities use buses as the most common mode. The fully accessible buses are critical, but of course they do not work for all. Issues remain regarding ease of access to the bus stop, access on/off the bus, and the length of time/amount of energy needed for a bus trip. Next most common modes were private vehicle and disability taxi. However, disability taxis were said to be expensive, do not operate beyond 6PM, and experiences with operators were sometimes negative. In contrast to others, power wheelchair users regularly powered in from South Dunedin, eschewing all other modes. For those who drive, parking was a issue, with the number, quality and location of disability carparks.

People with disabilities come to the city for a rich variety of reasons and uses: Education, shopping, entertainment, meeting friends and family, volunteering and of course, work, to name a few. When in the city, people with disabilities usually do several things each time they come into the city, rather than just coming in for one reason and then leaving again. This provides a solid connection to the city centre for these people. People with disabilities regularly move about the city, on foot or wheeling themselves. Several focus group members moved large distances, from the Octagon to university and back again. Movement was the rule rather than the exception. However, several people with disabilities described the need to take safe routes, and that these routes are not usually the shortest routes. The block sizes in Dunedin are relatively large. Some people with disabilities (and their carers) can only walk/wheel/push about one block due to fatigue. Regardless of relative ease of mobility, direct routes e.g. from public transport stops or mobility car parks are highly valued to minimise effort/time of movement.

Certainly, the literature describes multiple barriers in urban environments. Focus group/interview participants describe Dunedin City as "OK" from a disability perspective for most people with disabilities, but they also added that many places in the city need substantial improvement. In contrast, some of the interviewee's and some in the focus group described substantial barriers to moving about Dunedin City

centre. These people described an unwelcoming space for people with severe disabilities, and numerous obstacles in the environment.

Zebra crossings don't work well for visually impaired people or for those who are less confident/able movers. Such people only use signalised intersections or signalised mid-block crossings.

Regarding hospital appointments, the literature shows people with disabilities have a higher than average need to access hospital-level/outpatient health services and that transport is also their number one barrier. The literature tells us that people with disabilities die younger than the general population and are more likely to be socially isolated.

3.5.3 Tertiary students

There are about 25,000 university and polytechnic students and another 5,000 staff (23% of total population). The students have a high demand for health services too, but the vast majority of that is delivered by Student Health on campus. However, several university buildings, for example the Hunter Centre, are separated from the main campus by both State Highways meaning students regularly cross those roads.

Most students admit to mid-block crossings and acknowledge the danger of that, especially for those out-of-town who are not used to one-way systems. Students with disabilities can only safety cross at signalised intersections, of which there are relatively few.

Dunedin is unique in that the Campus South and Dunedin Central areas have extremely high rates of walking or cycling to education (97% and 84%). These rates are the highest in the country. Walking and cycling are active modes, contributing to health and wellbeing outcomes such as mental health and maintenance of a healthy weight to name just two of many.

Much of the student's movement is within the university site itself, but students regularly move all over the city and particularly the CBD. The students have a very strong attachment to Dunedin Central: the ability to live close to the university and the city, to be close to other students and the vibe of the city. Also, several expressed an interest in living in the CBD rather than the student area.

Students who cycled were confident cyclists and despite that, describe cycling in the city as '*downright dangerous.*' This was due to gaps in the cycle network, the need to veer across traffic on the one-way system and merging at intersections.

Dunedin has the third highest risk rating for pedestrians and fifth highest for cyclists out of 67 Territorial Authorities according to Waka Kotahi's Communities at Risk Rating.

3.5.4 Hospital staff

Dunedin Hospital is a Level 1 hospital with approximately 2,800 staff and 2,100 inpatients, outpatients and visitors. Hospital services make a direct contribution to wellbeing through diagnosis, treatment and management of illness and accidents.

Staff wellbeing is important and is regularly considered by the DHB due to demanding nature of the work (capacity, and the level of difficulty of presenting patients is increasing) so anything that can improve the working environment is welcomed.

Similarly, patients and visitors are typically unwell and/or highly stressed so high quality urban spaces are highly valued.

Staff mostly use a private vehicle to get to work (80%), though 5% bus, 5% cycle and 10% walk. But of those who use private vehicles, a large proportion would consider shifting modes. A hospital staff travel survey identified fifty percent would consider using a bus if it was direct to the hospital (and safe) and sixty percent would consider using free park and ride. Such mode shift has many positive contributions to

health, for example, extends life expectancy, halves the risk of heart disease, lowers stress levels, and reduces the risk of diabetes. Many have already used the Wakari to Hospital shuttle.

However, rather than concern about themselves, staff are primarily concerned about their patients and visitors. The focus group participants wanted to ensure that that their patients have equitable access to their service i.e. patients can get to the hospital using whatever mode they need/are able to.

Hospital staff also voiced their concern about vehicle pollution arising from vehicles. The literature is clear regarding negative effects on all-cause mortality, cardiovascular disease, some cancers, chronic and acute respiratory diseases, to name a few.

4. Assessment of programmes

This section presents the findings for Do Minimum, Programme 1 (P1) and Programme 2v3 (P2v3).

4.1 Do minimum: Overall score of -1.25, minor negative

The overall score is made up of an average from the individual scores for each determinant of health assessed, presented in the table below:

Determinant	Do minimum score
Access to health services	-1
Safety	-2
Modes of access to/from city; and connectivity within CBD	-1
Sense of place	-1
	-1.25 (Average score)

4.1.1 Rationale for score

Of the 66 people who participated in the engagement aspect of this assessment, zero preferred the Do Minimum scenario.

4.1.1.1 Access to healthcare (score of -1; minor/slight negative)

The New Dunedin Hospital (NDH) is sited between two State Highways at existing 50km/h speeds with many untreated intersections creating unsafe and challenging access to health services for all people across these roads, but especially for older people and people with disabilities. Under Do Minimum the high community risk rating for Dunedin city remains for all modes/population groups and may get worse as traffic volumes rise. The NDH sits within this existing environment.

Rural, low income, older people, people with disabilities and minority ethnic groups are more likely to have transport problems when accessing healthcare.

Without public transport improvements under Do Minimum and with only small improvements in physical infrastructure, access to the city and the NDH has the potential to remain constrained for those without vehicles, but especially for older people and people with disabilities. This compounds the empirical evidence which shows that for people with disabilities who are non-frequent users of public transport, medical appointments are the second most common purpose for using public transport.

The empirical evidence around transport and access to health shows that transportation affects every step in the healthcare journey. Transport is:

- a major reason for delay in seeking healthcare
- a major reason for cancelling or missing appointments
- the most common reason people withdraw from treatment.

Quotes from participants

"*The central city isn't a great place for me because of my disability, so any changes under option 1 or 2 would have to be a big improvement* "(Person with a disability).

"Having the one ways around the hospital will make it inhospitable (Student).

"*There's not much point in going to the city if you can't move around it. So I only go in when I need to. For a hospital appointment, I'd usually leave straight afterwards*" (Person with a disability).

4.1.1.2 Safety (score of -2; moderate negative)

The safety performance of the existing network is poor. Dunedin has the 7th highest risk rating out of the 67 Territorial Authorities and Unitary Councils in NZ. On top of that, Dunedin's risk profile is the third highest for pedestrians, third highest for older road users, fifth highest for cyclists, and has the highest risk rating in NZ for intersections. While the Do Minimum does lower vehicle speed in a small number of streets, safety issues largely remain unaddressed.

Just taking two examples, mid-block crossing on the State Highways continue in the university precinct and throughout the city; and many unsafe intersections remain. These are key factors for university students, older people and people with disabilities. Within the focus groups, hospital staff who cycle are confident cyclists, but even so, at times they fear for their lives. For the hospital staff who didn't cycle, safety was a major reason not to.

The empirical evidence confirms the obvious: Road traffic injuries and death are bad for people's health. Injuries and death happen across all transport modes to all age groups, though there are notable inequalities. Pedestrians and cyclists are more vulnerable road users because they can withstand only relatively gentle impacts. The fatality risk for pedestrians increases sharply beyond 30km/h.

The empirical evidence also shows that one way systems are typically less safe than two way. The existing one way system in Dunedin City is part of the environment and currently Dunedin City has a poor safety risk rating compared with other Territorial Authorities in New Zealand. One question from the Local Advisory Group was whether airports, with their one way vehicle systems, might be exemplary design for the NDH. The answer is no, because of the different characteristics between an airport and the NDH:

- Airports are on the fringes of the city whereas the NDH is in the city centre
- Airports are primarily accessed by vehicles, often travelling at 100km/h on the airport route
- Airports typically have little to no pedestrian or cycle infrastructure along that airport route, and so airports are primarily dealing with vehicles, and passengers of those vehicles
- When a vehicle arrives at an airport, the road design is often one way, but the one way system 'kisses' one side of the airport only. The airport is not ringed by roads on four sides as per the NDH.
- To enable safe pedestrian drop-off/pick-up and safe access by pedestrians from carparks, an airport one way system has significant treatments to slow vehicles, typically to 30km/h in the airport vicinity, then to 10km/h at the terminal itself. Dunedin Airport uses (very high) raised pedestrian crossings; Melbourne Airport has resorted to 'people with stop/go signs' as the volume of traffic and pedestrians is too high.
- As such, one way vehicle systems at airports can promote safe access, but at very low speeds. There is no proposal for such speeds at the NDH.

For those people with disabilities who drive to the city, car parking on the one-way is not plausible due to the design of the cycle path barriers, which prevent the people exiting from the 'footpath side' of the road. This means these people need to enter/exit their vehicle on the traffic side. This is too dangerous for most.

None of the programmes discuss the 5-street roundabout of St David, Regent, Park and George Street. This was considered a dangerous intersection by nearly all participants at the student focus group.

Quotes from participants

"My wheelchair was stuck! I couldn't go forward. I couldn't go back. A man on a motorcycle had to stop and help me out of the traffic lane" (Person with a disability).

"Bicycles are all mixed in with cars at the intersections and it's really confusing. Really dangerous. I really worry about hitting them" (Older person, driver).

"This option does nothing to improve the issues with the one way system" (Student).

"I have 'jay-walked' in my power chair, but only very very occasionally. It's really not safe!"

"The Do Minimum is no advantage for anyone" (Disability advocate).

4.1.1.3 Modes of access to/from the city and connectivity within the city (score of -1)

Multi modal access (vehicle, public transport, cycling, walking, taxi, shuttle) for journeys to/from the city and pedestrian/ cycling movement within the city remain constrained under a largely, business as usual approach. Existing roadways and intersections would become harder to cross over time as traffic volumes increase, especially for older people and people with disabilities.

Do Minimum has no major investment in public transport and vehicle travel times do not change. Combined with small improvements in physical infrastructure these will signal that vehicles will remain the dominant form of transport and remain attractive. This has the potential to undermine mode shift for hospital staff, older people and people with disabilities. The health benefits of active transport may not be unrealised.

The majority of the tertiary precinct is unchanged, and so the safety of students is potentially compromised in the face of increasing vehicle numbers.

The empirical evidence from the NZ Household Travel Survey shows that time spent walking is highest for those aged 15-24 years (18% of all travel time), 65+ years (15%) and 75+ years (19%) (Ministry of Transport, 2021). These age groups reliance on walking is undermined by little to no investment in pedestrian infrastructure.

Quotes from participants

"The camber of the roads, the curbs, the lip edges, traffic management fencing. You're just waiting for the next moment your path will be blocked" (Person with a disability).

"It'll be better for walking around George Street" (Student).

"Not much incentive to use PT is there?" (Hospital staff).

"As a person with a disability, I actively avoid travelling into and around the central city" (Person with a disability).

4.1.1.4 Sense of place (score of -1; minor/slight negative)

Under Do Minimum, feelings of safety and comfort for older people and people with disabilities have the potential to improve substantially on the four blocks of George Street; and for university students on the four streets in the tertiary precinct. This is because of reduced vehicle traffic and amenity improvements.

However, these people-focussed areas of the city remain small and disconnected for these population groups. Overall, without any other interventions, place quality slowly declines for these population groups because increased trips on the network are dominated by vehicle trips.

The State Highways constrain development opportunities around housing for potential inner city residents and businesses because of the (existing) shared authority of the State Highways, and so potential positives of density of population, vibrancy of the street space and eyes on the street are less likely to be realised.

Despite good efforts, the city urban environment is not truly welcoming to people with disabilities. Similarly, living spaces in the CBD are not well designed for people with disabilities or those with mobility issues. Therefore, very few older people or people with disabilities currently live in the CBD and this has little chance to change under Do Minimum.

Sense of place is not advanced, neither is amenity, nor feelings of safety.

Quotes from participants

"Dunedin will be less pedestrian friendly and less commutable than other cities in New Zealand" (Student).

"The central city has a few places which are welcoming to people with serious disabilities, but there is improvement needed in many areas. This wouldn't change much under Do Minimum" (Person with a disability).

"If you don't have experience of driving in Dunedin the one way street layout is confusing. The city is busy, it's stressful. On top of that is the worry about finding a carpark that's close enough for me to walk" (Older person, Oamaru).

"If you're in a disability van or shuttle, odds are it's because you can't move very far. There needs to be lots of these drop-off zones in different parts of the city so I can access different parts of the city" (Person with a disability).

4.2 Programme 1 (P1): Overall score of +0.75, slight/minor positive

The overall score is made up of an average from the individual scores for each determinant of health assessed, presented in the table below:

Determinant	Do minimum score
Access to health services	0
Safety	+1
Modes of access to/from city; and connectivity within CBD	+1
Sense of place	+1
	+0.75 (Average score)

4.2.1 Rationale for score

Of the 66 people who participated in the engagement aspect of this assessment, three preferred P1.

4.2.1.1 Access to healthcare (score of 0; neutral)

A number of potential effects are common to P1 and P2v3. These have the potential to create positive outcomes for access:

- The Barnes Dance crossings on key intersections (not just those close to NDH) and the slow speed zone have the potential to improve access for nearly all people, including older people, people with disabilities, university students and hospital staff.
- Improved public transport has the potential to support access to health services for those without vehicles, of which older people, people with disabilities and university students have higher proportions than other groups. The empirical evidence confirms the importance of public transport, because for those people with disabilities who are non-frequent users of public transport, medical appointments are the second most common purpose for using public transport. The literature also describes how public transport is only used when services are appropriate, match appointment times, and match an ability (health/energy wise, and supportive urban environment) to walk/move at either end of the public transport trip. About half of older people in New Zealand metropolitan areas use public transport.
- A pedestrian focus on St Andrew Street is important for linking the hospital to the northerly Southern DHB buildings e.g. Professional Learning Centre.

However, there are also some potential negative effects, common to both P1 and P2v3, regarding access to health services:

- For older people from Oamaru, the most common access to the hospital is either self-drive (if a confident long distance and city driver), get a lift from friends (who are also usually older people as well) or family, or take the door-to-door shuttle. Parking is the main concern for those who drive. A few people do other tasks while in the city, depending on their age/wellness and length of medical appointment. Carers/friends typically stay with the older person throughout the whole journey. Shuttle users have good access, being a door to door service, though the day is long. As such, there is little to differentiate the programmes regarding access to NDH for older people from Oamaru. The empirical evidence supports the above, showing most health service visits in New Zealand are taken in a private vehicle. However, for older people and people with disabilities, car ownership is low and ability to drive reduces sharply with age. Therefore, the evidence describes a greater reliance on friends, family, taxis and shuttle services. Asking people for a lift to attend medical appointments is considered appropriate (compared with say, to go shopping). Also, the literature describes how older New Zealanders with vehicles are generally happy to drive within their rural town but are reluctant to drive longer distances.
- The mid-block crossings on the State Highway at the ‘back door of the NDH’ to the east of the city, are unsafe for hospital staff and visitors who park their vehicles to the east and walk to the hospital.

Several characteristics which have potential negative effects regarding access to health services are specific to P1:

- The NDH is sited between two state Highways at 40km/h speeds.
- The two-lane State Highway on the city-side (western side) has the potential to reduce access compared with P2v3's local road.
- The uncontrolled mid-block pedestrian crossings to the NDH (across either State Highway) are likely to be less safe for older people or people with disabilities, potentially forcing routes which will take longer (time, distance and the person's energy).
- Heavy vehicles remain on both sides of the hospital, potentially contributing to noise, smells (from stock trucks), pollution and reducing feeling of safety. A positive hospital environment contributes to the wellbeing of staff and visitors and P1 is less likely to contribute to such an environment.

Quotes from participants

"It wouldn't be great for the hospital to be marooned on an island between the State Highways. Whether it's the city getting the most out of the NDH, or the NDH getting the most out of the city", we need the best possible connection" (Southern DHB representative).

"Better, but not great (Student).

4.2.1.2 Safety (score of -1; minor/slight negative)

A number of potential effects are common to P1 and P2v3. These have the potential to generally, create positive outcomes for safety:

- The Barnes Dance crossings on key intersections (not just those close to NDH) and the slow speed zone have the potential to improve safety for nearly all people, including older people, people with disabilities, university students and hospital staff. Similarly, the St Andrew Street calming is important for a safe linkage between the hospital and the northerly Southern DHB buildings for hospital staff, visitors and patients. Where intersections do not use Barnes Dance crossings the safety benefits are not as high.
- Some heavy vehicles divert from the State Highway to the Harbour Arterial route, leading to a small safety improvement for the Southern and Central sections of the State Highway. However, these diverted heavy vehicles re-join the State Highway at the university precinct (Frederick Street), leading to a small decrease in safety in this area.
- Mid-block pedestrian crossings to the New Dunedin Hospital (out the back door) are not safe for older people or people with disabilities and these groups will need to continue to use the intersections (Barnes Dance crossings) to cross safely
- Outside the hospital, if more parking is required near the Harbour area, this will increase the number of pedestrians crossing from the east on the arterial route to access the hospital and CBD. This is true of both programmes
- The slow speed zone from Jetty St to Union Street, and including the State Highway 1 pair, addresses vehicle speeds for a relatively large area (but not beyond Union Street in the tertiary precinct).
- The international literature is clear that one-way traffic flow is less safe than two way. However, because speeds are lower in P1 than P2v3, the effect in Dunedin is more likely to be neutral.

Several characteristics which have potential negative effects regarding safety are specific to P1:

- The State Highway 1 cycle lane is extended and provides safety benefits for confident cyclists for parts of the route. However, several dangerous situations where cyclists cross/merge with vehicle traffic remain on this route. Public Engagement supported removal of the cycle lanes from the State Highway from a safety perspective.
- Mid-block pedestrian crossings to the New Dunedin Hospital (across either State Highway) are not safe for older people or people with disabilities,
- Heavy vehicles remain on both sides of the hospital, contributing to reduced feelings of safety.
- The potential for all-mode conflict remains due to unchanged access to big-box retail in the south and fast food outlets in the north.

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- In the tertiary precinct, there is additional potential for accidents for students which may arise from a greater number of heavy vehicles on Frederick St (via Harbour Arterial), the installation of mid-block crossings on the State Highway arterials, and from the slow speed zone stopping at Union Street - therefore not including high-student foot traffic areas: residential and popular fast food restaurants. The additional potential for accidents is offset somewhat from the reduced speed of the two State Highway routes, so overall the risk tends neutral.

Overall - Several health benefits accrue, are substantially better than Do Minimum, but do not reach their full potential.

Quotes from participants

"Barnes Dance's are great" (Person with a disability).

"I still wouldn't cycle around" (Student).

"I can't park on one side of the one way as I'd have to get my wheelchair out of the car while facing a lane of traffic" (Person with a disability).

"This is not enough of a change" (Hospital staff).

"Parking on the one-way sucks now anyway" (Student).

"Please remove the cycle lanes from the State Highways!" (Hospital staff member).

"People are afraid of the State Highway one-ways" (Disability advocate).

4.2.1.3 Modes of access to/from the CBD and connectivity with the CBD (score of +1)

A number of potential effects are common to P1 and P2v3. These have the potential to create positive outcomes for mode of access and connectivity:

- Barnes Dance crossings on key intersections, along the whole route and not just those close to NDH, and the slow speed zone (30km/h), improve east-west and north-south connectivity for pedestrians, including people with disabilities, older people, hospital staff and students.
- Several changes are proposed (compared with Do Minimum) which may support mode shift, including parking management; public transport improvements, park and rides, cycle and pedestrian networks, and slow speed zones. These are projected to be major factors which underpin mode shift. Parking management is a key factor and the political appetite for increasing parking costs is often challenging at a local government level. Public Engagement supported all-day parking locations on the edge of the central city and acknowledged that inner city parking should be prioritised for people with mobility issues and short-stay retail. Public Engagement also strongly supported public transport improvements.
- There is a perception held by some that older people and people with disabilities do not take public transport. However, older people use their gold card to explore the city on public transport. The bus fleet in Dunedin is fully accessible, and nearly all points of interest are available through services. For those for whom money is an issue (including older and disabled people), the lower-cost fares increase the potential to use public transport.
- Both P1 and P2v3 do not allow cyclists to easily travel northbound if starting at the university. This is because of the circuitous nature of the P1 dedicated cycle lanes, and the two way cycle lane being on Great King Street for P2v3. In both situations, cyclists must travel west, cross Cumberland Street, to turn north at Great King Street. This could be alleviated by a Leith cycleway, connecting the university northwards.
- Public transport is described as the most common form of transport for people with disabilities in Dunedin (Disabilities Advocate). As such, improvements in public transport have a potential positive effect. The second most common mode is disability taxi, but the drop-off points are often dangerous, and cost is prohibitive. The existing fully accessible buses are critical for access for many people with disabilities. It gives additional mode choice over expensive taxis, or relying on families, or anxiety about parking if they drive themselves. For some people with disabilities, public transport is unlikely to work well. For example, one pariticipant described how she needed regular toilet stops, and the time required to take the bus, door to door, was simply too long.
- Park and rides were supported by older people, especially from Mosgiel, and from hospital staff. Because the existing park and ride options e.g. Wakari hospital shuttle, are not suitable for people in

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a wheelchair, people with disabilities had low expectations that park and ride facilities would assist mode shift for them.

Several characteristics which have potential effects on mode and/or connectivity are specific to P1:

- P1 lowers the speed limit of the State Highway 1 pair to 40km/h. This has the potential to further support east-west connectivity across the one-way pair. Extending the State Highway 1 arterial cycle lanes will support cycling for confident users along that route.
- Fewer opportunities for mid-block crossings and/or the use of uncontrolled mid-block crossings have the potential to hamper east-west connectivity improvements for people with disabilities and older people.
- Car based modes are well provided for, and vehicle travel times are maintained into the future and remain attractive which will hinder mode shift somewhat.

Quotes from participants

"The investment in public transport would mean I could explore Dunedin better" (Student).

"Pedestrian priority outside the hospital would mean I'd be more likely to get to class on time" (Student).

"It's fine. Not much change for me as I drive anyway" (Hospital staff).

4.2.1.4 Sense of place (score of +1; minor/slight positive)

A number of potential effects are common to P1 and P2v3. These have the potential to create positive outcomes for sense of place:

- These programmes have capital budgets that can provide significant safety and amenity improvements to the urban environment compared with the Do Minimum. The Public Engagement summary describes how many people strongly support more seating and planting to improve the main walking routes so they are safer and easier for everyone to use, regardless of age or mobility. Improvements to the urban have the potential to make the central city more welcoming for people with disabilities and older people, if designed and implemented well.
- The Barnes Dance crossings on key intersections of both State Highways have the potential to contribute to gains in older people's and people with disabilities feeling of comfort, feeling of safety and improved safety while crossing the State Highways at intersections.

Several characteristics which have the potential to effect sense of place are specific to P1 alone:

- Development opportunities for additional businesses and inner-city residents are improved, potentially affecting density of population, vibrancy of the street space and eyes on the street. The monetised liveability benefit is a substantial $112 million per year. Older people's willingness to stop/rest/engage with what is on the street is potentially improved over the Do Minimum but lower than P2v3.
- P1 provides a lower speed limit on both State Highways (compared with Do Minimum) and these have the potential to contribute to gains in older people's and people with disabilities feeling of comfort, feeling of safety and improved safety while crossing at intersections.
- However, this is somewhat offset by having no mid-block pedestrian crossings across either State Highway, reflecting lower permeability of the State Highways for people with disabilities and older people (compared with P2v3).
- Also, heavy vehicles remain on both State Highways. This contributes to lower comfort (noise, smells, pollution) and lower feelings of safety. The one way system is frequently described as unsafe and car-dominated by older people and people with disabilities (and this is supported further by the Public Engagement comments, and by empirical evidence) and while mitigated somewhat by reduced vehicle speed, safety issues have the potential to remain.
- The empirical evidence confirms a one way system is more confusing for people than a two-way system for wayfinding, especially for those who are less frequent travellers to the city. For example, people from out of town visiting the NDH, or older people and students.
- The literature also shows one way systems typically lead to less positive outcomes for business development, liveability, crash rates, property values and crime.

Quotes from participants

"I try to go to the hospital as little as possible [laughs], but when I do go, I take a cab so there's not much difference between the options for me on that. But when I'm out and about in the city, option 2 [P2v3] would help me get about much better than option 1 [P1]" (Person with a disability).

"The one way system is really confusing for students when they first move here" (Student).

"I can't see how option 1 would significantly improve the way things are?" (Hospital staff).

4.3 Programme 2v3 (P2v3): Overall score of +2.25, moderate positive

The overall score is made up of an average from the individual scores for each determinant of health assessed, presented in the table below:

Determinant	Do minimum score
Access to health services	+2
Safety	+2
Modes of access to/from city; and connectivity within CBD	+2
Sense of place	+3
	+2.25 (Average score)

4.3.1 Rationale for score

Of the 66 people who participated in the engagement aspect of this assessment, 63 preferred P2v3.

4.3.1.1 Access to healthcare

A number of potential effects are common to P1 and P2v3 and these are described in P1 above. As described above, these common effects, generally, have the potential to create positive outcomes for access to healthcare and will not be repeated here.

However, several assessment findings are specific to P2v3 alone:

- For those who must attend hospital, barriers to access must be as low as possible no matter how people choose/are able to travel. P2v3 best supports the full suite of travel choices for people travelling to the NDH: walk, cycle, public transport, drop off, taxi, shuttle, private vehicle.
- The NDH is sited with a low speed high amenity local road at its 'front door' (to the city), and a two-way 50km/h State Highway at its back door. Mid-block pedestrian crossings to the New Dunedin Hospital (at the back door) are not safe for older people or people with disabilities; but are substantially safer and shorter on the local road. Older people (one in four New Zealanders) and people with disabilities (one in five New Zealanders) need to take safe routes and these are not usually the shortest routes. The block sizes in Dunedin are relatively large. Many people with disabilities, carers, and older people can only walk/wheel about one block due to fatigue. So direct routes, say from the bus hub to the hospital are highly valued. Visually impaired people will typically only use signalised intersections to cross a road and there is greater opportunity for signalised mid-block crossings to be installed in P2v3 than P1. There is also greater opportunity for creation and allocation of disability parking spaces when the local road is under Dunedin City Council authority than if it is State Highway 1.
- Removing heavy vehicles from the local road improves safety for nearly all people moving within the city. Also, this removal of heavy traffic from the local road creates a calmer hospital environment for visitors, staff and patients. The hospital's spine for people movement (visitors, patients, etc) matches the local road. The hospital's ancillary services spine (catering, energy, water, machinery) matches the noisier/busier State Highway. P2v3 therefore best matches the hospital design to support a health promoting environment for staff and visitors.
- Option 2 allows the hospital to be a more considered, purposeful healthcare destination. The P2v3 environment has the potential to support the NDH, rather than the NDH trying to work within what is a transport-dominated environment.

There is a substantial amount of empirical research about transport and access to health services in the literature, but most is about transport and primary care services rather than hospital level care. Two interesting findings from New Zealand research are:

- A new parking building constructed to ease parking difficulties at Waikato Hospital did not ease transport access for many patients because of its distance from the services, especially for those with mobility and respiratory conditions.

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- One Maori provider has had success at breaking down transport barriers by picking people up directly and taking them to the service in a shuttle. This time in the shuttle built whanaungatanga and helped the service gain a deeper understanding of the patient's health needs, before their appointment.

There are some potential effects common to all three options regarding access to health services:

- Southern DHB perceives no issues for access by emergency vehicles under any of the three options.
- Across all three programmes, parking provision is similar. Lack of parking was mentioned by older people and people with disabilities when accessing the existing hospital. These groups voiced concerns about parking for the NDH, especially given the increasing demand for mobility parks with an ageing population and the more central location of the NDH. These groups require (and appreciate) mobility parks, drop-off zones, taxi-ranks and ask for a greater number of mobility parks, than currently available, from Southern DHB and Council. Guidelines for mobility parking are said to be poorly met quality wise. For example, adequate dimensions for increasingly common larger, van-type mobility vehicles; appropriate location and placement away from traffic streams; and appropriate nearby curbing to allow a person to alight from the vehicle and safely get to the footpath. Furthermore, the disability community have described the number of mobility parks available as being based on minimum requirements of guidelines, rather than based on an assessment of need.

Quotes from participants

"It's real tiring getting around by myself. It's tiring for my wife when she pushes me. Anything that can shorten the distance or make it easier to cross the road to the hospital is a big help" (Person with a disability).

"Less pollution around the hospital would be huge. You can smell the pollution as you stand at the corners. It's really bad for your health. There's so many studies showing that. We have lots of compromised people coming to our hospital and we expose them to that" (Hospital staff).

4.3.1.2 Safety

A number of potential effects are common to P1 and P2v3 and these are described in P1 above. As described above, these common effects, generally, have the potential to create positive outcomes for safety and will not be repeated here.

However, several assessment findings are specific to P2v3 alone:

- The local two way road at 30km/h will be substantially safer than P1 or Do Minimum. The international literature is clear that two-way streets are safer than one-way streets. Several high quality studies in peer reviewed scientific journals confirm a higher incidence of collisions and injuries on multi-lane one way streets than on their two-way counterparts – for motorists, bikes and pedestrians. So, while the State Highway in P2v3 will remain at 50km/h, it is unlikely to be any less safe than the one-way at 40km/h, especially since the peak time average speed of 35km/h is lower than the posted speed limit. U-turns at State Highway intersections would ideally be prevented to increase safety. For access to the fast food restaurants (university end of local road) and big box retail (southern end of local road), while these are high traffic areas (foot and vehicle) zones, the 30km/h vehicle speed and design will maintain safety in these areas.
- The safety aspects of the local road are expected to be high. The empirical evidence is clear that pedestrians and cyclists are more vulnerable road users because they can withstand only relatively gentle impacts. The fatality risk for pedestrians increases sharply when vehicle travel speed is beyond 30km/h. Not only will the local road be slow speed, but it will also draw increased numbers of people who walk and cycle from the State Highway system, effectively taking them out of harm's way. Further empirical evidence describes an often forgotten relationship with speed: The role of speed in crash likelihood is confirmed in numerous studies. For example, Nilsson (2004) and then Elvik (2013) demonstrated that lower mean traffic speeds in response to speed limit reduction results in reduced likelihood of casualty crashes. Literature describing a 'Safe System approach', says that in built-up areas where there is a mix of vulnerable road users and motor vehicle traffic, a 30km/h speed limit should be imposed.

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- The movement of the cycleway to the local road will improve safety for all cyclists, except for a small number of very confident cyclists who will choose to cycle on a State Highway even without a cycleway. Most cycle users will likely use the new cycle spine on the local road. The movement of the cycleway to the local road supports most comments from the Public Engagement which wished to see the cycleway moved from the State Highway 1 pair to the local road for safety reasons.
- At the tertiary precinct under P2v3, the State Highway 1 arterial will have a higher volume of traffic (in two directions) than either road in the existing State Highway pair (both in one direction). As such, mid-block crossings, which are currently unsafe and not desired by authorities, will remain that way and have the potential to be less safe without further treatment, such as speed restriction on the P2v3 State Highway. Having said that, the actual vehicle speed on P2v3 on the state highway is likely to be lower than the posted 50km/h, as the current average speed is 35km/h at peak time. Ensuring speeds do not 'creep up or above' 50km/h at the tertiary precinct is likely worthwhile though. In contrast, the 30km/h local road is far safer to cross mid-block than P1's 40km/h State Highway arterial, and so my assessment is it's slightly safer overall in the tertiary precinct for those (unsafe and unwanted) east-west pedestrian mid-block crossings.
- People with disabilities and older people strongly advocate for removal of e-scooters from footpaths due to safety risks (accident risk from speed; difficult to hear e-scooters coming; trip hazard when poorly parked; many users are inexperienced/have a low skill level). The improved treatment of cycling in P2v3 presents the opportunity to move e-scooters onto the Dunedin City Council controlled cycle network and off footpaths.
- The opportunity to increase residential density via the local road would increase the 'eyes on the streets', making people feel safer (from crime) as they move about.
- P2v3 leads to few significant changes regarding vehicle travel time, with the largest being a 2 to 4 minute increase for those driving south to north at peak times, the full length of the study area (the Oval to Botanic Gardens). This correlates with NZTA research which describes that where vehicles potentially conflict with vulnerable road users, lower speeds over finite lengths of road would be expected to result in only small time losses (Frith, 2012). The study authors say this would arguably be of little consequence and could be economically discounted, while the safety benefits to the vulnerable road users are demonstrably real. Frith (2012) goes on to describe international research where urban travel speeds were, on average, well below posted speed limits. One example in the Netherlands showed major urban through roads with a 50km/h limit had an average speed up to 38km/h. Frith summarises that reductions in the posted speed limit in urban areas therefore may contribute comparatively little if anything in terms of increased travel times (Frith, 2012). The average travel speed at peak hour in Dunedin is about 35km/h.

There are some potential safety drawbacks to P2v3 however:

- The State Highway is proposed to remain at 50km/h which is a high speed for an urban area, and is not contributing to a 'Safe Systems' approach.
- Two way streets are typically safer than one-way streets, though in this case the 50km/h speed limit nullifies those potential gains.
- Safety for people who cycle improves overall, but not for those confident cyclists who will continue to use the State Highway
- Several participants, particularly those whose primary mode was vehicle, were concerned about congestion on the State Highway and the convergence of vehicles as the number of lanes reduces.
- Student safety remains neutral at the Tertiary precinct overall, but mid-block crossing remains an issue along the length of the State Highway, as does Frederick Street heavy vehicle use (though students acknowledge the safety gains elsewhere via the local road). The slow speed zone does not extend beyond the campus at Union Street, which is a residential area for students and includes the fast food restaurants. Offset somewhat by the safety of the local road and the Increased residential density arising from opportunities to develop the local road provides more eyes-on-street.

Quotes from participants

"The road closest to the university would be busier :-(" (Student).

"I'd feel safer. I'm a confident wheelchair user but these improvements would make it safer, less stressful, less scary for me" (Person with a disability).

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"I'm worried about the cars bottle necking, especially as the highway drops lanes. That doesn't sound safe" (Hospital staff).

"We need to improve from what we have" (Hospital staff).

"I regularly push between around the Octagon, to parts of Moray Place, the Civic Centre and Library, down George Street and towards student-ville. Having a safer way to do that would be awesome" (Person with a disability).

"Those people [decision makers] are going to get old someday and they'll be grateful of it [P2v3] then" (Older person, Dunedin).

"I'm very concerned about heavy traffic using Frederick Street. I've had many near misses in this area as it is. It's very dangerous already" (Hospital staff).

"I always cross at the lights. It'd be amazing to have another safe option" (Person with a disability),

"Those things [e-scooters] are dangerous on the footpath. Some of the people in the Blind Foundation are using e-scooters to get around!" (Person with a vision disability).

4.3.1.3 Modes of access to/from the CBD and connectivity with the CBD (score of +1)

A number of potential effects are common to P1 and P2v3 and these are described in P1 above. As described above, these common effects, generally, have the potential to create positive outcomes for mode of access and connectivity and will not be repeated here.

However, several assessment findings are specific to P2v3 alone:

- The geographic area affected by the local road is large: 38 city blocks. The people who currently live in this area walk and cycle, predominantly, with extremely low vehicle use. This confirms that if densification occurs, it is plausible that future populations will also predominantly walk and cycle, further contributing mode shift and the health benefits arising from that. Under P2v3, the land use of the local road is much more likely to change due to the regulatory autonomy of Dunedin City Council, and due to the desirability created by the local roads urban space.
- To encourage travel to the city centre and within the city, barriers must be as low as possible no matter how people choose/are able to travel. P2v3 best supports the full suite of travel choices to and within the city for older people and people with disabilities: walk, cycle, public transport, drop off, taxi, shuttle, private vehicle.
- For all users, such as older people and people with a disability, pedestrian crossings and Barnes Dance crossings support mode shift. P1 has more limitations on installing these than P2v3.
- In the Public Engagement, many people supported joined up cycle networks, though some did not support cycle networks in any way. Ironically, those who do not support cycleways may prefer the removal of cycle lanes from the State Highway 1 arterials.
- P2v3 is particularly beneficial to support a cycling mode shift (for example university students and hospital staff) and power wheelchair users. P1 continues to mix people on bicycles and vehicles at busy intersections, on a noisy/high stress route only suitable for confident cyclists. Whereas P2v3 creates an active mode spine which has the potential to be safer, more pleasant north-south spine, for all cycling/power-chair abilities. The P2v3 pedestrian spine also provides better connectivity to George Street, the CBD and to the warehouse precinct. Several power wheelchair users power themselves to the CBD and back to their homes e.g. in South Dunedin. So direct routes and routes with calmed vehicle speeds are valued highly.
- Under P2v3, the mid-block cross between the bus hub and NDH can be signalised to allow people with all types of abilities another opportunity to cross the road to the NDH.
- There are two areas in P2v3 where there is complexity about crossing a single street east-west and these are discussed below. However, it remains that overall, east west severance is significantly improved in P2v3:
    - There is existing east-west severance on the current southbound State Highway 1 one-way arterial. Crossing is only safe at signalised intersections, such as at the existing desire line of St Andrews Street. The ability to cross mid-block is poor now (only for confident pedestrians during platooning of vehicles). Under P2v3 (two way State Highway1 arterial with three lanes), it is projected to be worse as there is no space for a median barrier, especially around the NDH. However, there is little in the way of desire lines either, as the only Castle Street hospital

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entrance is near St Andrew Street, on the existing desire line, which is near a signalised intersection. For both P1 and P2v3, mid-block crossings are not helpful for less confident pedestrians. As such both programmes score poorly for accessible mid-block crossings on Castle Street near the new hospital.

- In the tertiary precinct, existing east west severance across the current southbound State Highway 1 one-way arterial (turning into the two way State Highway 1 arterial) would improve slightly. Currently (and in P1), confident pedestrians can cross mid-block, across two one-way lanes, in-between platooning vehicles. Under P2v3 the ease of crossing mid-block (across the State Highway 1 two-way, one lane each way arterial), would be slightly improved. People would only have to deal with one lane of traffic at a time, stopping in a median zone. While the speed limit is higher in P2v3 (at 50km/h), the actual speed of vehicles is far slower (now) during peak times and will be slower again with the increased vehicle volumes under P2v3, maintaining the ability for confident pedestrians to cross mid-block.

- P2v3 performs better on four out of five key walking routes (and no difference on fifth) compared with P1. All routes have an east west component and most have a north-south component as well. These key routes link tertiary students to the health sciences campus and/or CBD; people/staff between the city, bus hub and the NDH; and strongly support connectivity to the employment and retail areas of George Street and the warehouse precinct. These improvements arise from additional signalised mid-block pedestrian crossings (for people with disabilities and older people), non-signalised mid-block crossing points (for confident pedestrians) and a reduction in traffic.
- There is a reduced level of pedestrian and cycling service along the new State Highway 1 arterial, however the connectivity assessment concludes the new spine (local road) will take its place because people will typically use the best path available, despite it being a little longer distance for a few north-south routes.
- For older people and people with disabilities who drive/park, there is improved mobility once they leave their car (and walk/move about) under P2v3 - for access to health services and the CBD.

Quotes from participants

"It's the only option that holds water in the long term" (Person with a disability).

"It's probably going to be harder to jaywalk on the two way state highway" (Student).

"We have to future proof our city. We've got a large older people's demographic arriving very soon in Dunedin" (Person with a disability).

"The linkages to the cycle spine really need to work well for this option to the harbour cucle network north and south, to Princess Street and South Dunedin, to North Dunedin. If the linkages are poor the cycle spine could be a stranded asset" (Hospital staff).

"This option could lead to better student housing options. Better than the crappy places we live in now. Other people would live here too if it was central and good quality" (Student).

"Getting cyclists off the state highway must be an improvement" (Hospital staff).

4.3.1.4 Sense of place

A number of potential effects are common to P1 and P2v3 and these are described in P1 above. As described above, these common effects, generally, have the potential to create positive outcomes for sense of place and will not be repeated here.

However, several assessment findings are specific to P2v3 alone:

- The local road is substantial in length, approximately 3.5km and affecting development opportunities for 38 city blocks. Development opportunities for additional businesses and inner-city residents are substantially improved by P2v3, in turn affecting density of population, vibrancy of the street space, eyes on the street and economic outcomes. For the university, it has the potential to increase opportunities for development along the local road. Inner city residents promote a socially cohesive environment, promote local employment and generally have excellent access to education, employment opportunities and services. NZIER's monetised liveability benefit for P2v3 is highly significant at $230 million per year. This is $118 million per annum greater than P1. Such value is created by extending the heart of the city east, to the new two-way State Highway, thereby opening up

the potential for development of approximately 38 city blocks compared with P1. NZIER's finding correlates with a New Zealand study (MacMillan, 2012) which modelled five different scenarios and identified the most effective approach, gaining greatest net benefit, was from: "… physical segregation on arterial roads (with intersection treatments) and low speed, bicycle-friendly local streets. We estimate that these changes would bring large benefits to public health over the coming decades, in the tens of dollars for every dollar spent on infrastructure."

- The local road has much lower traffic volumes, lower speed and fewer heavy vehicles over the entire length. This allows controlled and uncontrolled mid-block pedestrian crossings, complementing the Barnes Dance crossings on key intersections. Removing heavy vehicles from the local road improves feelings of safety for nearly all people moving about the city. These changes to the local road have the potential to create a calmer/quieter environment for all, encouraging nearly all people to safely explore knowing there are places of interest and places to rest nearby. The high potential for amenity improvements and activation of spaces on the local road means a high potential for gains in sense of place. The Public Engagement summary noted many comments about roads being unpleasant due to noisy and unsafe traffic.
- For people with sensory or cognitive disabilities, traffic noise is debilitating. The ability to move about or spend time in spaces without such noise is highly valued.
- The area outside the NDH on the local road becomes highly usable by NDH staff and allows staff, who are well paid relative to average incomes, to be able to access CBD businesses more easily.
- In the tertiary precinct, the State Highway 1 arterial is one lane each way at 50km/h. However, the two way nature of the road is judged by the Place Quality MCA to be an improvement for pedestrians regarding permeability (greater opportunities to cross), feelings of comfort (activation of space) and safety (safer opportunities to cross), over the 40km/h one way State Highway1 arterial. Their international literature, and the literature review carried out for this assessment, both conclude two way systems are typically safer than one way systems which in turn affects pedestrian permeability. Several well-controlled research studies have shown one way streets have higher crash rates, higher crime rates and lower property values than two way streets.
- Also, the literature describes one-way to two-way conversions that have occurred in various international cities: "it is difficult to find examples where the conversion did not result in increased business activity." This included revitalising city centres, increased numbers of jobs, economic growth and improved neighbourhood liveability. The authors attributed the change to exchanging vehicle speed with access brought about by the two-way circulation, liveability through streetscape design, activation of spaces, and increased property values. University student pedestrian desire lines are 'diagonal' from north of Albany Street, to get to the more easterly campus from the city. The diagonal desire line is better supported by P2v3 than P1 because of the greater permeability of the two-way State Highway 1 arterial compared with a one-way State Highway1 arterial.
- Tertiary students have a pedestrian desire line from their halls of residence, down Cumberland Street to New World. P2v3 has Cumberland Street as the local road, substantially improving that component of the journey for these residents.
- University students have embraced small-powered devices such as scooters and skateboards. These modes of transport are better supported by P2v3 because the spine/connectedness/legibility of the cycle-way is improved. With few gaps, the cycle network has the potential to encourage small-powered devices off the footpaths and onto the cycleway if designed accordingly. P2v3 has the potential to future proof for the eventual increase in small-powered devices. Older people and people with disabilities strongly desire the removal of small-powered devices from footpaths.
- The positive outcomes outlined above are somewhat offset by a reduction in pedestrian benefits and place quality on the three-lane two way State Highway 1 arterial in the CBD. This is due to the extra traffic lane (to three lanes) meaning there is neither ability to separate traffic from pedestrians, nor an easy way to cross mid-block, nor an ability to create substantial amenity planting.
- However overall, combined with the positive aspects presented above, there is a substantial improvement over Programme 1 and the Do Minimum.

Quotes from participants

"Less traffic noise on Great King Street, where I live, is very appealing!" (Student).

"When you plan for people with disabilities, you plan for everyone" (Disability advocate).

"This would be my preferred option, but for the different number of lanes on the state highway. That's way too complicated. But I really like the idea of one less State Highway" (Hospital staff).

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"When I go to the city I meet people for work, eat out with my wife, go to the library, have a beer with friends, go to a show – that sort of stuff" (Person with a disability).

"It's much safer to cross at the student quarter" (Student).

"I prefer the local road is under local control. More chance for trees, seats, better things for the people of Dunedin rather than for people who just drive on through" (Hospital staff).

"That option would make it much easier for me when I wheelchair push […] Yeah. I push from the Octagon to the university fairly often" (Person with a disability).

"Lots more choice about where I could live" (Student).

Being able to personalise a space like that, to make it inviting on a practical level and welcoming, that's huge" (Person with a disability).

"There'd be a better chance of getting more university facilities on the local road" (Student).

5. Health and wellbeing outcomes potentially affected by these programmes

Firstly, the number of people potentially affected by these outcomes is very large, being either thousands, or tens of thousands of the population of Dunedin City (134,100 people in 2020):

- Older people – approximately 34,000 people (25% of the city's population)
- People with disabilities – approximately 27,000 people (20% of the city's population)
- Tertiary students – 25,000 university/polytechnic students and 5,000 staff (22% of the city's population)
- Hospital staff – 2,800 staff and 2,100 inpatients, outpatients and visitors each day (4% of the city's population).

Secondly, many of these people are often termed as 'vulnerable', and for whom getting excellent outcomes is actually quite difficult. There are few opportunities to systematically address the social determinants of health at a city-wide scale and this is one of those opportunities. As a nation, we do not have many evidence-based ways to successfully address inequalities, except by addressing the social determinants. These determinants can affect health outcomes, employment outcomes, education outcomes or social outcomes. As such, any movement in the social determinants tend to have life-long and generational effects, creating very large financial benefits across multiple domains, if done well, or disbenefits if done poorly. For example, NZIER's calculation for the monetised liveability benefits generated by P1, but especially P2v3, are substantial per annum contributions.

Thirdly, the health outcomes arising from transport interventions have been rigorously studied and published in peer-reviewed scientific journals, reflecting the importance of transport to health and wellbeing. They are presented in the table below.

Determinant	Contribution to health and wellbeing outcomes
Access to health services	Contribution to direct health outcomes arising from diagnosis, treatment and management of acute and chronic health conditions. High quality of place (e.g. the environment within which the NDH sits) has strong positive associations with mental health and social connectedness for staff. The evidence about environment on patient treatment outcomes or recovery is inconclusive.
Safety	Stating the obvious, road traffic injuries and death are bad for people's health. Injuries and death happen across all transport modes to all age groups, though there are notable inequalities. Motor cyclists, pedestrians and cyclists are the three highest risk groups. Nationally, the number of traffic deaths has increased steadily from 2013 (253 deaths) to 2018 (377 deaths), with a more recent decrease to 320 deaths in 2020. A feeling of safety contributes to mental wellbeing.
Mode shift/ Connectivity	Active transport includes walking, cycling and public transport use. Public transport is typically regarded as active because of the walk/cycle required at the beginning and end of the bus/train ride. Benefits arising from active transport are varied, well described and widely accepted. They are summarised below (Community and Public Health, 2016): • Improves quality of life and life expectancy among adults (even if physical activity is adopted later in life) • Halves the risk of heart disease and stroke • Reduces the risk of some cancers (e.g. breast and colon cancer)

	• Reduces the risk and improves the management of type II diabetes (the most common form) • Assists with the prevention of falls in the elderly by maintaining bone mineral density • Reduces the symptoms of depression and anxiety, lowers levels of stress • Increases self-esteem • Helps maintain a healthy weight • Reduces air pollution and major respiratory illness. Improvement is independent of the type of active commuting, seen in both males and females, and for those previously untrained (Schaefer et al, 2020). Connectivity also contributes to social determinants such as social inclusion, access to education, access to employment, and access to housing to name a few.
Sense of Place	Contribution to mental health and social connectedness
Pollution	Pollutants from motor vehicles include $PM_{2.5}$, PM_{10}, black carbon, ultrafine particles, nitrogen dioxide (NO_2) and carbon monoxide (CO). These pollutants are released into the air via exhaust pipes, physical decomposition of the vehicle and road, and resuspension of particulate matter from the ground back into the air by motor vehicle traffic. Each pollutant is detrimental to human health and there is no safe level of intake. Light goods vehicles and buses contribute double the attributable deaths from PM_{10} and NO_2 per vehicle kilometre driven than cars, and heavy goods vehicles over four times. As such, moving one truck off a route is equivalent to potential improvements in air quality health outcomes of moving 4.5 cars. These pollutants lead to negative effects on all-cause mortality, cardiovascular disease, heart attack, some cancers, chronic and acute respiratory diseases, to name a few. There are 283 deaths per year attributed to New Zealand's road transport emissions of PM_{10} and NO_2. Reviews of air pollution exposure conclude that motorists are exposed to more particulate matter than both cyclists and pedestrians —who are the least exposed. This is because cars travel in the centre of roads where pollution levels are highest and pollutants become trapped in the vehicle cabin. To be clear, active transport modes such as walking and cycling provide health benefits which far outweigh the negative effects from any air pollution.

•

6. Suggestions to increase potential positive effects and avoid potential negative effects

Throughout the course of this work, several suggestions have been put forward by interviewee's and focus group participants regarding possible improvements to the programmes. Along with the assessor's own suggestions, those which are supported by findings and evidence are presented below.

Determinant of health supported	Suggestion to increase potential positive effects and/or avoid potential negative effects
- Access to health services - Safety - Mode shift / Connectivity - Sense of place	Choose P2v3 for moderate improvements in health and wellbeing. Choose P1 for slight improvements in health and wellbeing. Choose Do Minimum for a slight reduction in health and wellbeing.
- Access to health services	Regardless of programme chosen: Council and Southern DHB could work together to review mobility parking around the NDH. With explicit consideration of (1) the number of parks needed and (2) the quality of mobility carparks (carpark dimensions, safe access to the kerb, distance/route from hospital). This is further supported by the Public Engagement, where all-day parking locations were strongly desired on the edge of the central city, alongside acknowledgement that inner city parking should be prioritised for people with mobility issues and short-stay retail.
	Regardless of programme chosen: When contracting for NDH and any urban development work associated with a programme, have a specific clause in the bid document requiring specialist skills associated with designing/engaging for people with disabilities. These skills should include engagement with the disability community and specialist expertise in universal design as it relates to their field of expertise e.g. transport engineering. This expertise must incorporate the lived experiences of disabled people in Dunedin. And/or assign a Principal Advisor – Disability with the NDH/DCC teams. Ensure there is a list of physical features (for example, features important to people with disabilities) that cannot be traded-off as part of the tender evaluation process. Continue the principal advisory role into final sign-off for the 'practical completion certificate' to ensure what is said will be done is implemented appropriately.
	The Wakari shuttle service is used and supported. Consider other starting destinations for access to inpatient and outpatient services.
- Safety	Consider reducing the speed limit on the State Highway in P2v3
	The slow zone appears to stop short of the tertiary precinct and 50km/h speeds remain on the State Highway. Together with risks from mid-block crossing and heavy vehicles on Frederick St, consideration of an extension to the slow zone is warranted.
- Mode shift/Connectivity	Include consideration of small-powered vehicles (e.g. e-scooters and e-skateboards) into the design and construction of cycle lanes.
	Consider whether a park and ride is feasible for northern residents, or for NDH patients arriving from Central Otago/North Otago e.g. at Pinehill or elsewhere.
	The use of universal design is not standard within Dunedin City Council contracts and could be considered.
	Park and ride services (which are already proposed in P1 and P2v3) to be strongly promoted to hospital staff, especially if there is the opportunity to drop in front of the hospital and/or bus hub.
	Ensure the P2v3 cycle spine connects safely to the balance of the cycle network, particularly the Harbour route.

7. Conclusion

This assessment considers the potential impacts of the Shaping Future Dunedin Transport programmes on health and wellbeing.

The assessment collected data via multiple methods, including literature reviews, existing work such as the multi criteria analyses, and interviews/focus groups with stakeholders and community.

Overall, the Do Minimum option has the potential to negatively affect health and wellbeing outcomes. Whereas both P1 and P2v3 have the potential to improve health and wellbeing outcomes, with P2v3 substantially more so than P1.

A modest number of suggestions are made within the assessment to further embed potential positive outcomes and avoid/mitigate potential negative outcomes.

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Appendix 1: Statistical areas with study area

Figure 4. Campus South Statistical Area 2



Figure 5. Dunedin Central Statistical Area 2

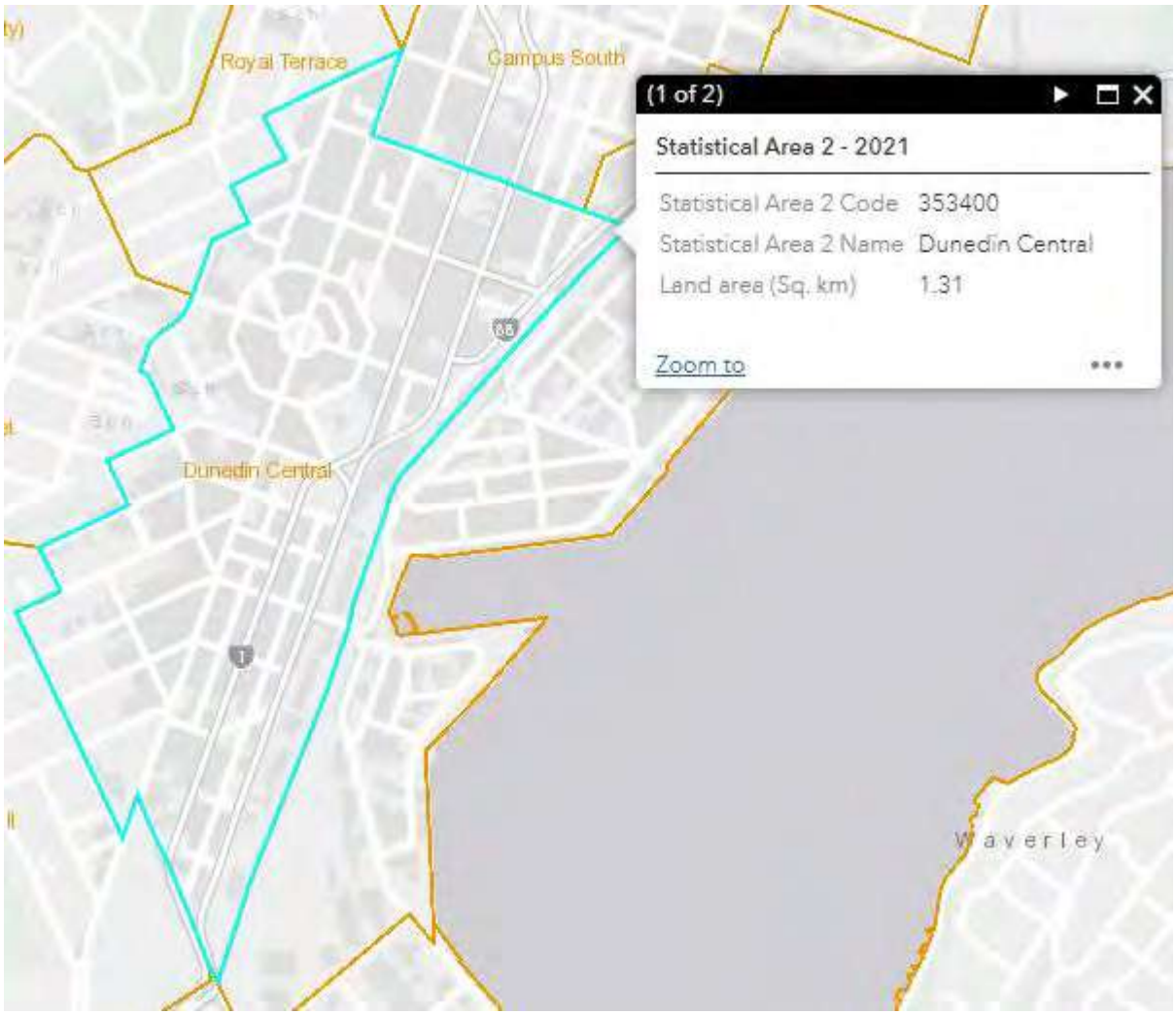
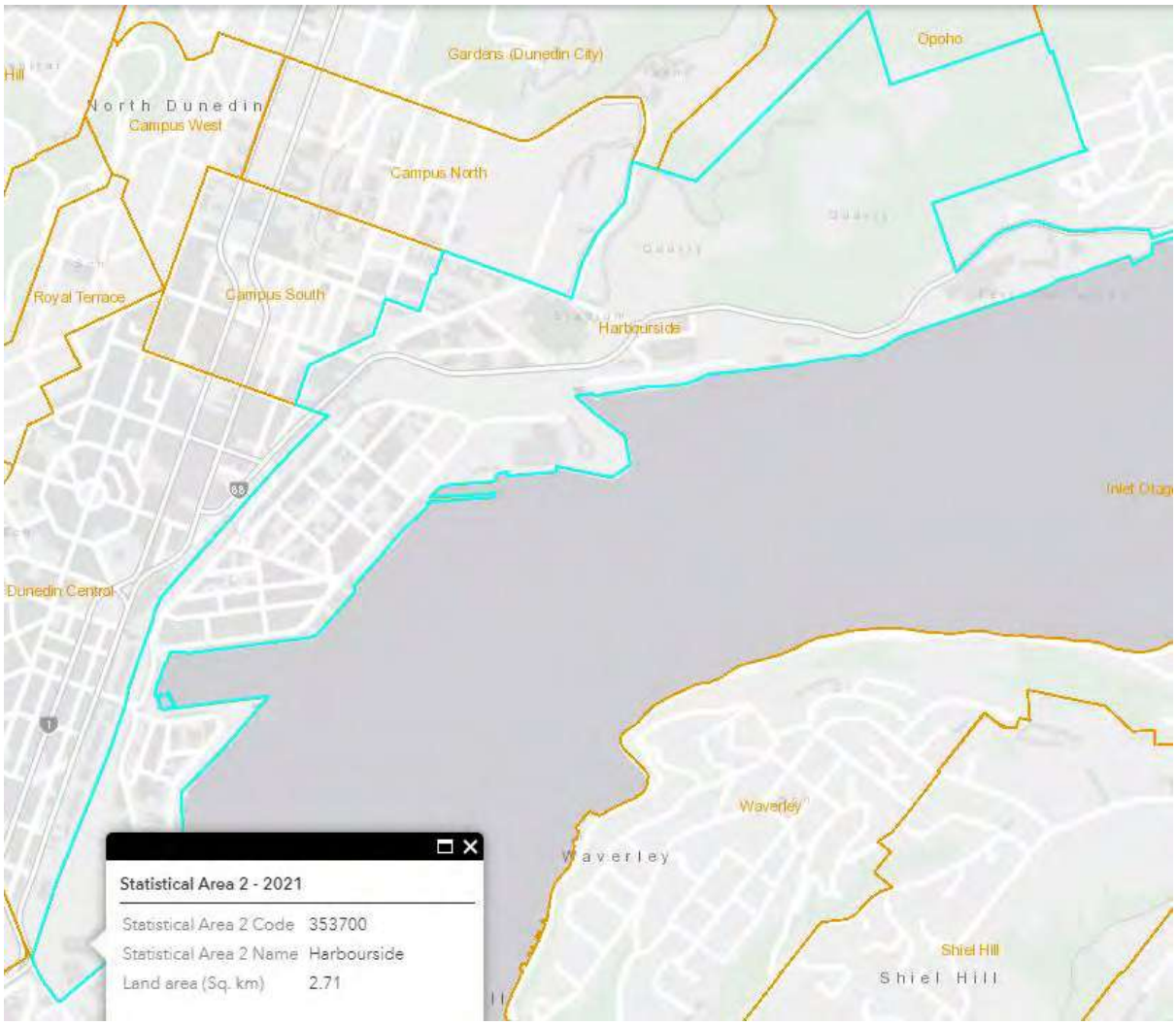


Figure 6. Harbourside Statistical Area 2



Appendix M Multi Criteria Assessments – Safety, Zero Carbon, Place Quality, Economic Evaluation, Connectivity, Transport Choice, Technical Challenge, Reliable Journey Times

Shaping Future Dunedin Programme Business Case

MCA Technical Assessment for Safety

Rev. no	Date	Description	Prepared by	Checked by	Reviewed by	Approved by
1	16/02/2021	Draft for Review	MM	JB	SC	GO
2	29/04/2021	Final	MM	JB	SC	GO

1 Overview

1.1 Purpose

The purpose of this report is to provide a technical assessment of Programme 1 and Programme 2v3. The results will be used for the Shaping Future Dunedin Programme Business Case MCA scoring.

This assessment focuses on the performance of each programme in relation to Safety.

1.2 Programme Development Process

During the short-listing process, four programmes were assessed in detail. The most significant difference between each programme was the configuration of SH1 through central Dunedin. The four programmes were as follows:

Programme	One way	Two way	Description
P1	√		Two, one-way arterials with two through lanes
P2		√	Two lane local road and arterial with two through lanes
P2v2		√	Two lane local road and arterial with four through lanes
P2v3		√	Two lane local road and arterial with following configuration: • Two through lanes north of Albany Street • Three through lanes (two southbound and one northbound) between Albany Street and Queens Gardens (in line with Burlington Street) • Four through lanes south of Queens Gardens

P1, P2 and P2v2 were assessed against the criteria. P2 went through a number of iterations. Modelling and fatal flaws analyses were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width.

Through this process, P2v3 was identified as the preferred layout for a two-way option. This assessment evaluates only P1 and P2v3.

2 Assessment Approach

2.1 Definition

For the purposes of this assessment, Safety is defined as follows:

Project Outcome: Improve Safety
Investment Objective: Moving towards vision zero in the central city.

The assessment considers how well the programme has a positive impact on road safety in the study area, how it reduces the number of injury crashes and how it improves safety for vulnerable road users.

2.2 Assessment Approach

The Safety Assessment considered the following sub-criteria:

- General safety performance on the northbound and southbound state highway routes and the Harbour Arterial
- Impact for cyclists on the routes
- Impact for pedestrians and other vulnerable road users
- Impact of Heavy Commercial Vehicles on the routes

The Do Minimum and the Programmes were considered with reference to:

- The existing crash data
- The configuration of the existing and proposed individual intersection layouts including consideration of signal phasing (e.g., Barnes Dance, filtered right turns and split phasing arrangements)
- The configuration of the proposed mid-block cross sections along both of the existing one-way routes.

- Existing and proposed land use along corridors
- One-way versus two-way configurations

The sub-criteria were taken into account for each of these elements to provide a relative score and then this was rolled up into one score per route/direction.

2.2.1 Review of the Reported Crash History

A review of the 384 reported crashes on the existing one-way system for the five-year period between 2015 and 2019 was undertaken. The crash data included the SH1/Pine Hill Road/Great King Street intersection in the southbound data however it is understood that this intersection is not part of the overall analysis because it is the subject of a separate study.

227 crashes were at intersections (59 percent of total). One person died, 17 were seriously injured and 70 people received minor injuries in these crashes. 15 crashes involved pedestrians while six involved cyclists. Nearly one third of crashes at intersections involved a vehicle running a red light even though only half of the intersections are signalised. In the 157 mid-block crashes, nine people were seriously injured and 46 received minor injuries. Ten crashes involved pedestrians while 13 involved cyclists. Two out of every five crashes were a rear end type movement.

Due to the naming convention that results in two state highway intersections with the same name at each side road intersection, the crash database has difficulty in correctly locating crashes. We found errors in ten percent of the crashes that were reviewed, the majority of which were located at the incorrect intersection. Where these inconsistencies have been identified, the Transport Agency has been notified and our assessment has been updated to ensure the crashes have been attributed to the correct intersection.

The Harbour Arterial has had six serious injury, 14 minor injury and 39 non-injury crashes in the five-year period between 2015 and 2019. There were a variety of crash movements with 39 crashes occurring at intersections and eleven rear end movement crashes along the route. Note that this crash data excludes the SH1 / Andersons Bay Road intersection.
A summary of the reported crash history between 2015 and 2019 is given in the following table for both the SH1 One Way Pair and the Harbour Arterial.

Location	Crash Severity				Total Number of Crashes	Common Crash Movements		Vulnerable Road User Involvement	
	Fatal	Serious	Minor	Non-Injury		Rear End in Traffic	Run Red Light	Pedestrian	Cyclist
SH1 Northbound	1	13	64	113	191	49 (26%)	43 (23%)	14	9
SH1 Southbound	0	13	52	128	193	42 (22%)	27 (14%)	11	10
Combined SH1 Total	***1***	***26***	***116***	***241***	***384***	***91 (24%)***	***70 (18%)***	***25***	***19***
Harbour Arterial	0	6	14	39	59	11 (19%)	1	2	6

3 Programme Performance

3.1 Programme Descriptions

The programmes are defined in Attachment 1.

3.2 Performance of Programme 1

Programme 1 provides improved safety outcomes on the existing one-way routes with an average score of +1.

This reflects that both routes will have a slow speed zone in the core and maintain separated cycle lanes and pedestrian facilities. The slow speed zone is seen as being particularly advantageous for vulnerable road users by improving overall safety for all road users between St David Street and Jetty Street, but nothing measurable north or south of that central area.

Traffic flows are not believed to be altered significantly under this Programme, together with similar proportions of heavy vehicles using both the one-way routes particularly at the northern end, so the main benefits will be realised within the inner slow speed zone.

Relocation of some HCVs to the Harbour Arterial will have a positive effect on safety for other road users at the southern end of this one-way pair.

The on-street parking is to be maintained along the one-way pair.

On its own, this inner section would score higher than +1 however there is relatively little change when compared to the Do Minimum outside the slow speed zone area to the north and south, therefore the safety benefits are seen to be minimal as speeds will not change on those sections which in turn reduces the averaged safety score.

3.3 Performance of Programme 2v3

Programme 2v3 received an average score of +1. This reflects positive safety improvements on the city street leg being offset somewhat by negative effects on the arterial leg.

3.3.1 City Street Route (Current Northbound one way)

The existing northbound route will become a city street with reduced through function and more emphasis on catering to all modes, in particular vulnerable road users with the slow speed zone and retention of the separated cycle lanes.

It is assumed there will be reduced traffic volumes and a lower proportion of heavy commercial vehicles due to the change in function to a city street together with the proposed improvements to the Harbour Arterial route.

However, with the proposed two-way layouts at the intersections, this introduces additional conflict points with turning movements that do not exist at present (vehicle versus vehicle and vehicle versus vulnerable road user).

This route was initially assigned a score of +2 due to clear benefits from a road safety perspective but acknowledging a level of risk remains due to the potential for vehicle / vulnerable road user interactions.

On reflection of the opportunity that the proposed change in function this programme provides for the existing northbound route, the score could be increased to +3 but only on the following basis:

- That the route is treated as one corridor and not split into sub-sections for say ease of design or procurement practices.
- The city street route is designed and implemented as one route to ensure the design is consistent along the whole route from north to south.
- The additional conflict points introduced at all intersections with the conversion of one-way to two-way are fully addressed so that all intersections operate safely with no additional hazards for any road users (effectively safety should be enhanced with this programme, not degraded).
- Undertaking anything less than a corridor approach will undermine the effectiveness of the implemented measures to improve safety for all road users on this corridor. Legibility, cohesiveness and consistency are key to attain the desired safety enhancements.

3.3.2 Arterial Route (Current Southbound one way)

The existing southbound route will have an arterial function with no cycle facilities provided.

A combination of two, three and four lane cross section configurations are proposed.

- At the northern end from Albany Street north, the arterial is proposed to be two lane through the campus area. Solid medians are proposed mid-block while no on-street parking is to be provided. Whilst this provides a narrower carriageway to facilitate vulnerable road user crossing movements, this arterial route remains the primary heavy commercial vehicle route into Dunedin from the north. Therefore, the risk remains of potential for truck versus other road user crashes.
- The three-lane configuration incorporates two lanes southbound and one lane northbound and is proposed to be located between Albany Street and Queens Gardens. Solid medians are proposed mid-block while no on-street parking is to be provided.
- The wider four lane cross section being located from Queens Gardens to the south. It is considered that the proposed layout in the southern area will improve safety because existing intersections will become left in left out and a solid median will be provided. The only concern is that parking will remain on this section, so the risk of manoeuvring crashes remains. Where the two northbound lanes merge into one north of Queens Gardens (into the three-lane section above), this creates a potential safety risk and therefore any design would have to address what mitigations would be required at this merge point.

There is a risk of additional conflict at the intersections with the two-way configuration and that some approaches will now have filter right turn movements with through and turn movements sharing lanes. Some mitigation measures are proposed including split signal phasing, dedicated right turn phases and Barnes dance operations to partially reduce the risk although the overall risk is higher for two way when compared to the number of conflicts at intersections on a one-way configuration.

No slow speed zones are proposed for this route which reduces benefits to all vulnerable road users, especially pedestrians despite the expected increase in midblock crossing demand due to the location of the new hospital between Hanover Street and St Andrew Street.

This option proposes a solid median which will prevent crossing/turning movements at high traffic generator accesses but may exacerbate U-turn manoeuvres at nearby intersections instead.

With a reduced traffic flow on the existing northbound route, it can be assumed that there would be an increase in traffic volumes on the existing southbound route which introduces additional safety issues along much of the route.

This route was assigned a score of -1.

4 Programme Scores

4.1 Scoring

A seven-point scoring system was used for this assessment:

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernible or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

The scoring for the two programmes reflects how well each programme performs against the criteria, compared to the Do Minimum. The Do Minimum consists of the transport network as it currently exists with the addition of the following committed interventions:

- Permanent Barnes Dance at both Albany Street/SH1 intersections (currently a trial)
- George Street – 10 km/h for four blocks - Albany to Moray Place
- Tertiary – 30km/h speeds on Union Street, Harbour Terrace, Clyde Street and Forth Street.

4.2 Programme 1 and Programme 2v3 Scores

The table presents the scores for each programme, for Safety.

Programme	Score	Summary Rationale for score
Do Minimum NBD	-1	• Assessed a slightly adverse score as proposed Do Minimum is not significantly different to the existing situation with the exception of the Albany St / SH1 intersection Barnes dance movement being made permanent.
Do Minimum SBD	-1	

Programme	Score	Summary Rationale for score
Do Minimum – Averaged Score	**-1**	• Other proposed measures including the change in speed limits on George Street and around the University do not impact the current operation of the one-way pair. • The issues with students crossing mid-block remain in the University precinct. • Undesirable intersection configurations remain, e.g. Duke Street. • The negative score reflects that the Do Minimum has safety concerns that require addressing.
Programme 1 - NBD	+1	• Relocation of some HCVs to the Harbour Arterial will have a positive effect on safety for other road users on this route together with the slow speed zone which improves overall safety for all road users between St David Street and Jetty Street, but nothing measurable north or south of that central area. • Fast food outlet accesses remain at northern end together with on street parking and access to big box retailers at the southern end on the northbound route. • Some improvements at intersections for vulnerable road users while the separated cycle lanes will be retained along the whole length. • No change to existing footpaths however there will be more crossing demand in the vicinity of the new hospital on both routes depending on where the pedestrian accesses are located. • Access to existing businesses/attractions remain on both routes. Unknowns about the proposed vehicle accesses to the new hospital site and where people will predominantly park. • On-street parking to be retained.
Programme 1 - SBD	+1	
Programme 1 – Averaged Score	**+1**	
Programme 2v3 – NBD	+3	• The city street will only score as significantly positive for enhancing safety along the whole length if treated as one corridor for subsequent design and implementation stages. • Separated cycle way works well for the mid-blocks but creates more challenges at the busier intersections to be addressed through design for the city street. • Less traffic on city street route which improves environment for all vulnerable road users. • Slow speed zone improves overall safety for all road users between St David Street and Jetty Street on the city street route. • The proposed two-way layouts at the intersections introduce additional conflict points with turning movements (vehicle versus vehicle and vehicle versus vulnerable road user) on both the city street and arterial routes. • Some of the intersections are proposed to be addressed through split signal phasing and Barnes dance operations while others will remain as filtered right turns which creates increased turning crash risks. • There is no slow speed zone proposed for the arterial route however a solid median is proposed in the mid-block sections which prevents uncontrolled right turns from accesses. • High traffic generator accesses along the arterial route will create increased conflict points. While a solid median is proposed to prevent right turning movements at these accesses, left in left out movements will still be allowed and there is the risk of motorists attempting to make U-Turn manoeuvres at the next intersection. • All on street parking is proposed to be removed north of Queens Gardens which reduces manoeuvring risks on the arterial route north of Queens Gardens. • Although there are few parking options on the CBD side of the hospital at present, they are all appear to be operating close to capacity. Removal of on street parking will only exacerbate the situation of more pedestrians crossing the arterial to and from parking areas to the east. • Generally little impact for pedestrians except between Hanover and St Andrew Streets where there will be an increased mid-block crossing demand due to the new hospital. Unknowns about final layout of the hospital site with regard to both pedestrian and vehicle accesses. Also made assumptions on where people will predominantly park, which is most likely to the east of the new hospital site which will generate more pedestrian traffic across the arterial route at Castle Street. • Separated cycleway removed and located on NBD route only. Risk of confident cyclists continuing to use the arterial route with no specific facilities provided, unless cyclists are banned which is problematic in this urban environment. • Benefits for the conversion of the NBD route to two way are negated by the conversion of the existing SBD route to two way.
Programme 2v3 - SBD	-1	
Programme 2v3 – Averaged Score	**+1**	

Programme	Score	Summary Rationale for score
		• This programme has slightly improved safety outcomes by addressing potential for conflict points at some intersections, removal of most on-street parking on the arterial route and providing solid medians in the mid-blocks. • Noted that there is some relocation of traffic to the Harbour Arterial as part of this option which marginally reduces the volumes on the existing routes.

Appendix A: Programme Descriptions

Programme 1 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: retain one way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

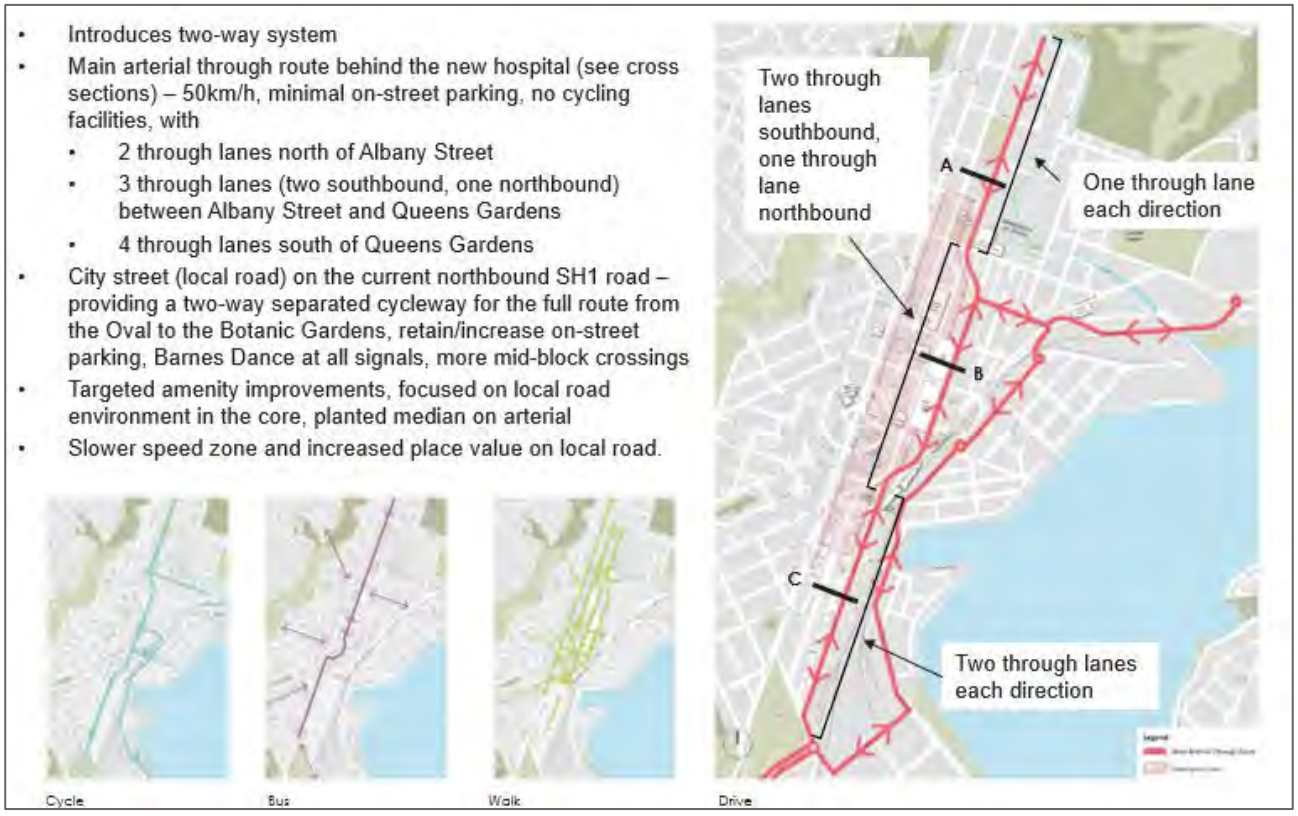
5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

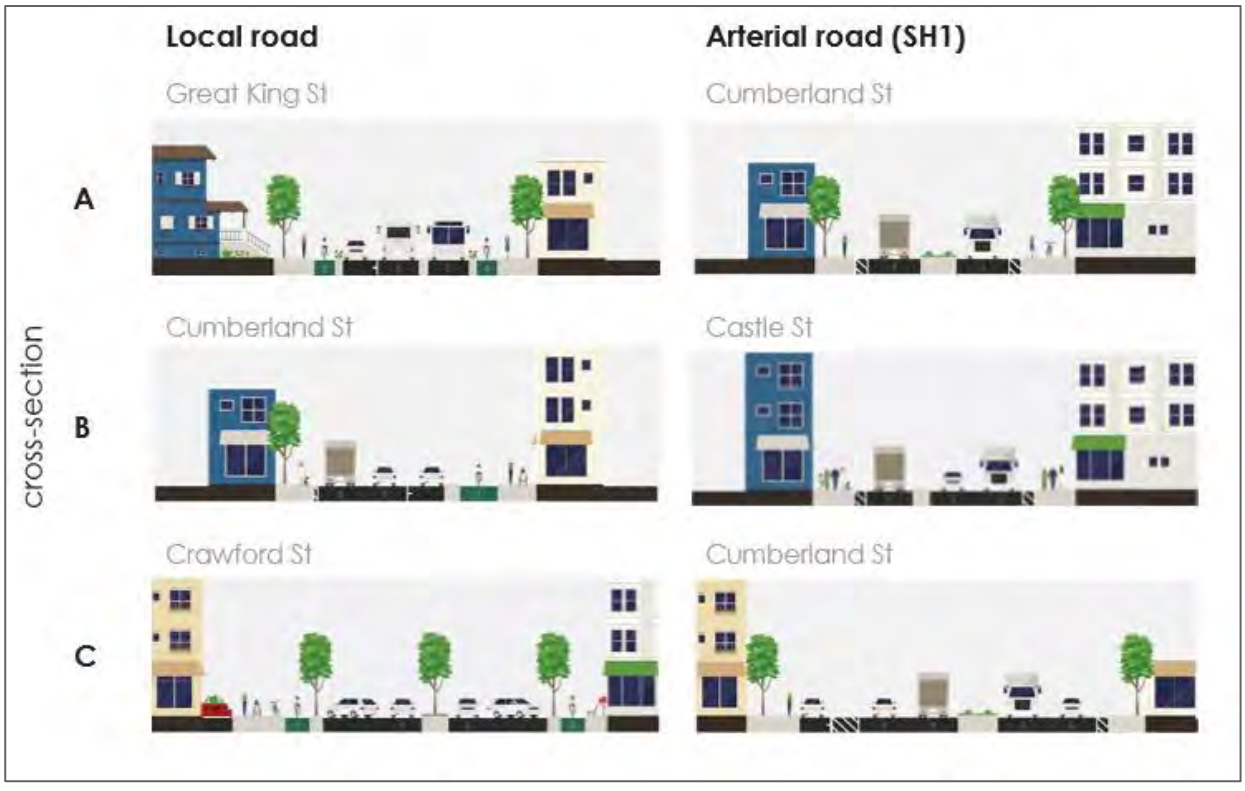
7. Behaviour Change: The Council will work with employers and schools to support and incentivise walking, cycling and public transport use.

Programme 2v3 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: introduce two-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

7. Behaviour Change: The Council will work with employers and schools to support and incentivise walking, cycling and public transport use.

Shaping Future Dunedin Programme Business Case

MCA Technical Assessment for Zero Carbon

Rev. no	Date	Description	Prepared by	Checked by	Reviewed by	Approved by
1	29/04/21	Final	SC	GW	JMcT	GO

1 Overview

1.1 Purpose

The purpose of this report is to provide a technical assessment of Programme 1 and Programme 2v3. The results will be used for the Shaping Future Dunedin Programme Business Case MCA scoring.

This assessment focuses on the performance of each programme in relation to Carbon.

1.2 Programme Development Process

During the short-listing process, four programmes were assessed in detail. The most significant difference between each programme was the configuration of SH1 through central Dunedin. The four programmes were as follows:

Programme	One way	Two way	Description
P1	√		Two, one-way arterials with two through lanes
P2		√	Two lane local road and arterial with two through lanes
P2v2		√	Two lane local road and arterial with four through lanes
P2v3		√	Two lane local road and arterial with following configuration: • Two through lanes north of Albany Street • Three through lanes (two southbound and one northbound) between Albany Street and Queens Gardens (in line with Burlington Street) • Four through lanes south of Queens Gardens

P1, P2 and P2v2 were assessed against the criteria. P2 went through a number of iterations. Modelling and fatal flaws analyses were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width.

Through this process, P2v3 was identified as the preferred layout for a two-way option. This assessment evaluates only P1 and P2v3.

2 Assessment Approach

2.1 Definition

The Carbon impact assessment uses the following definitions:

Project Outcome: Improve transport sector alignment with the DCC's Zero Carbon 2030 target
Investment Objective: Support decarbonisation of the city's transport sector

The assessment considers how well each programme contributes to the DCC's Zero Carbon 2030 target. The DCC's Zero Carbon 2030 target is aiming to achieve net zero carbon dioxide emissions city-wide by 2030.

2.2 Assessment Approach

Greenhouse gas emissions (GHG converted to carbon dioxide equivalent when measured and therefore often referred to as carbon emissions) are generated at multiple stages in the lifecycle of a project. PAS2080 is the global standard for managing carbon in infrastructure and provides a framework from which to consider emissions. It recognises three different types of GHG emissions:

- capital carbon: emissions released during construction e.g. processes used, transport of materials, embodied carbon in materials, which varies depending on the type of material type and quantities used.
- operational carbon: emissions released through maintenance/operation of the asset or service.
- user carbon: emissions released through use of the asset.

Capital and operational carbon are not considered in this report, because the focus of the DCC's Zero Carbon 2030 target is on user carbon (emissions). However capital and operational carbon can be minimised in later planning and design phases through designs that maximise connections and ease of use for public and active transport modes, align carparking management with low emissions transport outcomes, minimise maintenance requirements and energy use,

minimise use of carbon intensive materials (concrete, steel), maximise locally sourced materials and focus on diverting waste from landfill during construction.

The Dunedin Community Carbon Footprint 2018/19 reported that emissions from the transport sector in Dunedin make up 39% of total gross emissions, with 25% from land transport. This is the highest emitting sector, generating 613,793 tonnes $CO2_e$ for 2018/19. While direct comparisons with the earlier (2014/15) footprint are difficult to make due to a change in methodology, increases in the level of fuel sales suggest transport is also the fastest growing source of emissions. Transport emissions are dominated by carbon dioxide. Initiatives to reduce emissions from transport are therefore a high priority in terms of achieving the DCC's Zero Carbon 2030 target.

The DCC's recent Climate 2030 Rapid Review (completed in 2020) identified a list of mitigation levers which can be used to reduce emissions from transport. This list has been used to consider the carbon impact of P1 and P2v3. The assessment focuses on user carbon as this is the clear priority in terms of achieving the Zero Carbon 2030 target. The findings of the Climate 2030 Rapid Review generally align with the Climate Change Commissions' draft package of advice to the Government (the 'Draft Advice Report', 2021) on how to achieve emissions reduction targets.

The Draft Advice Report suggests New Zealand would need to almost completely decarbonise land transport to meet the national target of net carbon neutrality by 2050. Uptake of light electric vehicles, facilitated by bans on combustion engine imports and electric vehicle (EV) subsidies, is required to meet the government's 2050 goals. The report suggests 20% of the light vehicle fleet must be electric by 2030. The report emphasises changes in how and how much New Zealanders travel, assuming, by 2030:

- around 7% reduction in the average household travel distance per person (for example through more compact urban form, and encouraging remote working)
- an increase in the share of this distance travelled by walking, cycling and public transport, by 25%, 95% and 120% respectively.

Due to the high-level nature of the SFDT programmes and the wide-ranging potential for national policy and actions to influence emissions, it is not possible at this stage to make accurate forecasts of possible emissions reduction. Instead, a qualitative carbon impact assessment has been undertaken, with external influences excluded.

The following information has been used to inform the assessment:

- Traffic model – which provides estimates of likely congestion for P1 and P2v3
- Mode shift estimates for P1 and P2v3 from the Travel Choice Assessment Report
- Dunedin City Council Climate 2030 Rapid Review (January 2021)
- Peak Oil Vulnerability Assessment for Dunedin, Dr Susan Krumdieck and EAST Research, 2010
- Climate Change Commission 2021 Draft Advice for Consultation, January 2021.

3 Programme Performance

3.1 Programme Descriptions

The programmes are defined in Attachment 1.

3.2 Performance of Programme 1 and 2v3

The table below provides an assessment of the performance of P1 and P2v3 against the relevant mitigation opportunities identified in the DCC's 2030 Rapid Review. As some projects are in both programmes, the comments associated with those projects are the same. Blue font has been used to highlight points of difference.

The seven high-level project elements identified for both programmes are described in Appendix A.

Mitigation Lever	Opportunity	Programme 1	Programme 2v3
Reduce the need to travel, or reduce vehicle kilometres travelled by motor vehicle	Intensify land use and mixed-use development in central city and suburban notes	Offers specific opportunities to intensify land use and promote mixed use development on Princes Street, which will become less car dominated. No specific opportunities in the central city on SH1; although P1 does not preclude rezoning it may be difficult to create additional accesses to residential/mixed use developments on to SH1 northbound and southbound, due to efficiency and safety requirements for the highway. Any mixed use/residential development that eventuates on the one-way pair will potentially be less successful/desirable, due to high traffic volumes and high percentage of freight in the traffic stream.	Offers specific opportunities to intensify land use and promote mixed use development on Princes Street, which will become less car dominated. Changing SH1 northbound to a slow speed, pedestrian focussed local road offers opportunities to intensify land use and zone for mixed use residential development in the central city, which will reduce the need for vehicle travel for those living in the central city. Any mixed use/residential development that eventuates on the new local road has the potential to be successful/desirable, due to low traffic volumes and active mode focus. More people living in the central city is likely to reduce carbon impact, particularly if the city is designed to enable low-emission lifestyles.
	Integrate land use and transport system planning	Land use and transport system will be better integrated on: • Princes Street - shopping area and bus stops more accessible for active modes and bus users. • New Dunedin Hospital - some positive changes in amenity and provision for pedestrians and bus users accessing the hospital, through Barnes Dances, and 40km/h speed limit. • Tertiary area – active mode and superstop upgrade on Albany Street will make access easier by active modes and bus. • Queens Gardens – better access by cycle due to extension of separated cycleways. No other change. • Warehouse Precinct – better access by cycle due to extension of separated cycleways. No other change.	Land use and transport system will be better integrated on: • Princes Street - shopping area and bus stops more accessible for active modes and bus users. • New Dunedin Hospital – a local road with low speed (30kmh), low traffic/freight volumes, active mode focus including opportunities for pedestrians to cross via mid-block crossings and Barnes Dances, will make access easier by bus and active modes. • Tertiary area – active mode and superstop upgrade on Albany Street will make access easier by active modes and bus. • Queens Gardens – better access by active modes as local road boulevard provides connection to north and south. Far lower traffic volumes than current condition means easier access for pedestrians. • Warehouse Precinct – better access by active modes as local road boulevard provides connection to north and south. Far lower traffic volumes than current condition means easier access for pedestrians.
	Flexible working	Travel planning with employers will enable the DCC to promote flexible working practices.	
	Car parking management	The Parking Management approach will move longer term parking to the periphery of the central city and offers opportunities for the DCC to pursue emissions goals through reviewing parking charges and supply, as well as parking for lower emission modes such as mopeds, motorbikes and electric vehicles. A real time wayfinding system will reduce circulating traffic looking for a parking space.	

Mitigation Lever	Opportunity	Programme 1	Programme 2v3
Increase sustainable modes	Walking and cycling infrastructure	Extends the existing separated cycle facility on SH1 south from Queens Gardens to the Oval. However, cycle routes on SH1 remain negatively affected by high traffic and freight volumes, which is likely to suppress demand and restrict use to more confident riders. Completes gaps in cycle network in central city through connecting harbour route to central city via Albany and St Andrew Streets. These routes will be popular and provide links to key parts of the city including the Tertiary and Retail areas. Walking network improvements are targeted on Princes Street and St Andrew Street. St Andrew Street will have a pedestrian focus, and the Princes Street upgrade will improve connectivity and pedestrian experience. The slow speed zone (40km/h on SH1 routes and 30km/h on other central city streets) will improve the walking experience. Barnes Dances at key intersections will improve the level of service for pedestrians within the central city.	The new local road in the central city (on SH1 northbound) will become a walk/cycle boulevard, with low traffic volumes, 30km/h speeds, amenity improvements and low freight volumes. This will support use of this route for commuting both within the central city, and to the central city from North East Valley and South Dunedin areas. The route will be suitable for cyclists of all ages and will unlock the benefits of prior investment in the cycling network. Completes gaps in cycle network in central city through connecting harbour route to central city via Albany and St Andrew Streets. These routes will be popular and provide links to key parts of the city including the Tertiary and Retail areas. Walking network improvements are targeted on Princes Street and St Andrew Street. St Andrew Street will have a pedestrian focus, and the Princes Street upgrade will improve connectivity and pedestrian experience. The new local road with its 30km/h slow speed zone and pedestrian focus (combined with 30km/h speed zone on other central city streets) will support walking both within the central city and to and from North East Valley/South Dunedin. Barnes Dances at key intersections will improve the level of service for pedestrians within the central city.
	Road space reallocation	Road space reallocation is expected on Princes Street, Albany Street, and St Andrew Street. This will improve the level of service for active modes relative to the private motor vehicle.	Road space reallocation is expected on the new local road (SH1 northbound), Princes Street, Albany Street, and St Andrew Street. This will improve the level of service for active modes relative to the private motor vehicle.
	Reduce vehicle speeds	Vehicle speeds will be reduced to 40km/h on SH1 between St David Street and Police Street. On central area local roads, they will be reduced to 30km/h. This will improve safety and comfort for active modes and increase travel times by private car thereby encouraging active mode use. The change to 40km/h speed limit on both SH1 routes will result in internal combustion engine vehicles travelling on this route emitting more carbon than they would travelling at 50km/h.	Vehicle speeds will be reduced to 30km/h on the new local road (current SH1 northbound) between St David Street and Police Street. This will align with the 30km/h speed limit on local roads in the central area. This will improve safety and comfort for active modes and increase travel times by private car thereby encouraging active mode use. The introduction of a 30km/h new local road means internal combustion engine vehicles on this road will emit more carbon than if they were travelling at 40km/h or 50km/h. However, given traffic volumes are significantly lower overall the change in carbon emissions related to speed is likely to be less than for Programme 1, as speeds remain at 50km/h on the new arterial route, where the majority of traffic is located. During the evening peak the model forecasts some congestion on the new arterial, but the rest of the time the route is relatively free flowing.

Mitigation Lever	Opportunity	Programme 1	Programme 2v3
	Support behaviour change e.g. travel planning, end of trip facilities, wayfinding	P1 and P2v3 include a travel behaviour change component which includes travel planning with employers and schools, as well as community travel planning. The three new central city bike hubs will improve end of trip facilities for cycling.	
More efficient vehicle use	PT improvements – high quality infrastructure, bus lanes, fares, Park and Ride (Mosgiel)	There will be significant improvements to PT infrastructure through superstop and bus hub upgrades to provide better facilities including real time information, as well as a review of fares and frequencies. There will be a significant increase in services to the south of the city including express buses from Mosgiel, and two park and ride sites.	There will be significant improvements to PT infrastructure through superstop and bus hub upgrades to provide better facilities including real time information, as well as a review of fares and frequencies. There will be a significant increase in services to the south of the city including express buses from Mosgiel, and two park and ride sites. For P2v3, it is proposed that buses will use the northern section of the new local road, one block closer to the Tertiary Area. The bus hub will be more accessible in P2v3.
Increase lower emission vehicles	Micromobility schemes	Parking for e-scooters will be considered as part of the Princes Street upgrade. Slower speeds will support these modes by providing a more comfortable environment. Skateboarding is a popular active mode in Dunedin with 8% of University students using this mode for transport. The slower speeds proposed in the central area as well as on Princes and St Andrew Street will benefit these users.	Parking for e-scooters will be considered as part of the Princes Street upgrade. Slower speeds will support these modes by providing a more comfortable environment. The new local road will provide a considerable extension to the slow speed zone. As for P1, skateboarding is popular active mode in Dunedin. The slower speeds proposed in the central area as well as on the new local road, Princes and St Andrew Street will benefit these users.
	Increase use of rail (moving goods)	The harbour arterial upgrade will improve the Ward Street route, resulting in lower traffic volumes on the at-grade rail crossing on St Andrew Street, and provision of a high-quality alternative route for vehicles (including heavy vehicles) when the at-grade crossing is closed. This initiative will improve freight efficiency for trucks and will enable rail freight to have priority on this corridor, noting that reducing carbon emissions from rail freight will be part of the national focus.	

3.3 Discussion

In terms of achieving the DCC's Zero Carbon 2030 target, recommended approaches (as identified for Dunedin through the Climate 2030 Rapid Review, and for New Zealand through the draft advice of the Climate Change Commission) suggest that contributions to lowering emissions across the wider transport network, are of greater importance. The most significant reductions in emissions are likely to stem from the network changes that support a reduction in vehicle kilometres travelled, facilitate urban densification, enable and encourage greater use of sustainable modes of transport, and improve the efficiency of vehicle use (with a focus on public transport).

Of the seven high level projects identified for both programmes, six are common to both. Of these six common projects, five have close alignment with recommended approaches to reduce emissions from transport, with a focus on reducing vehicle kilometres travelled, promoting sustainable modes, and integrating land use and transport. The sixth project - the Harbour Arterial is an enabling project which will support the other projects by moving through traffic and heavy vehicles out of the central city. The seventh project – state highway route configuration - is the primary difference between the programmes in terms of carbon impact, and this is discussed in more detail below.

3.3.1 Comparison of P1 and P2v3

Overview
The defining benefit of P2v3 in terms of carbon emissions is the freeing up of Great King Street, Cumberland St, and Crawford St from being a State Highway to become a local road, enabling more active transport mode shift and low

emission lifestyles by moving cars and traffic further away from the urban centre, on to the new two-way arterial and the Harbour Arterial, in favour of people-orientated design in the central city.

Local road status gives more autonomy to DCC to control and adapt the road as it sees fit. This includes rezoning land along the new local road to aid urban densification; amending road allocation, levels of service and vehicles speeds to promote alternative modes; and enabling tactical urbanisation opportunities for people centred streets.

Aiding urban densification
The local road status achieved through P2v3 better aligns with DCC's Draft 10 Year Plan 2021-2031 and Central City Plan, which are focused on improving the safety and accessibility of the city's public spaces and creating compelling, attractive spaces where people want to spend time. Densification of the city centre enables residents from the surrounding low-density housing areas to move into the centre of the city. This in turn greatly reduces and sometimes eliminates the need for a personal vehicle. With residents living near the centre, the travel distance decreases significantly, and public transport and active modes become the primary transport modes. The Peak Oil Vulnerability Assessment for Dunedin Report (2010) suggests that the adaptability to active modes and shorter distances provides about 60% fuel reduction for the residents who move into the centre. This results in a 25% overall fuel demand reduction for Dunedin if 80% of the people who currently live 10–30km from town, but work in town, move into the city.

Although P1 does not preclude rezoning, it may be difficult to create additional accesses to residential/mixed use developments on to SH1 northbound and southbound, due to efficiency and safety requirements for the highway. It may also be difficult to create a compelling living environment for people to live at higher densities.

Promoting alternative modes
The creation of a local road in P2v3 is also considered more likely to strengthen behaviour change and mode shift through supporting low cost, low emission transport alternatives and therefore enabling low emission options for a larger proportion of the city's population. It better integrates land use and transport planning, making key locations more accessible by active modes, such as the central city, Tertiary area, new Dunedin Hospital, Queens Gardens and the Warehouse Precinct. These areas are important to consider as they are used by large number of the city's population and are some of Dunedin's biggest employers.

The Travel Choice Assessment provides the following estimates for mode shift for each programme:

Dunedin Mode Share Estimate				
	Census	Census	P1	P2v3
Mode	*2013*	*2018*	*2030*	*2030*
Work from home	7.0%	10.2%	13.0%	16.0%
Bus	3.0%	3.4%	8.0%	10.0%
Bike	3.0%	2.1%	5.0%	8.0%
Walk	11.0%	9.9%	14.0%	16.0%
Total non-car mode share	24.0%	25.6%	40.0%	50.0%

The table shows that P2v3 is expected to provide a stronger impetus for behaviour change than P1. This reflects:

- A more appealing cycleway design with a two-way separated cycleway on the full length of the new local road from the Oval to the Botanic Gardens, compared to P1 which essentially maintains the current arrangement but extends it from Queens Gardens to the Oval. The current arrangement is not ideal. SFDT consultation in 2020 highlighted concerns about the disjointed nature of the paths, hazards at vehicle crossings and traffic lights, narrow cycle lane widths, and the safety hazard of having cyclists on a major state highway and heavy freight route. P2v3 cycleways are considered to make travel by bike more feasible, safe and convenient than P1.
- A more legible public transport system, with buses using the same road regardless of direction. The bus hub will be easier to access as severance will be reduced, and a more direct route will be provided via Great King Street in the north of the city.
- Congestion in the evening peak, which can be a trigger for people to change mode, because travel times by modes such as bus, walk or cycle, become comparable to travel times by driving. It can be difficult to get mode shift without a 'push' factor caused either by congestion or by parking availability/cost.
- A 30km/hr speed limit on the local road, which will encourage more active mode uptake compared to P1. Speed limits have a major influence on the uptake of alternative modes of transport, with Waka Kotahi NZ Transport Agency Tactical Urbanisation Handbook suggesting that controlling vehicle speed and priority, or removing traffic, to improve walking and cycling safety and local amenity is a key mechanism for mode shift.
- Opportunities for attractive, higher density residential development on the new local road, which may lead to more people living within walking/cycling distance of their destinations.

Speed Limits
Additional congestion in the evening peak in P2v3 is likely to lead to increased emissions at this time of day, due to 'stop/start' driving conditions, which require more fuel. Overall, the proposed speed limits are expected to result in lower emissions with P2v3, because most vehicles are on a route with a 50km/h speed limit – which means overall, less carbon will be emitted than on the two, 40km/h routes in P1. Congestion during the evening peak will reduce this effect, but the rest of the time the route is relatively free flowing.

Freight
Freight and goods movement is likely to change in future with the Government's Draft Advice Report suggesting that emissions from freight be reduced by switching some freight movements from road to rail and coastal shipping. Long term priorities may focus on maintaining and enhancing the rail and port infrastructure, with a reduced need for a more extensive SH1 arterial.

4 Programme Scores

4.1 Scoring

A seven-point scoring system was used for this assessment:

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernible or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

The scoring for the two programmes reflects how well each programme performs against the criteria, compared to the Do Minimum. The Do Minimum consists of the transport network as it currently exists with the addition of the following committed interventions:

- Permanent Barnes Dance at both Albany Street/SH1 intersections (currently a trial)
- George Street – 10 km/h for four blocks - Albany to Moray Place
- Tertiary – 30km/h speeds on Union Street, Harbour Terrace, Clyde Street and Forth Street.

4.2 Programme 1 and Programme 2v3 Scores

The table presents the scores for each programme, for Carbon Impact (refer to Appendix A for descriptions of project elements 1-7 for each programme).

Programme	Score	Summary Rationale for score
Do Minimum	-3	In terms of achieving the DCC's Zero Carbon 2030 target, the impact would be significantly adverse. With population growth, any adverse impacts from carbon emissions may not be able to be managed or mitigated. Preliminary work undertaken for DCC suggested that relying significantly on offsets would be extremely cost prohibitive and that transport sector emissions should be a focus for early emissions reduction efforts.
Programme 1	+2	In terms of achieving the DCC's Zero Carbon 2030 target, P1 is assessed to fall between minor and moderately positive. There is good carbon reduction in P1 from elements 2-7. With effective parking management, a +2 could be achieved, however limiting parking supply and/or increasing parking charges may not be acceptable to the community. Without this disincentive to driving, a +1 is more likely. Also, there is no significant change to SH1 which is

Programme	Score	Summary Rationale for score
		central to the travel choices made by a significant proportion of transport network users. This may reduce the effectiveness of elements 2-7, as driving will still be very attractive.
Programme 2v3	+3	In terms of achieving the DCC's Zero Carbon 2030 target P2v3 is assessed to be significantly positive. P2v3 combines the carbon reduction contribution of elements 2-7, with the creation of a new local road and an arterial route that is further from the city. It provides regulatory autonomy for future changes on the local road, and opportunities for successful urban densification, low carbon lifestyles and a more liveable city. It provides a stronger incentive for mode shift, through better active mode levels of service and congestion in the evening peak. The assessment concluded that reconfiguring the SH1 one-way pair as proposed in P2v3 is the largest lever for the city to create change, because it allows a restructure of the heart of the city. It is expected that this would generate significant change in user behaviour and provide ongoing opportunities to influence where people live and how they travel. As for P1, the success of P2v3 relies on effective parking management, which may not be acceptable to the community. However, P2v3 is less reliant on this for success because the additional congestion with P2v3 creates a separate disincentive to driving. A combination of P2v3 and effective parking management would be the most powerful approach to reducing carbon emissions.

Appendix A: Programme Descriptions

Programme 1 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: retain one way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

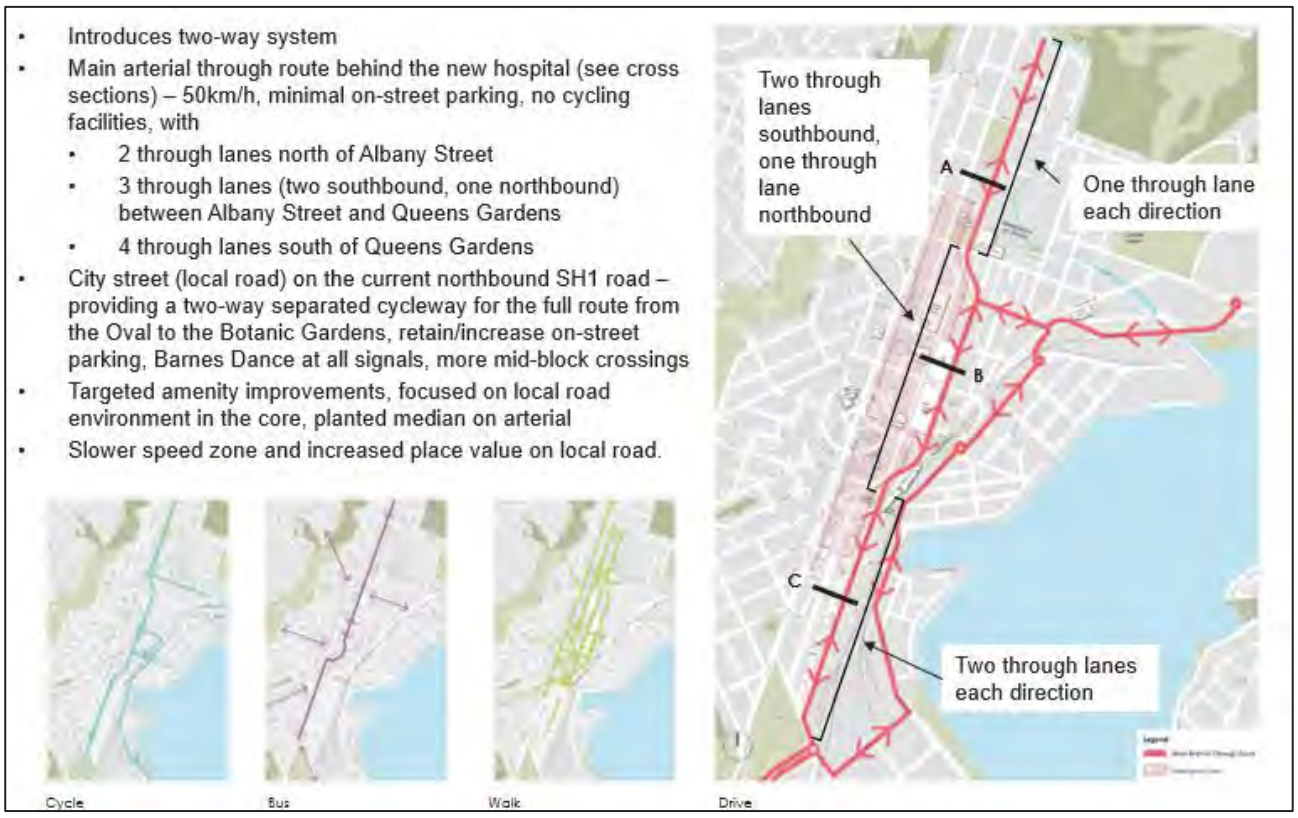
5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

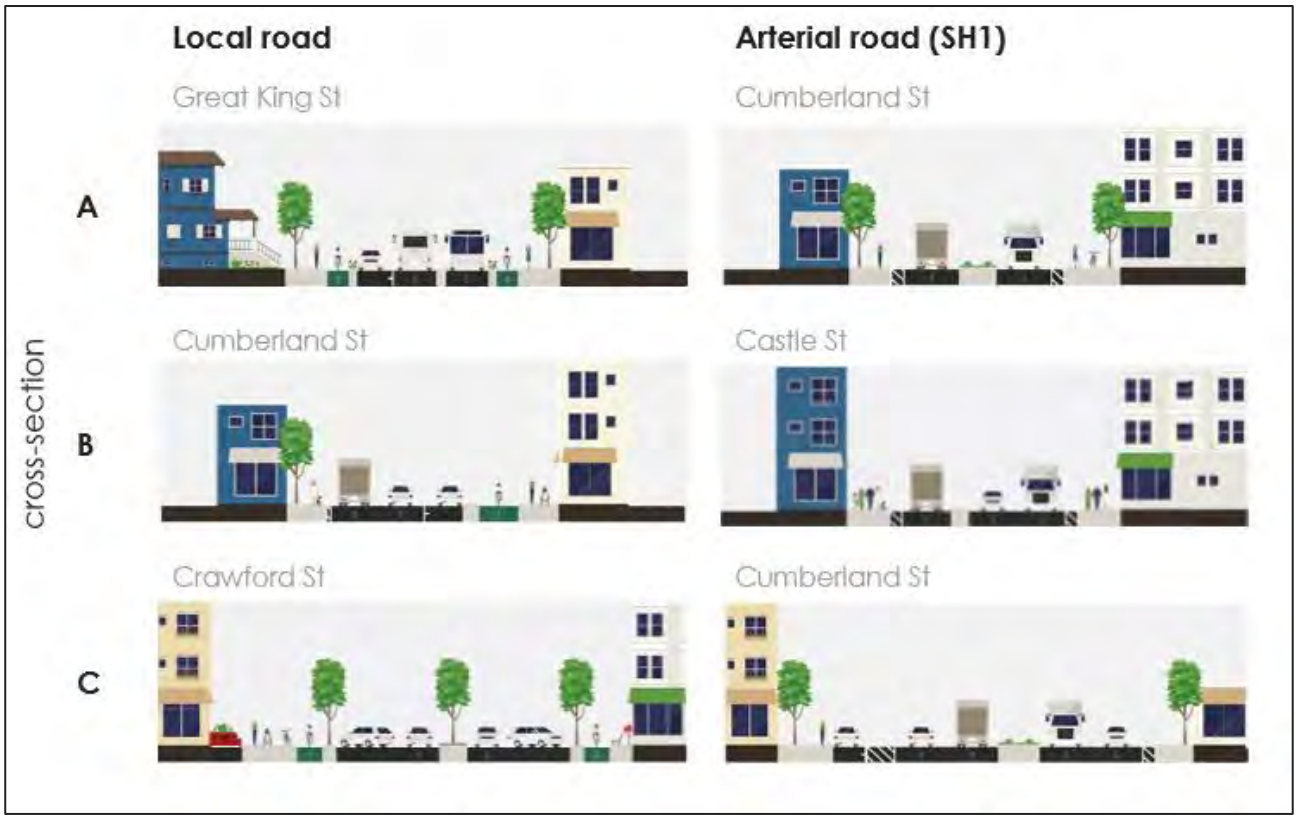
7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Programme 2v3 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: introduce two-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

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   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
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   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Shaping Future Dunedin Programme Business Case

MCA Technical Assessment for Place Quality

Rev. no	Date	Description	Prepared by	Checked by	Reviewed by	Approved by
1	12/02/2021	Draft Place Quality MCA Assessment	Kurt Cole	-	Rachael Eaton	Marc Baily
2	29/04/21	Draft Place Quality MCA Assessment v 2	Kurt Cole	-	Rachael Eaton	Marc Baily
3	13/05/2021	FINAL	Emma Taylor		Rachael Eaton	Marc Baily

1 Overview

1.1 Purpose

The purpose of this report is to provide a technical assessment of Programme 1 and Programme 2v3. The results will be used for the Shaping Future Dunedin Programme Business Case MCA scoring.

This assessment focuses on the performance of each programme in relation to Place Quality.

1.2 Programme Development Process

During the shortlisting process, four programmes were assessed in detail. The most significant difference between each programme was the configuration of SH1 through central Dunedin. The four programmes were as follows:

Programme	One way	Two way	Description
P1	√		Two, one-way arterials with two through lanes
P2		√	Two lane local road and arterial with two through lanes
P2v2		√	Two lane local road and arterial with four through lanes
P2v3		√	Two lane local road and arterial with following configuration: • Two through lanes north of Albany Street • Three through lanes (two southbound and one northbound) between Albany Street and Queens Gardens (in line with Burlington Street) • Four through lanes south of Queens Gardens

P1, P2 and P2v2 were assessed against the criteria. P2 went through a number of iterations. Modelling and fatal flaws analyses were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width.

Through this process, P2v3 was identified as the preferred layout for a two-way option. This assessment evaluates only P1 and P2v3.

2 Assessment Approach

2.1 Definition

One of the outcomes of the Shaping Future Dunedin Transport project is to improve place quality, including the walking environment in the central city. For the purposes of this MCA3 Technical Assessment, 'Place Quality' is defined as:

The extent to which each programme (Programme 1 and Programme 2v3) contributes to a sense of place and provides a quality experience for people on foot. This includes how well each programme improves the walking environment in the central city and encourages people to spend time at central city locations such as the areas around the University of Otago, outside the new Dunedin Hospital, in Queens Garden and the Warehouse Precinct

2.2 Assessment Approach

The Place Quality assessment approach is based on the Valuing Urban Realm Toolkit (VURT) methodology[1]. VURT assessments have been undertaken for each programme at key locations along the road network (as per Appendix B). The VURT assessments have been used to establish a monetary value to the benefits to pedestrians of changes to the street environment of Programme 1 and Programme 2v3. This, combined with the expert judgement of the Boffa Miskell team, forms the basis of the Place Quality MCA scores outlined in Section 4.2 of this technical report.

[1] VURT is a methodology developed by Transport for London (TfL) and has been adapted for use in NZ

Valuing Urban Realm Toolkit
The use of streets and public spaces by pedestrians has a value in both social and economic exchange. To value the potential investment in the quality of Dunedin's city centre streets proposed for each programme the Valuing Urban Realm Toolkit (VURT)[1] methodology has been used. By putting a monetary value on the more hard-to-quantify benefits of investing in better streets and spaces, VURT allows them to be considered alongside conventional timesaving and safety benefits[2]. The VURT process has been:

- Assess the existing streetscape quality using Pedestrian Environment Review System (PERS) audit tool
- Assess the future streetscape quality arising from the proposed programmes (plan based PERS assessment)
- Evaluate the change in streetscape quality between the existing (baseline) situation and the future scenario
- Assess how many people will experience that change in quality
- Monetise all user benefits by applying Willingness-to-Pay values to the total number of people using the space
- Calculate user benefits over the specified lifetime of the project (which for the purposes of this assessment is 30 years)

Pedestrian Environment Review System (PERS)
The PERS audit is part of the VURT assessment and is a standardised approach to evaluating the attributes that combine to shape the quality of a street or place. The place quality attributes in PERS include link attributes and space attributes as set out below.

Link Attributes		Space Attributes
Effective width	Personal security	Moving in the space
Dropped kerbs	Surface quality	Interpreting the space
Obstructions	User conflict	Personal safety
Permeability	Quality of environment	Feeling comfortable
Legibility	Maintenance	Sense of place
Lighting		Opportunity of activity

If the attributes are not present or are in poor condition, then the street or place will not be a good place for pedestrians, and they will avoid or only go there if they have no choice. The opposite is that if the attributes are present and in good condition the street or place will be attractive to pedestrians and people will choose to go there, which both benefits social and economic outcomes for those people and at that place.

Each attribute is scored (+3 to -3) for each the current street condition in each programme. As noted above this score is combined with current and future pedestrian volumes to calculate (using inbuilt model willingness to pay values) the user benefits of each scenario. For the purposes of this assessment, based on Dunedin projected population growth, future pedestrian volumes have been derived by applying a 1.3% pedestrian growth rate per annum to existing pedestrian numbers and overlay this with the localised changes coming from hospital redevelopment and the university development.

3 Programme Performance

3.1 Programme Descriptions

The programmes are defined in Attachment 1.

3.2 Outcome of VURT assessment for both Programme 1 and Programme 2v3

The table below summaries the outcome of the VURT assessment for each programme. The improved street attributes are estimated to provide benefits to pedestrians over the next 30 years of $16 million for Programme 1 and $19.9m for Programme 2, both in present value terms.

Present value of pedestrian benefits relative to Status Quo ($0m) – Refer to Attachments for locations		
Street Section (refer to Appendices for locations)	Scenario 1	Scenario 2
Castle Street (CA1)	$0.5	$0.3
Castle Street (CA2)	$1.0	$0.5

[2] Case Study Research into Applying the Transport For London VURT Methodology in Auckland, New Zealand (2017) Boffa Miskell in collaboration with Auckland Council

Present value of pedestrian benefits relative to Status Quo ($0m) – Refer to Attachments for locations		
Street Section (refer to Appendices for locations)	Scenario 1	Scenario 2
Cumberland Street (C1)	$9.8	$11.2
Cumberland Street (C2)	$3.8	$4.5
Cumberland Street (C5)	$0.4	$1.0
Great King Street (GK5)	$0.2	$1.7
Queens Gardens North (QN)	$0.2	$0.5
Queens Gardens South (QS)	$0.1	$0.2
Sub-total	**$16m**	**$19.9m**

Further commentary about the performance of each programme, particurly in relation to the PERS place quality attributes is set out below.

3.3 Performance of Programme 1

The improvements to place quality resulting from Programme 1 is estimated to provide benefits to pedestrians over the next 30 years of $16 million. The effect is greatest on the Cumberland Street section outside the new Dunedin hospital, with an estimated value of pedestrian benefits totalling $9.8 million.

Multiple factors including high pedestrian numbers associated with the new hospital contribute to the Cumberland Street effect. Pedestrian permeability is provided between the hospital campus by proposing St Andrew Street as a low speed traffic space. Potential new open spaces and through block connectivity within the hospital site will also improve permeability further and potentially increase the available green space in this part of the city centre. The most influential of the PERS attributes which contribute to the Cumberland Street effect are from the proposed improvements in amenity through planting and kerb build outs and increased feelings of comfort and safety resulting from the separation of the footpath provided by either parking bays and/or cycleways from the one-way traffic lanes. The slow speed zone also provides benefit to the pedestrian and when coupled with the above attributes helps to improve place quality.

It should be noted that a key component of the pedestrian benefits on Cumberland Street outside the new hospital is the separated footpath. If this separation is not provided i.e. a footpath is directly adjacent to two one-way traffic lanes this will impact on the benefits to pedestrians as valued by VURT and in turn place quality.

The value of pedestrian benefits on Castle Street behind the new hospital, whilst also positive compared to the status-quo is much lower than on Cumberland Street. This is primarily due to less opportunity for improving pedestrian permeability and amenity, which impact of feelings of comfort and safety, coupled with lower pedestrian numbers.

There is a slight increase in value of pedestrian benefits around the University under Programme 1. This is primarily related to some slight increase in feelings of comfort and safety due to introduction of a lower speed limit on both Cumberland and Castle Streets. Some improvement in pedestrian permeability is also provided by proposing Albany Street as a slower speed street.

The lowest value of pedestrian benefits is at Queens Garden (southbound). This is primarily due to pedestrian permeability continuing to be limited by the severance caused from the one-way system. The slight increase in benefits acknowledges that there may be a reduction in traffic volume as some of the existing traffic may move to the harbour arterial and providing some separation (planting, parking and/or cycleway) between footpath and two lanes of one way traffic improves feeling of comfort and safety.

3.4 Performance of Programme 2v3

The improvements to place quality resulting from Programme 2v3 is estimated to provide benefits to pedestrians over the next 30 years of $19.9 million.

As per Programme 1, the effect is greatest on the Cumberland Street section around the new Dunedin hospital. The estimated value of pedestrian benefits on Cumberland Street outside the hospital under Programme 2v3 totals $11.2 million. Again, multiple factors including high pedestrian numbers associated with the new hospital contribute to this value. The most influential of the PERS attributes are the proposed improvements in pedestrian permeability, through the introduction of a two-way local road and mid-block crossings, improved amenity through addition of planting and kerb build outs and increased feelings of comfort and personal safety and environmental quality due to reduced traffic volumes, introduction of sow speed zone and less heavy traffic as more traffic use the arterials (Harbour Arterial and SH1).

It should be noted that under Programme 2v3, the value of pedestrian benefits on Castle Street behind the new hospital, is now significantly lower than the value of pedestrian benefits on Cumberland Street. Whilst Programme 2v3 still provides a positive (although minimal) effect compared to the status-quo, that benefits to pedestrians is now lower than Programme 1 benefits despite working to same predicated pedestrian numbers. This is primarily due to the proposed three through lanes between Albany Street and Queens Garden. Because of spatial constraints within the road corridor, the additional traffic lanes results in no ability to provide for general amenity planting nor separate the footpath from the traffic lanes (either with cycleway, parking or planting). This has a significant impact on the PERS attributes of feelings of comfort and personal safety, quality of environment and pedestrian permeability.

Under Programme 2v3 there is an increase in value of pedestrian benefits around the University. Again, this is primarily related to increases in feelings of comfort and safety due to introduction of a lower speed limit on both Cumberland and Castle Streets, and the introduction of a two-way local road replacing the current one way system, which will increase feelings of comfort and personal safety, provide more pedestrian permeability and opportunities for activation.

Again, the lowest effect overall is at Queens Garden (southbound) where there is $0.2m value of pedestrian benefits above the status quo (do minimum). This is mainly due to pedestrian permeability continuing to be limited by the severance and impacts on feelings of comfort, personal safety and pedestrian permeability caused from the proposed three through lanes of traffic. The slight increase in benefits acknowledges that there may be a reduction in traffic volume as some of the existing traffic may move to the harbour arterial which improves comfort to some extent.

South of Queens Garden due to the introduction of a two-way local road on Crawford Street, there will be increased pedestrian benefits resulting from improved feelings of safety and comfort and increased permeability to the Warehouse Precinct. Furthermore, on Cumberland Street, whilst there is four through lanes of two way traffic, the introduction of a footpath which is separated from the traffic lanes (by cycleways, parking and amenity) helps to improve the PERS attributes of comfort and safety and in turn improve place quality.

4 Programme Scores

4.1 Scoring

A seven-point scoring system was used for this assessment:

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernable or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

The scoring for the two programmes reflects how well each programme performs against the criteria, compared to the Do Minimum. The Do Minimum consists of the transport network as it currently exists with the addition of the following committed interventions:

- Permanent Barnes Dance at both Albany Street/SH1 intersections (currently a trial)
- George Street – 10 km/h for four blocks - Albany to Moray Place
- Tertiary – 30km/h speeds on Union Street, Harbour Terrace, Clyde Street and Forth Street.

4.2 Programme 1 and Programme 2v3 Scores

Programme Scores: The scoring system and Do Minimum have been summarised for you. Please complete the table which shows your scores for Programme 1 and Programme 2v3 against your assigned criteria, and a summary of the justification for those scores. The table presents the scores for each programme, for place quality.

Programme	Score	Summary Rationale for score
Do Minimum	0	Whilst slower speeds will help with people being able to cross the road more safely and slightly improve feelings of comfort when walking along footpaths without being combined with other attributes such as improved amenity these will have no discernible impact on place quality.
Programme 1	+1	Includes improvement in place from a repositioning of traffic volumes -some to the harbour arterial which when coupled with slow speed zone will improve comfort to some extent. The proposed additional streetscape improvements will contribute to the legibility of the street network and with some amenity improvement to arterials. User conflicts in terms of better cycle amenity and footpath widths and separation form traffic lanes in places is also positive. There is some improvement in the opportunity for activation and amenity in some locations particularly outside the new hospital. The retention of the two-way system, however, will continue to have an impact on pedestrian permeability and feelings of comfort and personal safety and in turn place quality.
Programme 2v3	+2	Reallocating larger volumes of traffic across to the east side of the new hospital enables a more city street quality environment graduating back towards the city centre. The slowing of traffic and reduced volumes also adds to the permeability of the street to crossing in combinations with new mid-block crossings. The legibility of the street network is also enhanced as is the users experience with the two-way system. Local identity can also be more easily understood and stopping options are increased in terms of business visibility which enhanced opportunities for new activities. The quieter street environments will also encourage people to spend time in the place which assist the activation. Whilst the proposed three through lanes between Albany Street and Queens Garden, presents a reduction in pedestrian benefits and place quality behind the hospital when compared to Programme 1, the benefit of improvements to Cumberland Street, Great King and Crawford Street resulting from the introduction on a two way local road, will provide a more positive impact to place quality than Programme 1.

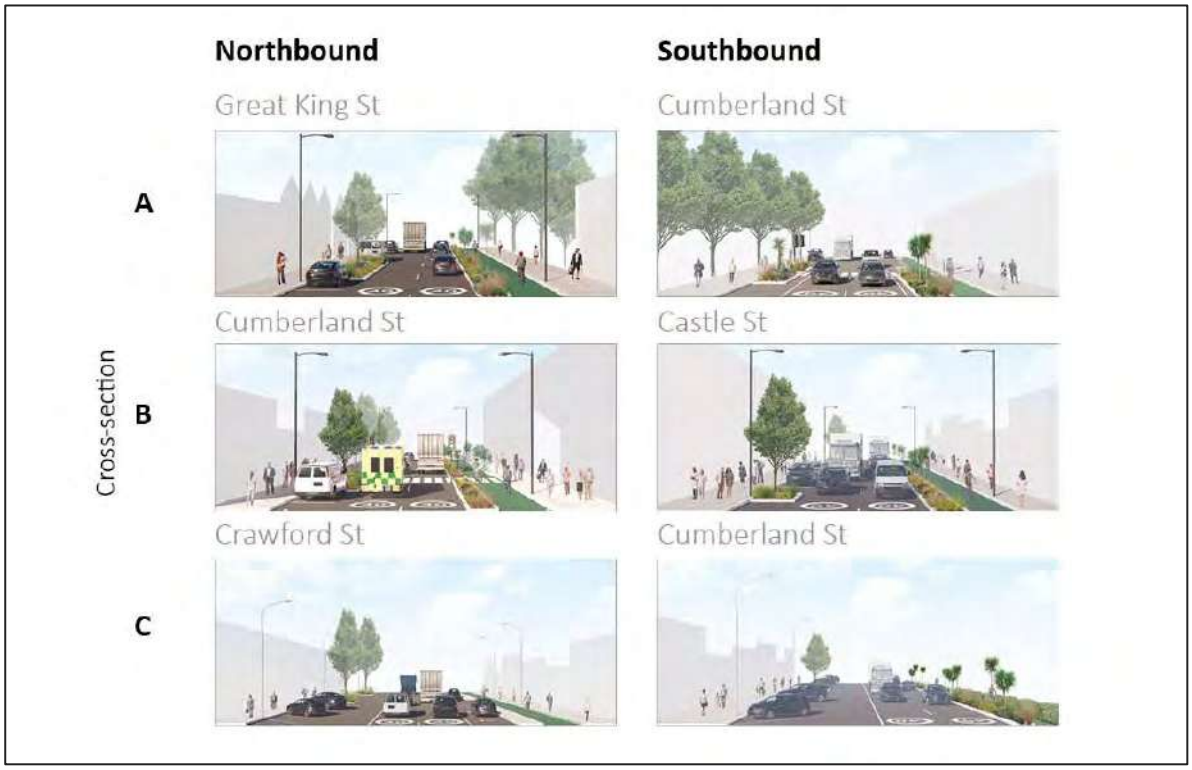
Appendix A: Programme Descriptions

Programme 1 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: retain one-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:

- Direction signage and real time information promoting the route
- Major and minor intersection upgrades to address known safety and efficiency issues
- Corridor improvements to reduce side friction
- Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:

- Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
- Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
- Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:

- Demand responsive pricing to which will reduce congestion caused by circulating traffic.
- Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
- Parking Wayfinding System to direct drivers to selected off street parking locations.
- Replace parking meters with more efficient parking technologies for payment and enforcement.
- Install sensors for data collection and easy analysis of information.
- Longer term – consolidate existing off-street carparking and explore potential new parking areas.

5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:

- Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
- Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

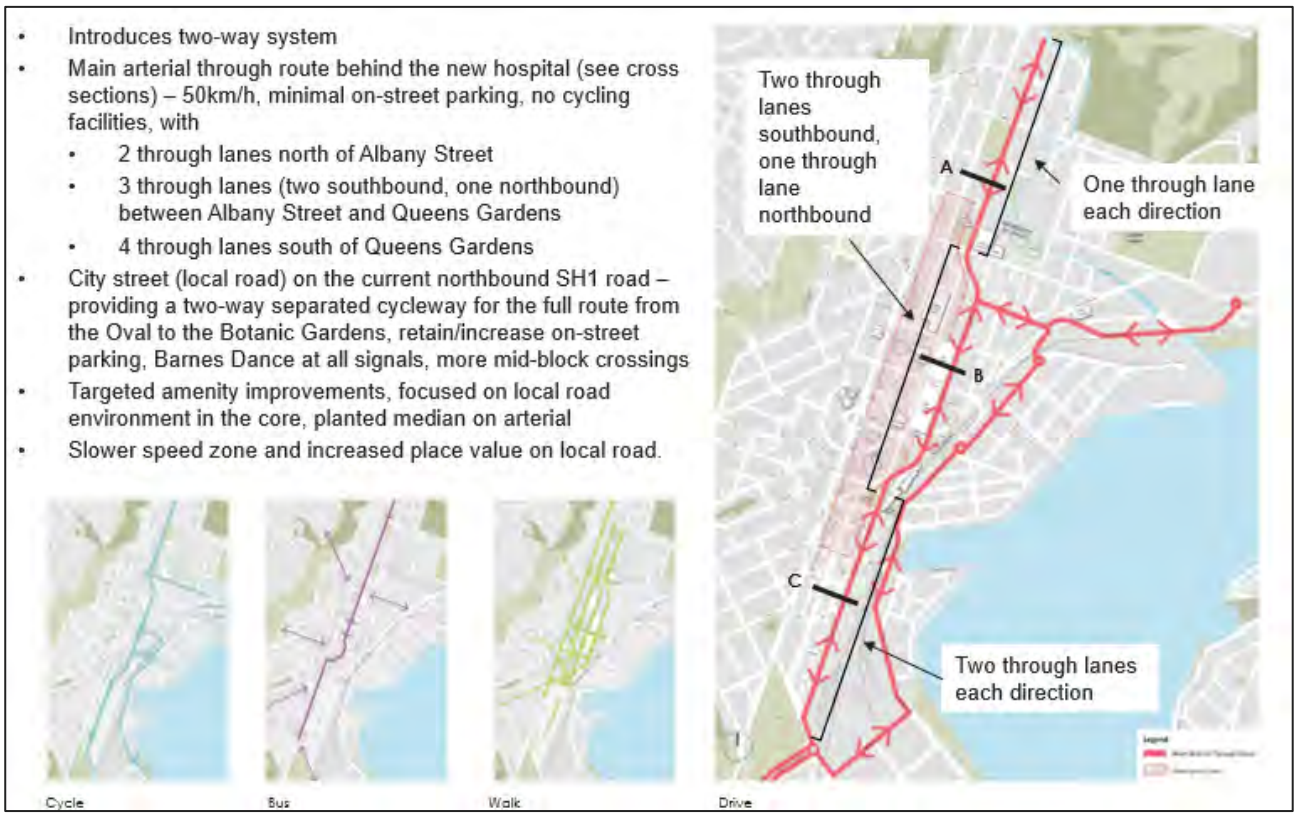
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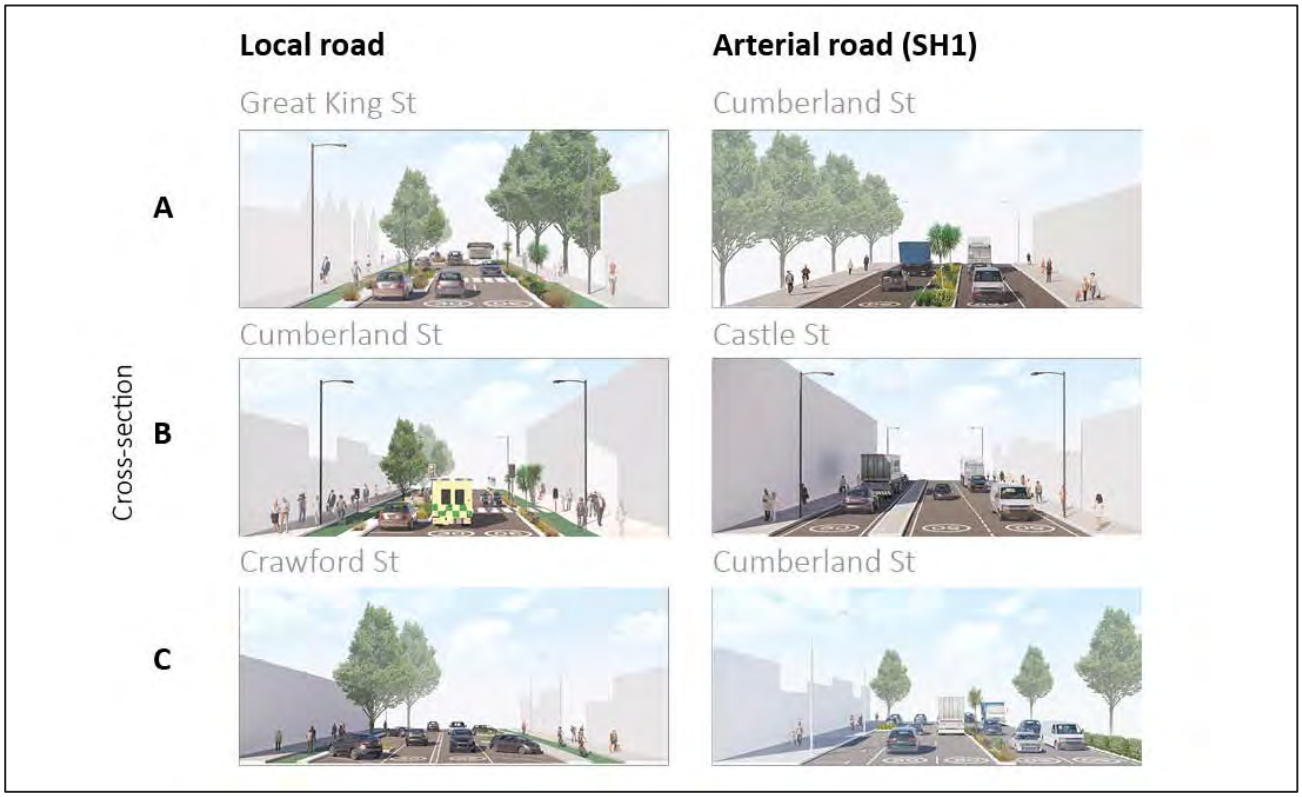
7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use

Programme 2v3 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: introduce two-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:

- Direction signage and real time information promoting the route
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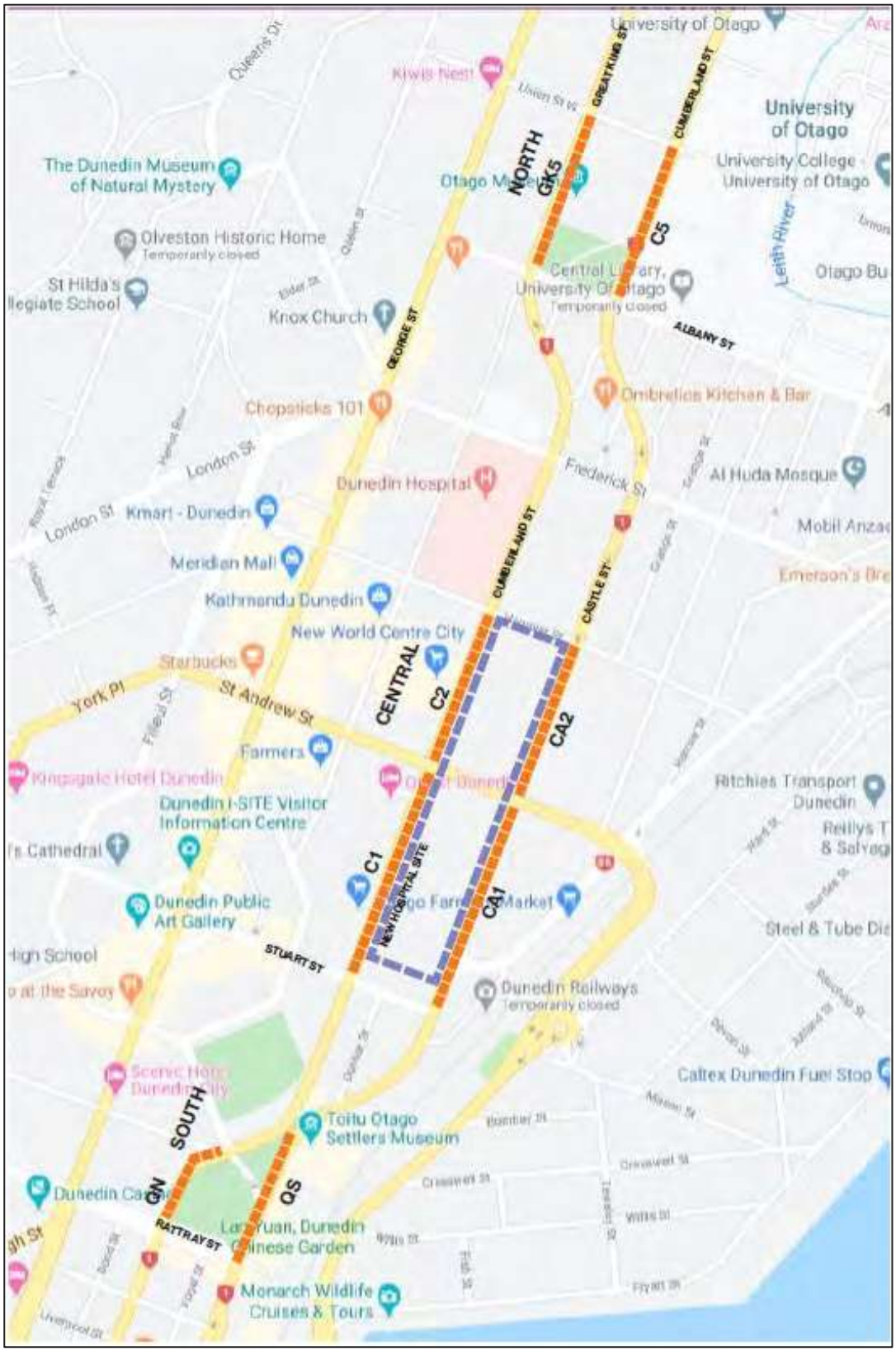
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- Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Appendix B: VURT location reference plan



Shaping Future Dunedin Programme Business Case

MCA Technical Assessment for Economic Evaluation

Rev. no	Date	Description	Prepared by	Checked by	Reviewed by	Approved by
1	24/05/21	Final	MM	GO	SC	GO

1 Overview

1.1 Purpose

The purpose of this report is to provide a technical assessment of Programme 1 and Programme 2v3. The results will be used for the Shaping Future Dunedin Programme Business Case MCA scoring.

This assessment focuses on the performance of each programme in relation to Economic Evaluation.

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During the short-listing process, four programmes were assessed in detail. The most significant difference between each programme was the configuration of SH1 through central Dunedin. The four programmes were as follows:

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P1, P2 and P2v2 were assessed against the criteria. P2 went through a number of iterations. Modelling and fatal flaws analyses were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width.

Through this process, P2v3 was identified as the preferred layout for a two-way option. This assessment evaluates only P1 and P2v3.

2 Assessment Approach

2.1 Economic Evaluation Methodology

2.1.1 Introduction

The economic evaluation is focused on the monetised element of the analysis as defined in the Waka Kotahi NZ Transport Agency *Monetised Benefits and Costs Manual* (MBCM) requirements.

To assess value for money, the monetised impacts are summed to establish a benefit-cost ratio.

The analysis is a full procedures economic evaluation performed in accordance with Waka Kotahi's MBCM (February 2021), using 4% discount rate and a 40-year analysis period.

The latest available update factors have been used, effective 1 July 2020.

The analysis adopts benefits from travel time, vehicle operating, vehicle emissions, pedestrian and cyclist benefits and crash savings for the two programmes under consideration. The analysis considers the proposed programmes as a package for both the northbound and southbound one-way corridors plus the Harbour Arterial corridor including all intersection and mid-block improvements, although several elements could be considered (from an economic viewpoint) as stand-alone projects.

2.1.2 Traffic Growth

The analysis adopted 10 years historic growth from two sites, 01S00704 and 01S00706, yielding on average a 1% growth per annum for the existing state highway corridors in both directions at 2020 (year zero).

2.1.3 Travel Time Benefits

Travel time is the key benefit contributor derived from the results of a Paramics network model. The City Centre microsimulation mode has been applied to testing the SFDT option scenarios. Full details of this testing and operations results are provided in the Stantec Report '*Microsimulation Modelling Option Testing Results, Prepared for Shaping Future Dunedin Transport, 09/06/2020'*. Further updates were made with the testing of Programme 2v3, with these results incorporated into the latest version of the economic evaluation.

The model scenarios have been run for each of the three programmes for the original Dunedin model base year (2017) and the 2038 forecast scenario estimated in 2017-18 with the SFDT Travel Demand Management (TDM) strategy. Zone blocking and bottleneck issues have been improved in the model scenarios for the economic assessment to reduce high travel times in the Network Wide Statistics economics outputs. The main driver of the travel time (TT) benefits is not current (2017) delays, it is growth in delays triggered by escalating modelled congestion. The model outputs are for the full network incorporating the effects that each programme has on the wider network.

The time periods modelled were:

- AM - 6am – 9am
- IP - 11am – 1pm
- PM - 3pm – 6pm

The reason that the AM demand is so much lower than the PM is that there is a relatively long period with low traffic volumes / demands at the start of the AM period (from 6:00am to 07:45am which equates to around half of the whole 3-hour period). In contrast, the PM period has steady / high demands through the entire 3 hours. Weekend peaks were not modelled and therefore were not assessed as part of this evaluation.

Given that the PBC economic assessment is relatively high-level, and therefore using network-wide averages and total trips to calculate economic indicators in a Variable Trip Matrix (VTM) assessment is likely to be appropriate. At a later stage, if the VTM approach is applied the economic values should probably be calculated on an OD-by-OD basis for improved robustness.

The 2038 Do Minimum model is based on the Do Minimum scenario with no travel demand management (TDM) measures. This does result in more vehicle trips in the modelled time periods because there are no TDM measures applied to encourage people to use other modes.

After 2038, growth is capped and the net benefit remains constant for all programmes until the end of the analysis period. This may result in the assessment being conservative. The capping of the growth and hence the benefits derived from the Paramics model has been applied because there is no indication on what the potential growth would be in the later years of the evaluation.

2.1.4 Vehicle Operating Cost Benefits

The vehicle operating cost (VOC) benefits applied are based on the travel distance outputs from the Paramics model and reported together with the travel time savings for each of the programmes.

Similar to travel time, the growth is capped after 2038 and the net benefit remains constant for all programmes. Without further information on potential growth in the later years of the evaluation, this results in the assessment being conservative.

2.1.5 Vehicle Emission Benefits

The vehicle emission benefits follow the methodology laid out in Section 3.3 of the Monetised Benefits and Costs Manual (MBCM). The methodology is carried out separately for each programme.

Inputs including the length of each section, the speed environment, average travel time, number of vehicles per time period, and heavy traffic composition, are used to calculate the dollar value of the four different vehicle emissions. Table 1 summarises the emission rates in tonnes per day for each programme by model year.

Table 1: Calculated Emissions Rates in Tonnes per Day

Programme	Year	Carbon Monoxide	Nitrous Dioxide	Particulate Matter	Hydrocarbons
		CO	NOx	PM10	HC
Do Minimum	2017	1.775	0.438	0.023	0.145
	2038	1.889	0.466	0.025	0.154

Programme	Year	Carbon Monoxide	Nitrous Dioxide	Particulate Matter	Hydrocarbons
		CO	NOx	PM10	HC
Programme 1	2017	1.775	0.438	0.023	0.149
	2038	1.830	0.451	0.024	0.149
Programme 2v3	2017	1.775	0.438	0.023	0.145
	2038	1.830	0.451	0.024	0.149

A calculation using an alternative carbon dioxide calculation as a percentage of VOC multiplied by a factor for light and heavy CO2 emissions from the EEM is summarised in Table 2.

Table 2: Calculated Emissions Rates in Tonnes per Day

Programme	2017 CO2 per Day (tonnes)	2038 CO2 per Day (tonnes)
Do Minimum	622	660
Programme 1	622	639
Programme 2v3	622	636

As can be seen from the results the tables, the impact of applying no TDM measures in 2038 in the Do Minimum scenario results in a significant increase in carbon dioxide emissions.

At this stage we have not made any allowance for vehicle fleet improvements in our calculations, e.g. electric/hybrid vehicles and technological improvements.

Similar to travel time and VOC, the growth is capped after 2038 and the net benefit remains constant for all programmes.

2.1.6 Walking and Cycling Benefits

This analysis uses the cycling and pedestrian demand methodology provided in Section 4.2 of the MBCM.

The method uses population density and commute share data along the length of the paths to estimate current demand generated by providing separated cycle facilities and pedestrian facilities.

A composite benefit of $2.20 per cyclist per kilometre of an improved facility was used for cyclists while where a facility eliminates or improves a route that is an impediment to safe walking, a benefit of $4.40 was ascribed to pedestrians using the facility. These composite benefits cover health and environment benefits.

Programme 2v3 proposes a significant change because the arterial route will not have any specific cycling facilities. It is proposed to remove the existing separated cycle lane on the current southbound corridor because the northbound corridor is intended to become a city street that accommodates the vulnerable road users. Programme 1 retains the existing separated cycle lanes as per the Do Minimum with significant improvements at intersections, accesses and mid-block to improve the attractiveness of the facility.

2.1.7 Crash Benefits

This Crash Cost analysis follows the methodology laid out in Appendix 2 of the MBCM. The methodology was applied to the entire corridor to estimate the impact of the corridor wide improvements for each scenario. A crash-by-crash analysis has been applied for the do minimum analysis and a crash rate analysis has been used for the option crash analysis to incorporate the varying impacts on the proposed improvements for each scenario.

Dependent on the programme, the proposed changes to intersection operations with Barnes dances for pedestrians, additional signalised mid-block crossings, slow speed zones with thresholds, diversion of heavy vehicles, solid and flush medians, retaining separated cycle facilities together with removing of some parking have been considered in the option crash analysis for the corridors under consideration. The Harbour Arterial crashes have been included in the analysis because the improvements to that route are common across the programmes.

The crash analysis adopted all reported crashes from 5 years CAS data (calendar years 2015 to 2019). The Crash Reduction Factors (CRF) that were used to assess the option crash costs were derived from the MBCM Crash Estimation Compendium's CRF tables.

A review of the 384 reported crashes on the existing one-way system for the five-year period between 2015 and 2019 was undertaken. The crash data does not include the SH1/Pine Hill Road/Great King Street intersection. This intersection is not part of the overall analysis because it is the subject of a separate study.

209 crashes were at intersections (57 percent of total). One person died, 16 were seriously injured and 59 people received minor injuries in these crashes. 15 crashes involved pedestrians while six involved cyclists. Nearly one third of crashes at intersections involved a vehicle running a red light even though only half of the intersections are signalised.

In the 157 mid-block crashes, nine people were seriously injured and 46 received minor injuries. Ten crashes involved pedestrians while 13 involved cyclists. Two out of every five crashes were a rear end type movement.

Due to the naming convention that results in two state highway intersections with the same name at each side road intersection, the crash database has difficulty in correctly locating crashes. We found errors in ten percent of the crashes that were reviewed, the majority of which were located at the incorrect intersection. Where these inconsistencies have been identified, the Transport Agency has been notified and our assessment has been updated to ensure the crashes have been attributed to the correct intersection.

The Harbour Arterial has had six serious injury, 14 minor injury and 39 non-injury crashes in the five-year period between 2015 and 2019. There were a variety of crash movements with 39 crashes occurring at intersections and 11 rear end movement crashes along the route. Note that this crash data excludes the SH1 / Andersons Bay Road intersection.

A summary of the reported crash history between 2015 and 2019 is given in Table 3 for both the SH1 One Way Pair and the Harbour Arterial.

Table 3: Reported Crash History for SH1 One Way Pair and Harbour Arterial (2015 to 2019)

Location	Crash Severity				Total Number of Crashes	Common Crash Movements		Vulnerable Road User Involvement	
	Fatal	Serious	Minor	Non-Injury		Rear End in Traffic	Run Red Light	Pedestrian	Cyclist
SH1 Northbound	1	13	64	113	**191**	49 (26%)	43 (23%)	14	9
SH1 Southbound	0	12	46	117	**175**	42 (24%)	27 (15%)	11	10
Combined SH1 Total	1	25	110	230	**366**	91 (25%)	70 (19%)	25	19
Harbour Arterial	0	6	14	39	**59**	11 (19%)	1	2	6

The DSi (death and serious injuries) equivalents were calculated for the Do Minimum and both programmes. These are summarised in the following table.

Table 4: DSI Equivalent Summary

Programme	DSi Equivalents
Do Minimum	12.18
Programme 1	3.76
Programme 2v3	4.95

Programme 1 provides the highest reduction in DSi equivalent when compared to the Do Minimum.

2.1.8 Wider Economic Benefits

The Wider Economic Benefits (WEBs) have been assessed with the following evaluations undertaken:

- VURT Benefits provided by Boffa Miskell Ltd based on the Valuing Urban Realm Toolkit (VURT) methodology. Refer to their report dated 27 May 2020 for further detail. These benefits were updated for the MCA in early 2021 and these latest values used in this updated evaluation.
- Liveability benefits were calculated by NZIER, with the improved Wellbeing benefits used for each Programme. Refer to the NZIER report dated 15 June 2020 for further detail.

Table 5: Summary of the WEBs Benefits

Programme Benefit	Shaping Future Dunedin Transport Application	Programme 1 Undiscounted Value	Programme 2v3 Undiscounted Value
VURT	Whole Corridor	$16,000,000	$19,900,000

Programme Benefit	Shaping Future Dunedin Transport Application	Programme 1 Undiscounted Value	Programme 2v3 Undiscounted Value
Improved Wellbeing Benefits (Total)	Whole Corridor	$111,900,000	$230,000,000
Total WEBS	**All**	**$127,900,000**	**$249,900,000**

The assumptions for these WEBs are as follows:

- Liveability is a component of wellbeing and taken into account in the Wellbeing approach. If these were added together then this would lead to double counting.
- The annual benefit is not additive as per the notes from the NZIER report therefore the WEBs have been discounted at the year in which the benefits are first realised.

2.1.9 Cost Estimates

Cost estimates have been provided as Expected Estimates including contingencies. These costs were tested in the evaluation as a sensitivity test together with testing the BCRs with and without the Wider Economic Benefits.

The cost estimates are as follows:

Programme 1 $103,238,000

Programme 2v3 $127,038,000

Note no costs have been included as part of the Do Minimum together with any annual and periodic maintenance costs.

3 Programme Performance

3.1 Programme Descriptions

The programmes are defined in Appendix A.

3.2 Economic Evaluation Summary

The assumptions used in the economic evaluation are given in Table 6.

Table 6: Economic Evaluation Assumptions Summary

Economic Evaluation Assumptions	
Earliest implementation start date	2023
Expected duration of implementation	3 years
Date of first year of benefits realised	2026
Time zero	1 July 2021
Base date for costs and benefits	1 July 2020

Table 7 summarises the Benefit Cost Ratio (BCR) ranges for each programme with and without the WEBs. The full evaluation worksheets are provided in Appendix B.

Table 7: Benefit Cost Ratios for 40 Year Analysis Period and 4% Discount Rate

Programme	Including WEBS	Excluding WEBs
Programme 1	3.2	2.0
Programme 2v3	2.7	0.7

The best performing programme economically is Programme 1 with a BCR range of 2.0 to 3.2 for the 40-year analysis. WEBs provide the most significant benefits for all programmes followed by crash costs, then travel time and vehicle operating costs.

Programme 2v3 has travel time and vehicle operating cost disbenefits, while the potential for safety benefits is reduced due to the proposed function of the arterial road. Essentially the positive benefits gained from the improvements to the city street corridor with slower speeds and better amenity for vulnerable road users are negated by the proposed cross section for the arterial road. The WEBs are a significant proportion of the benefits for Programme 2v3 and when these are removed, the overall BCR reduces.

A summary of the Present Value (i.e. discounted) benefits and costs are provided in Table 8 for reference together with a graphical representation of the benefits in Figure 1.

Table 8: Present Value Benefits and Costs for 40 Year Analysis Period and 4% Discount Rate

Programme	Travel Time and VOC	Vehicle Emissions	WEBs	Crash Costs	Walking and Cycling Benefits	Total Benefits	Discounted Cost ($m)
Programme 1	$38,009,645	$3,099,805	$109,329,456	$95,022,391	$36,089,142	$281,550,438	88,207,796
Programme 2v3	$46,353,874	$3,074,909	$213,615,567	$79,061,427	$38,673,139	$288,071,169	108,542,805

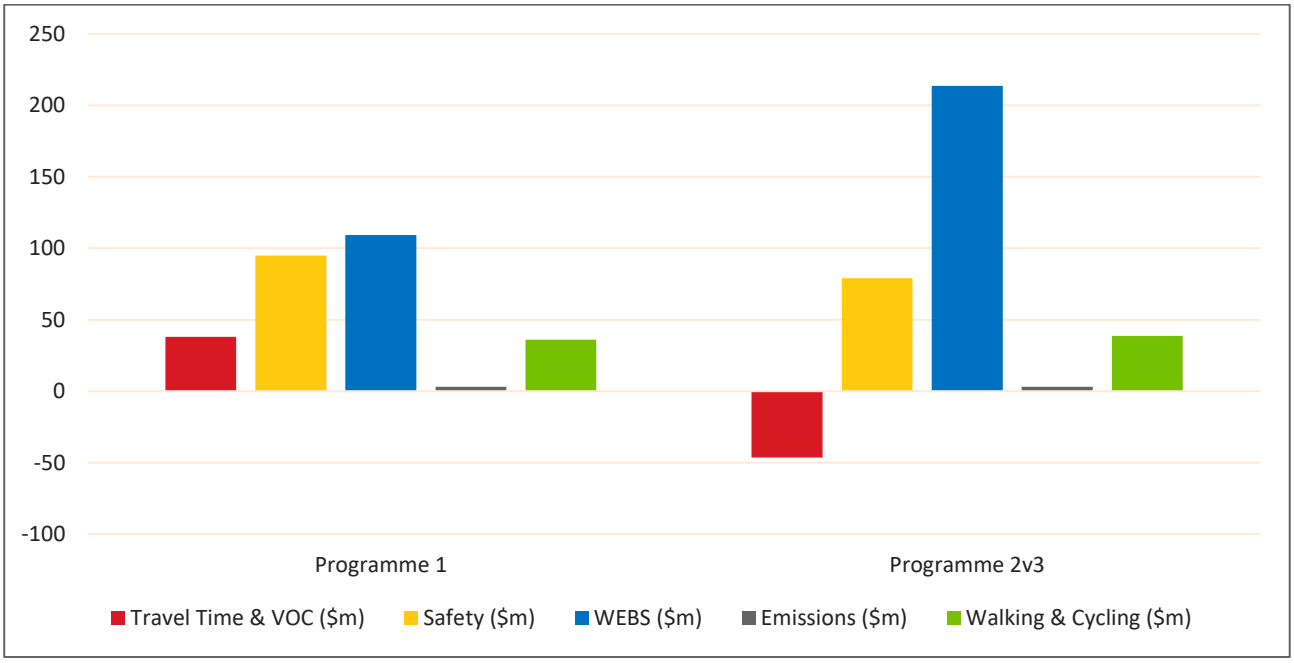


Figure 1: Summary of Programme Economic Benefits for 40 Year Analysis Period and 4% Discount Rate

Appendix A: Programme Descriptions

Programme 1 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: retain one way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

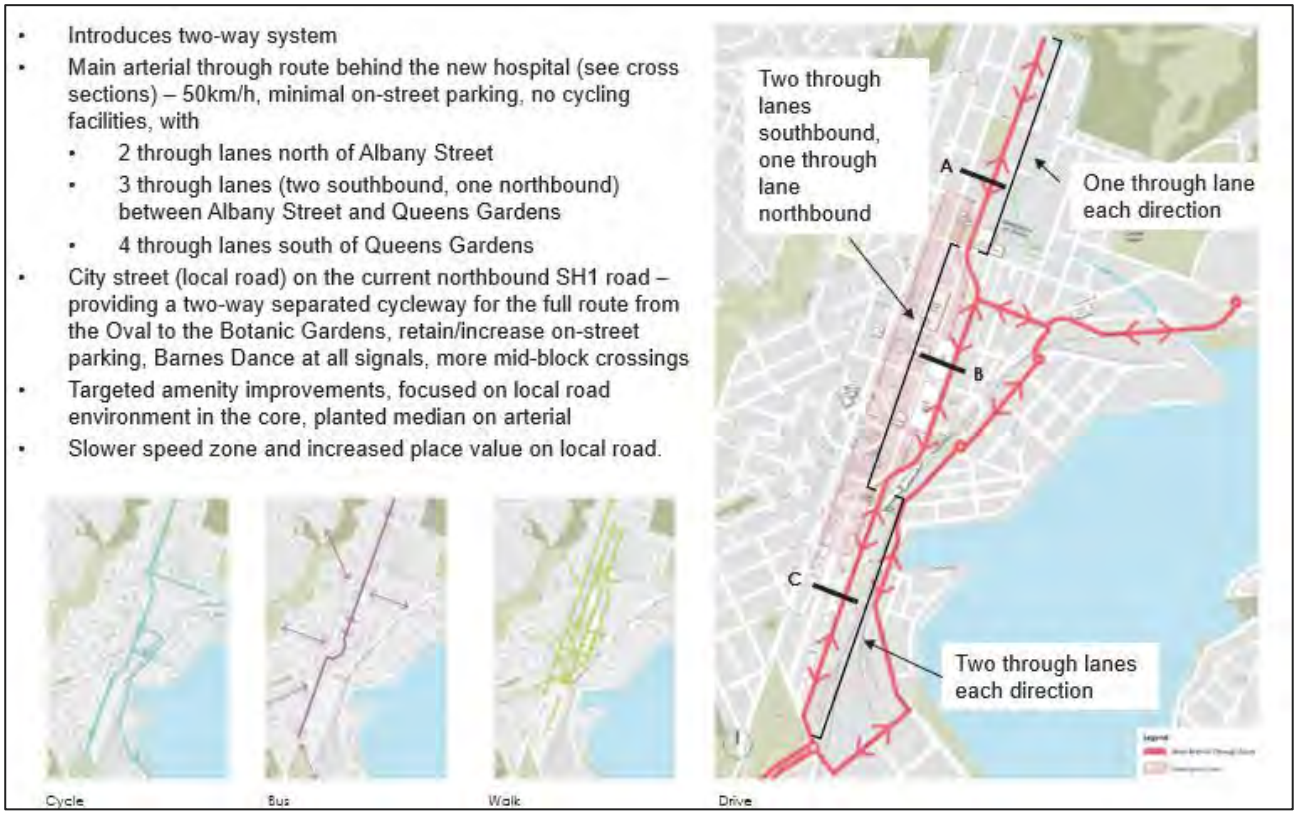
5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

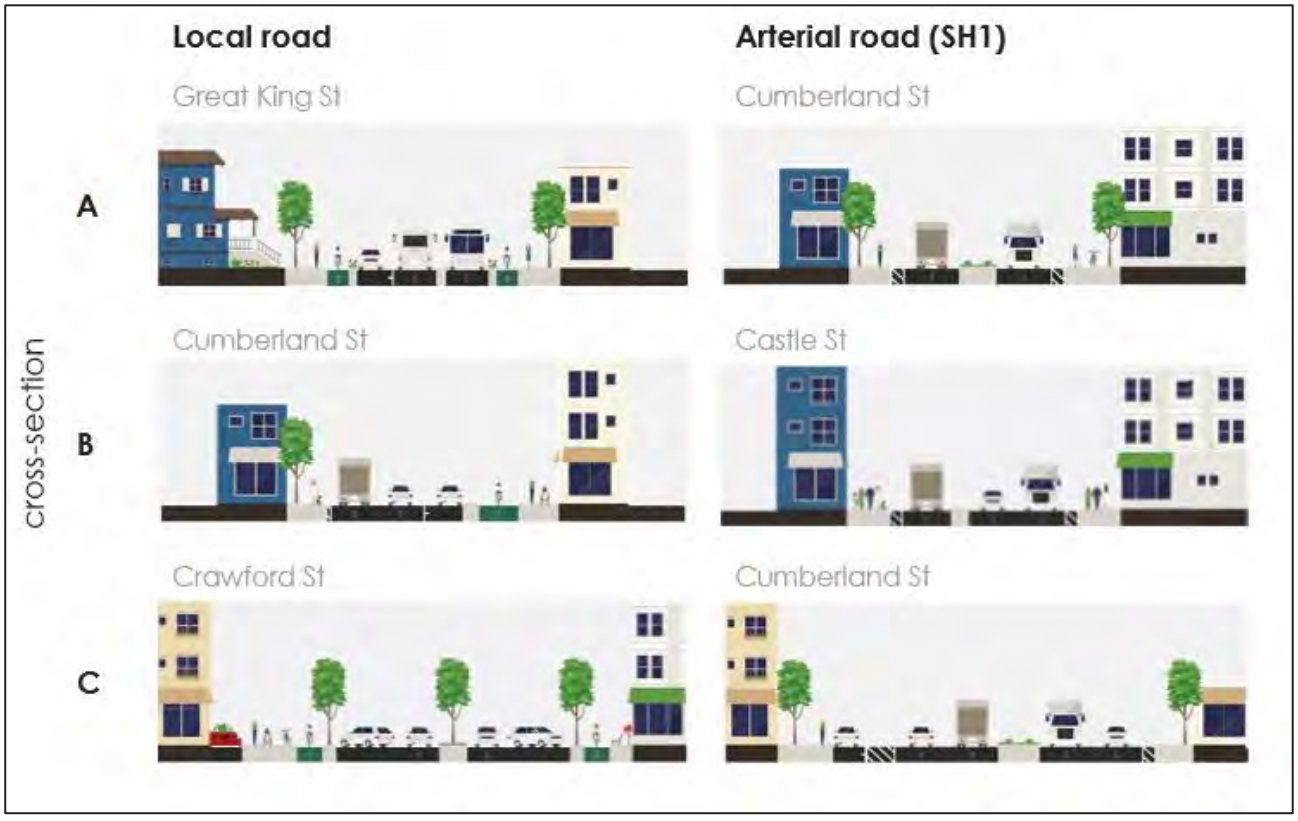
7. Behaviour Change: The Council will work with employers and schools to support and incentivise walking, cycling and public transport use.

Programme 2v3 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: introduce two-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

7. Behaviour Change: The Council will work with employers and schools to support and incentivise walking, cycling and public transport use.

Appendix B: Economic Evaluation Worksheets

See Shaping Future Dunedin Transport PBC Appendix N.

Shaping Future Dunedin Programme Business Case

MCA Technical Assessment for Connectivity

Rev. no	Date	Description	Prepared by	Checked by	Reviewed by	Approved by
1	29/04/21	Final	SW	SL	SC	GO

1 Overview

1.1 Purpose

The purpose of this report is to provide a technical assessment of Programme 1 and Programme 2v3. The results will be used for the Shaping Future Dunedin Programme Business Case MCA scoring.

This assessment focuses on the performance of each programme in relation to connectivity.

1.2 Programme Development Process

During the short-listing process, four programmes were assessed in detail. The most significant difference between each programme was the configuration of SH1 through central Dunedin. The four programmes were as follows:

Programme	One way	Two way	Description
P1	√		Two, one-way arterials with two through lanes
P2		√	Two lane local road and arterial with two through lanes
P2v2		√	Two lane local road and arterial with four through lanes
P2v3		√	Two lane local road and arterial with following configuration: • Two through lanes north of Albany Street • Three through lanes (two southbound and one northbound) between Albany Street and Queens Gardens (in line with Burlington Street) • Four through lanes south of Queens Gardens

P1, P2 and P2v2 were assessed against the criteria. P2 went through a number of iterations. Modelling and fatal flaws analyses were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width.

Through this process, P2v3 was identified as the preferred layout for a two-way option. This assessment evaluates only P1 and P2v3.

2 Assessment Approach

2.1 Definition

The Connectivity assessment uses the following definitions:

Project Outcome: Enhance connectivity between key central city destinations for active modes.
Investment Objective: Increase active mode level of service in and between key city precincts.

This assessment considers how well the programme improves linkages and provides better quality routes for active mode travel between and within key city precincts.

2.2 Assessment Approach

The Project Outcome focuses on active modes as a complete mode class, however there are certain factors that need to be considered separately for different active modes. For this reason, the assessment was split into an assessment of pedestrian connectivity and an assessment of cycling connectivity. Other active modes are generally encompassed by these two categories (for instance, what is good for enhancing pedestrian connectivity will be good for jogging connectivity; similarly, what is good for cycling will generally be good for other wheeled modes like skateboards and micromobility).

Various factors that contribute to pedestrian and cycling levels of service (LoS) were identified. Each programme was then analysed on how it performs against each of these factors compared to the Do Minimum programme (see Attachment B). In some cases, the performance is highly dependent on specifics in the road layout. Road layout has been anticipated at a high-level concept level, but specific details are yet to be developed and confirmed. There will be therefore be opportunities through the design process to maximise connectivity for active modes, if this is a priority.

There was also consideration of how the programmes affect future ability to improve active mode accessibility in some key areas.

In addition, Pedestrian LoS was considered along five key routes in and between city precincts, which stakeholders have identified as the highest priority for pedestrian connectivity improvements. These are:

A. The Wellness Corridor (existing hospital – Dental School – Otago Museum – University Central Library – Otago Business School – Polytech Hub – Stadium)

B. City to New Hospital via Bus Hub

C. Octagon to Railway Station

D. Octagon to Waterfront via Queens Gardens

E. Warehouse Precinct east/west connections (currently bisected by northbound SH1).

Finally, the various ways the programmes perform were holistically summarised into an MCA scoring.

The following information has been used to inform the assessment:

- Traffic model – which provides estimates of likely congestion for P1 and P2v3
- Technical Note 5 (Developing Pedestrian Packages) – which discusses anticipated road layouts at a broad concept level.

3 Programme Performance

3.1 Programme Descriptions

The programmes are defined in Attachment 1.

3.2 Performance of Programme 1 and 2v3

The table below provides a summary of the assessment of P1 and P2v3 in relation to pedestrian and cycle connectivity.

The assessment is supported by a detailed analysis of critical factors that should be considered in an assessment of pedestrian and cycle connectivity, alongside anticipated aspects of the relevant programme's anticipated road layout (Attachment B) and results of modelling (Attachment C).

Factor	Programme 1	Programme 2v3
Pedestrian connectivity	General pedestrian LoS is increased within the central city with slightly lower traffic volumes, lower speeds, and redesigned Albany Street and Princes Street. North-south LoS is somewhat increased with reductions in traffic along the one-ways. East-west severance is slightly reduced through the addition of more Barnes Dances and mid-block crossings in targeted areas.	General pedestrian LoS is increased within the central city with lower traffic volumes, lower speeds, and redesigned Albany Street and Princes Street. North-south LoS is greatly increased by having the local road act as a dedicated north-south pedestrian route with significant reductions in traffic volumes and heavy vehicle percentages. While the arterial would have a significant increase in traffic volume, the local road provides an alternative route that is more suited to key desire lines between precincts. In the case of the University, walking routes through campus provide an alternative to the busy arterial road as well, mitigating increased traffic in this area. Increased traffic on George Street decreases north-south LoS on this route, however this is mitigated with future DCC plans for the street and having the alternative route of the local road. East-west severance across the current northbound one-way is significantly reduced as lower traffic volumes allow for many more midblock marked pedestrian crossings, and more Barnes Dances in North Dunedin between Dundas Street and Duke Street. The severance across the current southbound one-way is contributed to by more traffic on the arterial road under P2v3, however this severance only affects key desire lines in the northern and central parts of the city. In the sections north of Albany Street a solid median can enable more mid-block crossing points to help mitigate this issue, although this may not be achievable due to safety concerns around the New Hospital. Increased traffic on George Street decreases east-west LoS on this route, however this is mitigated with future DCC plans for more marked pedestrian crossings.

Factor	Programme 1	Programme 2v3
Cycle connectivity	Cycle connectivity is increased with St Andrew Street upgrades and the Albany Street cycleway. An emerging connected cycle network is catered for. Cycle LoS is increased along the north-south Oval-City-University-NEV route with upgraded separated cycle facilities along the one-ways and lower traffic volumes. Access through the Warehouse Precinct is only provided along the northbound cycleway on Crawford Street.	Cycle connectivity is increased with St Andrew Street upgrades and the Albany Street cycleway. An emerging connected cycle network is catered for. Cycle LoS is significantly increased along the north-south Oval-City-University-NEV route with separated cycle facilities along the local road, significantly lower traffic volumes, and lower heavy vehicle percentages. The local road allows direct cycleway access in both directions through the Warehouse Precinct. While the local road does not service the University as well as a cycleway along Cumberland Street would, this can be mitigated in the future with the implementation of direct routes to the campus e.g. via Castle/Leith Streets.

3.3 Pedestrian LoS along key routes

The table below provides a comparison of pedestrian LoS along five important routes within and between central city precincts, described in section 2.2. Sub-routes were determined by considering key intermediate destinations. A map of these routes is attached in Appendix D: Map of Key Routes.

Route	Description/sub-route	P1	P2v3	Comparison
A	Existing Hospital to Dental School	No change to the existing level of service.	No change to the existing level of service.	No difference.
	Dental School to Otago Museum	A mid-block crossing point on Albany Street between Walsh Street and the Museum Reserve may be installed.	Significantly lower traffic volumes along Malcolm Street allow for a marked pedestrian crossing between Great King Street and Walsh Street on the existing desire line. A mid-block crossing point on Albany Street between Walsh Street and the Museum Reserve may be installed.	Upgrading the existing desire line across Malcolm Street to a marked pedestrian crossing would greatly increase pedestrian LoS. Lower speeds and traffic volumes on the new local road will improve pedestrian LoS for many students moving between the main campus and health sciences precinct.
	Otago Museum to Otago Business School	No change to the existing level of service.	No change to the existing level of service.	No difference.
	Otago Business School to Polytechnic Hub	A lower speed environment along Union Street and planned footpath widening increases LoS.	A lower speed environment along Union Street and planned footpath widening increases LoS.	No difference.
	Polytechnic Hub to Stadium	No change to the existing level of service.	No change to the existing level of service.	No difference.
B	George Street to Bus Hub	No change to the existing level of service.	No change to the existing level of service.	No difference.

Route	Description/sub-route	P1	P2v3	Comparison
	Bus Hub to New Hospital	A path could be secured through the existing Countdown carpark. An uncontrolled crossing point is proposed that will cross Cumberland Street to the main hospital entrance. Cumberland Street is decreased from 50kph to 40kph.	A path could be secured through the existing Countdown carpark. Significant traffic reductions on the Cumberland Street local roads allows for a marked pedestrian crossing between this path and the main hospital entrance. Cumberland Street is decreased from 50kph to 30kph.	The lower speeds, traffic volumes, freight percentages and the provision of the road crossing across Cumberland Street to the main hospital entrance provides a far greater LoS under P2v3.
C	Octagon to Railway Station	LoS is increased with Barnes Dances at Stuart/Cumberland and Stuart/Castle intersections. Cumberland Street and Castle Street both move at 40kph.	LoS is increased with Barnes Dances at Stuart Street/Cumberland Street and Stuart Street/Castle Street intersections. Cumberland Street moves at 30kph while Castle Street moves at 50kph.	Insignificant difference.
D	Octagon to Queens Gardens	A Barnes Dance is provided at Queens Gardens/Dowling Street intersection. The northbound one-way has slightly lower traffic volumes and travels at 40kph.	A Barnes Dance is provided at Queens Gardens/Dowling Street intersection. The local road has significantly lower traffic volumes and travels at 30kph.	Lower traffic volumes and speeds with P2v3 improve Pedestrian LoS.
	Queens Gardens to Waterfront Precinct	No change to existing crossing from Queens Gardens to the Chinese Garden except for a reduction in traffic speed to 30kph. From the Chinese Garden a future bridge will provide a link to the waterfront.	No change to existing crossing from Queens Gardens to the Chinese Garden. From the Chinese Garden a future bridge will provide a link to the waterfront.	The only difference is the speed of the road, which will have negligible effects as the intersection is signalised.
E	Warehouse Precinct east-west connections	LoS is slightly increased through lower traffic volumes.	A major increase to LoS is achieved through lower speeds, significant reductions in traffic volumes, increased frequency of midblock crossing points, and a solid median providing crossing refuge.	P2v3 allows for a major increase in pedestrian east-west connectivity through the Warehouse Precinct.

Overall, there is roughly equivalent LoS for routes C and D. However, when considering routes A, B and E, P2v3 has a clear advantage. It should be noted the importance of accessibility in route B (outside the hospital), and P2v3 provides better for this.

4 Programme Scores

4.1 Scoring

A seven-point scoring system was used for this assessment:

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernible or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

The scoring for the two programmes reflects how well each programme performs against the criteria, compared to the Do Minimum. The Do Minimum consists of the transport network as it currently exists with the addition of the following committed interventions:

- Permanent Barnes Dance at both Albany Street/SH1 intersections (currently a trial)
- George Street – 10 km/h for four blocks - Albany to Moray Place
- Tertiary – 30km/h speeds on Union Street, Harbour Terrace, Clyde Street and Forth Street.

4.2 Programme 1 and Programme 2v3 Scores

The table presents the scores for each programme for connectivity. The only major difference between programmes is having two one-way roads that provide good active mode LoS or having two two-way roads where one gives a very high active mode LoS and one a lower LoS. Bringing this difference out of the context of SFDT can help in evaluating which may be scenario better: if walking in a field, it is better to have one clean, firm path and one muddy, wet path over two damp paths, as people can always choose the nice path in the former but to settle with average path in the latter.

Programme	Score	Summary Rationale for score
Do Minimum	-2	Existing active mode severance exists within and between city precincts and becomes worse as traffic volumes increase.
Programme 1	+1	Somewhat reduced traffic volumes along the one-ways enhances central city connectivity. Other aspects common to both programmes contribute to connectivity, like the Albany Street cycleway, Princes Street improvements, and central city 30kph zone extension.
Programme 2v3	+2	Significant increase in active mode connectivity through the new local road with its low traffic volume, low speed, separated cycle lanes, increased number of crossing points and increased accessibility of crossing points. All these factors combine to produce a roadway that allows great north-south active mode connectivity while reducing east-west severance between key areas. This is seen when considering the key routes of University Campus to Dental School (Health Sciences Precinct), Bus Hub to New Hospital and connections in the Warehouse Precinct (A, B and E). The effect of increased traffic on the new arterial (existing southbound one-way) is mitigated through midblock crossings north of Albany Street. Other aspects common to both programmes contribute to connectivity, like the Albany Street cycleway, Princes Street improvements, and central city 30kph zone extension.

Appendix A: Programme Descriptions

Programme 1 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: retain one way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

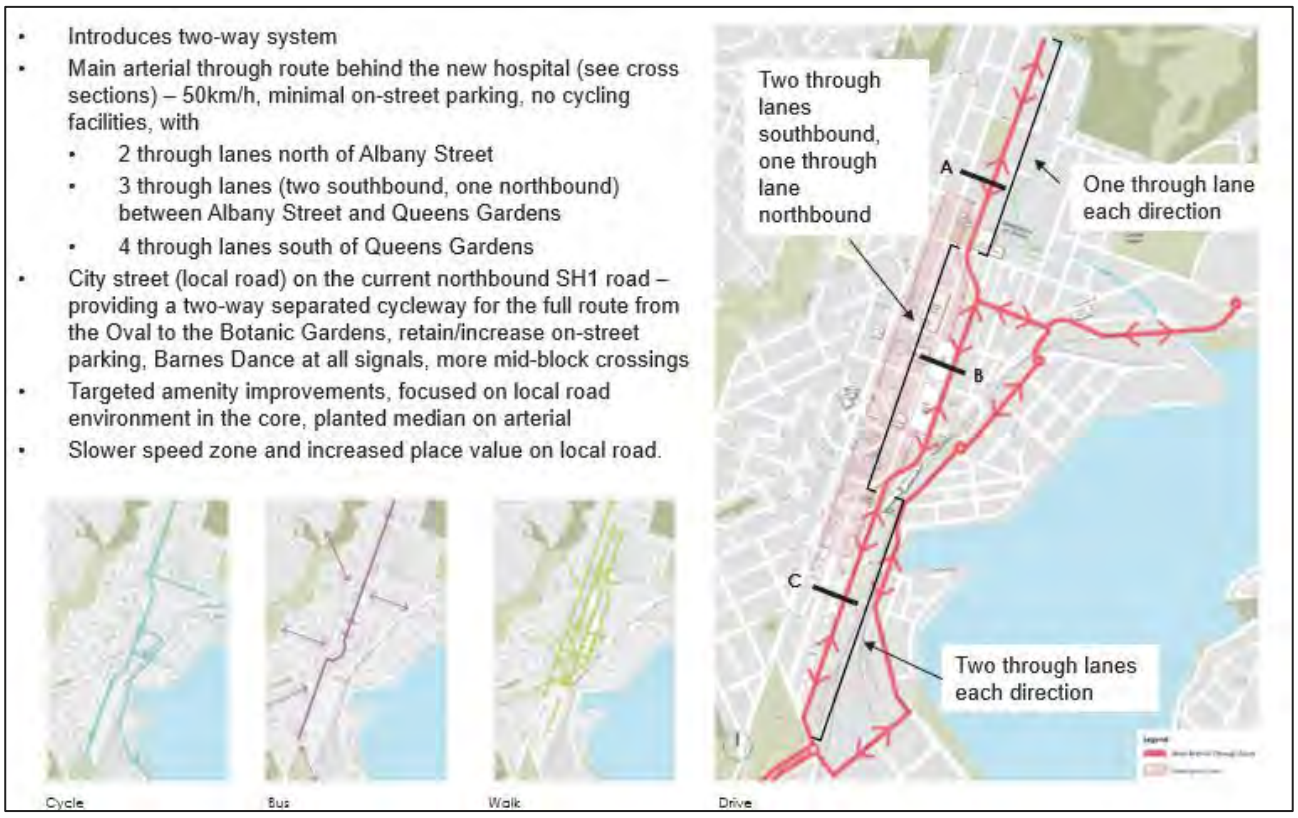
5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

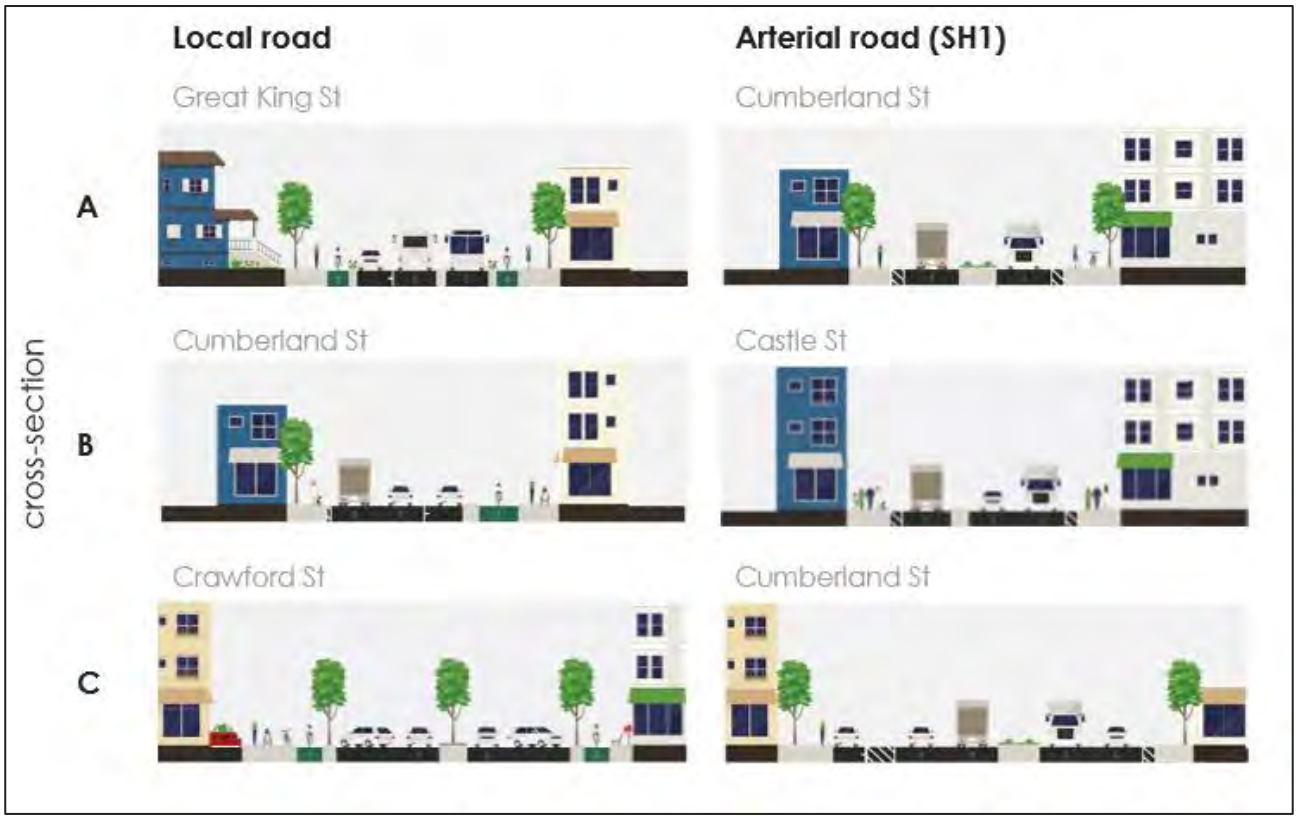
7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Programme 2v3 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: introduce two-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Appendix B: Pedestrian and Cycle Connectivity Analysis

Factors to consider for pedestrian connectivity

Key factors	Description and points to consider
Directness of routes	Are routes direct? Do routes feel as if pedestrians have been considered first or as if they have been fit around other modes?
Road crossings	A major aspect of pedestrian connectivity is minimising severance roadways have on street environments. Maximising the ability for pedestrians to crossroads results in greater connectivity.
• *Crossing point frequencies and locations*	Greater ability to crossroads is achieved with more crossing points, and, importantly, positioning crossing points on key desire lines.
• *Traffic volumes*	Less traffic allows for: • signalised crossings to afford more time for pedestrian phases, • and the installation of more marked pedestrian crossings.
• *Traffic speeds and number of heavy vehicles*	High traffic speeds and more heavy vehicles act as a deterrent to crossing the road at uncontrolled points. Conversely, very low traffic speeds (10 kph) allow for shared street environments where the roadway can be crossed anywhere.
• *Gaps in traffic*	Gaps in traffic allow for more crossing at uncontrolled crossing points. However, this is only applicable to people who can quickly walk or run across the road. To anyone with difficulty moving quickly, for instance people in wheelchairs or people pushing prams, gaps in traffic has little to no benefit.
• *Accessibility*	As explained above, uncontrolled crossing points are not as universally accessible as crossing points where pedestrians have priority — that is, marked pedestrians crossings and signalised crossings. Therefore, it is important to consider not only the number of crossing points, but their type too. Accessibility is also increased when there are less lanes of traffic to cross, which can be achieved with refuge islands.
Alternative routes	The ability for pedestrians to exercise agency in their route choice. If some routes are unpleasant for pedestrians (e.g. loud or busy), are there alternatives?
Future opportunities	Does the programme allow or prevent future potential pedestrian-focused improvements? Key opportunities to consider are: • the removal of the Malcolm Street and Gowland Street s-bends • extension of the Queens Gardens Reserve back to Kettle's original triangular plan by closing surrounding roadways. These are future concepts detailed in DCC documentation like the Central City Plan.

P1 and P2v3 Comparison - Pedestrian Connectivity

Factor to consider	Performance compared to Do Minimum	
	Programme 1	Programme 2v3
Directness of routes	Some more crossing points across the one-ways allow for more slightly more direct routes.	Significantly more crossing points across the local and arterial roads allow for much more direct routes.
Road crossings • *Crossing point frequencies and locations*	Mid-block crossing points will be around the New Hospital on the northbound road but not on the southbound. More crossing points will be installed along Albany Street and St Andrew Street.	Solid medians along both the local and arterial roads north of Albany St would allow for a significant amount of mid-block crossing points in the University area. Mid-block crossing points will be around the New Hospital on the local road but not on the arterial. A solid median on the local road south of Queens Gardens allows for many more mid-block crossing points in the Warehouse Precinct. More crossing points will be installed along Albany Street and St Andrew Street.
• *Traffic volumes*	Microsimulation forecasts the following differences in vehicle volumes during the interpeak period[1]. • Along both the northbound and southbound routes there are less vehicles per hour (vph). • Vph decreases along George Street between Union Street and St David Street. • Vph slightly decreases along Frederick Street and St Andrew Street. • Vph increases along the Harbour Arterial. The full microsimulation outputs are detailed in Appendix B: Microsimulation Outputs.	Microsimulation forecasts the following differences in vehicle volumes during the interpeak period. • The local road experiences a very significant reduction in vph. • The arterial road sees an increase in vph. • Vph doubles along George Street, Union Street and St David Street. • Vph slightly decreases along Frederick Street and St Andrew Street. • Vph increases along the Harbour Arterial.
• *Traffic speeds and number of heavy vehicles*	The 30kph zone would be extended but excludes the arterial routes which would move at 40kph. Microsimulation forecasts the following differences in heavy vehicle volumes during the interpeak period. • Along most roads the percentage of heavy vehicles remains the same, so the vph increases or decreases according to the predicted change in general traffic vph. As such the above commentary for traffic volumes applies here as well.	The 30kph zone would be extended but excludes the arterial route which would move at 50kph. Microsimulation forecasts the following differences in heavy vehicle volumes during the interpeak period. • Along most roads the percentage of heavy vehicles remains the same, so the vph increases or decreases according to the predicted change in general traffic vph. As such the above commentary for traffic volumes applies here as well. • Except for the new local road, which sees a significant drop the percentage makeup of heavy vehicles.
• *Gaps in traffic*	Along the one-ways, the green-wave signal phases result in a platooning effect of traffic. As such, at any point on the northbound and southbound arterials, there is a significant predictable gap in traffic every signal cycle.	There is no platooning effect associated with the two-way arterial or local road, so gaps are distributed as the same as on all other streets.

[1] The highest number of pedestrian movements occurs in the interpeak period.

Factor to consider	Performance compared to Do Minimum	
	Programme 1	Programme 2v3
• *Accessibility*	Both the northbound and southbound arterials would require two lanes of traffic to be crossed without refuge. The types of crossings implemented would be like the do minimum — Barnes Dances in select location and existing uncontrolled crossing points.	The local road would be two lanes wide and not permit a refuge in the central section, however north of Albany Street and south of Queens Gardens a solid median could be implemented. The arterial road would have a solid median throughout however it may not be able to be used as a pedestrian refuge for uncontrolled crossing points south of Albany Street. The lower traffic volumes on the local road would permit more marked pedestrian crossings and more uncontrolled crossing points. Signalised intersections across the local road between Dundas Street and Duke Street would be changed to Barnes Dances.
Alternative routes	No significant difference.	For north-south journeys, the local road provides an alternative route to the busy arterial.
Future opportunities	Both the s-bends and the roads arterial roads adjacent to Queens Gardens would not be able to be altered, thus prohibiting these potential developments.	High traffic volumes on Gowland Street would prohibit removal of its s-bend. Low volumes on Malcolm Street may allow for removal of its s-bend by routing local road traffic along Frederick Street and Great King Street. This would improve pedestrian connectivity along the Wellness Corridor. Low traffic forecasts on the local road along Queens Gardens may allow for future closing of the road, or development into a shared space. This would greatly improve pedestrian connectivity between the Retail and Waterfront precincts.

Factors to consider for cycle connectivity

Key factors	Description and points to consider
Location of cycle facilities	Cyclists, like pedestrians, endeavour to choose the easiest route. Therefore, the location of cycle infrastructure greatly affects cycling level of service; a separated cycleway that requires a detour to use is not very useful for cycle connectivity.
• *Desire lines*	The benefits of quality cycle infrastructure are enhanced when along key desire lines.
• *Network connections*	A noted issue with Dunedin's cycle infrastructure is the lack of a connected, seamless network. Hence the level to which the programmes contribute to building a network should be considered as cycle infrastructure benefits are amplified once a network effect is reached. This will also consider future planned and potential cycling developments in the central city: • cycle lanes along George Street/Bank Street between Albany Street and North Road • upgraded North East Valley cycling facilities • cycle facilities along Duke Street and Malvern Street • cycle facilities along Castle Street through the University campus and surrounding area • cycle facilities along Dundas Street and Butts Road • cycle facilities along Serpentine Avenue • cycle facilities along South Road • and cycle facilities along Andersons Bay Road.
• *Direction of roads*	One-way roads without contraflow lanes are generally detrimental to cycle level of service, as they may require cyclists to circumnavigate a block before starting their journey. In practice, this leads to cyclists using the footpath for the first block of a journey.
Traffic	
• *Traffic volumes*	If cycle facilities are separated from traffic, then high traffic volumes result in less available time for cycle phases at intersections (assuming the facilities remain separated throughout the intersection). If the facilities are not separated, then high traffic decreases safety.
• *Traffic speeds and number of heavy vehicles*	High traffic speed and high number of heavy vehicles significantly reduces cycle level of service through turbulent effects. This can be mitigated, though, with wide buffers between traffic and cycle infrastructure.
Alternative routes	The ability for cyclists to exercise agency in their route choice. If some routes are unpleasant (e.g., loud or busy), are there alternatives?
Future opportunities	Does the programme allow or prevent future potential cycling-focused improvements? Key opportunities to consider are the same future plans as detailed in *Network connections*.

P1 and P2v3 Comparison - Cycle Connectivity

Factors to consider	Performance compared to Do Minimum	
	Programme 1	Programme 2v3
Location of cycle facilities • *Desire lines*	Upgrades to Princes Street would provide good links to the future tunnels trail. The preferred option for the Pine Hill intersection under this programme may prevent cycle movements from Great King Street adjacent to the Botanic Garden onto the southbound one-way, which would severely impact route directness. The southbound Cumberland Street cycle lane south of Queens Gardens would service the City-South Dunedin desire line, however it would miss the desire line of connection from city to the Warehouse Precinct.	Upgrades to Princes Street would provide good links to the future tunnels trail. Separated cycle lanes along the local road north of Albany Street will service the desire line of City-North East Valley, however they miss the desire line of north-south movements along the University campus. Although, this may be mitigated in the future by the proposed Castle Street cycleway through University. The local road south of Queens Gardens meets the desire line of travelling south to the Oval and South Dunedin, as well as access to apartments, shops and workplaces in the Warehouse Precinct.
• *Network connections*	The Albany Street cycleway, St Andrew Street slow street, and future planned Chinese Gardens bridge will link the north/south spine well to the harbour path. Planned cycleways would be linked into a seamless network through the northbound and southbound separated lanes and Princes St upgrades.	The Albany Street cycleway, St Andrew Street slow street, and future planned Chinese Gardens bridge will link the north/south spine well to the harbour path. Planned cycleways would be linked into a seamless network through the local road separated lanes and Princes St upgrades
• *Direction of roads*	The southbound and northbound arterial roads are both one-way.	The local and arterial roads are both two-way.
Traffic • *Traffic volumes*	The same comments as in the *Pedestrian Road crossings* section apply.	The same comments as in the *Pedestrian Road crossings* section apply.
• *Traffic speeds and number of heavy vehicles*	The same comments as in the *Pedestrian Road crossings* section apply.	The same comments as in the *Pedestrian Road crossings* section apply.
Alternative routes	Planned painted cycle lanes along George Street provide an alternative to the higher volume arterial roads.	The local road provides an alternative to the arterial road, and to George Street which is forecasted to have higher vph.
Future opportunities	No change to do minimum.	No change to do minimum.

Appendix C: Microsimulation Outputs

IP PEAK HOUR VOLUMES		Do Min	TDM Only	Final One-Way		Final Two-Way	
		vph	vph	vph	Diff to DM	vph	Diff to DM
University	Great King Street (Union to St David)	865	832	739	-126	72	-792
	Cumberland Street (Union to St David)	816	802	759	-57	1,016	200
	George Street (Union to St David)	427	438	504	77	844	418
	Malcolm Street	975	962	795	-180	255	-720
	Gowland Street	958	938	845	-113	1,160	202
Health Precinct	Frederick Street (Cumberland to Castle)	913	928	786	-127	843	-70
	St Andrew Street (Cumberland to Castle)	624	622	535	-89	522	-102
	Cumberland Street (Stuart to St Andrew)	1,137	1,130	961	-176	292	-846
	Cumberland Street (St Andrew to Hanover)	1,226	1,227	968	-258	264	-962
	Castle Street (Stuart to St Andrew)	1,081	1,068	902	-179	1,205	124
Tourism (Attractions, Queens Gardens, new bridge)	Castle Street (Stuart to Dunbar)	1,180	1,167	911	-268	1,277	98
	Queens Gardens N (Queens G to Dowling)	1,229	1,229	1,091	-138	238	-990
	Queens Gardens S (Dowling to Queens G)	1,344	1,341	1,050	-294	1,514	170
Warehouse Precinct	Crawford (Liverpool to Water)	1,178	1,192	1,111	-67	316	-862
	Cumberland (Police to Water)	1,064	1,078	891	-173	1,354	290
	Jetty (Bond to Princes)	517	507	555	38	531	14
	Princes (Rattray to Water)	400	382	422	22	547	147
Harbour Arterial	Anzac Avenue (Hanover to Frederick)	532	551	151	-381	530	-2
	Ward Street (Devon to Bauchop)	176	189	700	524	448	272
	Ward Street Bridge	377	393	671	294	503	126
	St Andrew Street (roundabout to Anzac)	1,127	1,141	755	-371	1,231	105
	Thomas Burns Street (Willis to Cresswell)	1,332	1,346	1,221	-111	1,491	159
	Wharf Street (Strathallan to Kitchener)	1,777	1,772	1,824	47	1,869	93
	Strathallan Street (Otaki to Portsmouth Drive)	624	634	648	24	638	14

Colour scale key:	-1,000
	1,000

IP PEAK HOUR HEAVY VEHICLE VOLUMES AND PERCENTAGE SPLIT		Do Min		TDM Only		Final One-Way			Final Two-Way		
		vph	% heavy of all vehicles	vph	% heavy of all vehicles	vph	% heavy of all vehicles	Diff to DM	vph	% heavy of all vehicles	Diff to DM
University	Great King Street (Union to St David)	39	5%	37	4%	37	5%	-3	2	3%	-37
	Cumberland Street (Union to St David)	46	6%	42	5%	43	6%	-3	66	6%	20
	George Street (Union to St David)	27	6%	27	6%	29	6%	2	40	5%	13
	Malcolm Street	44	5%	41	4%	38	5%	-6	5	2%	-39
	Gowland Street	51	5%	49	5%	45	5%	-6	74	6%	23
Health Precinct	Frederick Street (Cumberland to Castle)	47	5%	49	5%	50	6%	4	45	5%	-2
	St Andrew Street (Cumberland to Castle)	57	9%	56	9%	43	8%	-14	24	5%	-33
	Cumberland Street (Stuart to St Andrew)	72	6%	73	6%	67	7%	-5	6	2%	-67
	Cumberland Street (St Andrew to Hanover)	64	5%	63	5%	54	6%	-10	8	3%	-56
	Castle Street (Stuart to St Andrew)	72	7%	71	7%	68	7%	-4	98	8%	27
Tourism (Attractions, Queens Gardens, new bridge)	Castle Street (Stuart to Dunbar)	89	8%	89	8%	67	7%	-22	110	9%	21
	Queens Gardens N (Queens G to Dowling)	84	7%	81	7%	76	7%	-7	10	4%	-74
	Queens Gardens S (Dowling to Queens G)	91	7%	94	7%	70	7%	-21	115	8%	24
Warehouse Precinct	Crawford (Liverpool to Water)	79	7%	76	6%	73	7%	-6	12	4%	-66
	Cumberland (Police to Water)	78	7%	80	7%	58	6%	-21	94	7%	15
	Jetty (Bond to Princes)	28	5%	30	6%	30	5%	1	31	6%	2
	Princes (Rattray to Water)	52	13%	52	14%	55	13%	3	64	12%	12
Harbour Arterial	Anzac Avenue (Hanover to Frederick)	56	10%	58	10%	13	9%	-42	51	10%	-5
	Ward Street (Devon to Bauchop)	33	18%	34	18%	91	13%	58	61	14%	28
	Ward Street Bridge	64	17%	63	16%	79	12%	15	54	11%	-10
	St Andrew Street (roundabout to Anzac)	107	9%	106	9%	47	6%	-60	92	7%	-15
	Thomas Burns Street (Willis to Cresswell)	109	8%	111	8%	121	10%	12	139	9%	30
	Wharf Street (Strathallan to Kitchener)	146	8%	145	8%	159	9%	13	168	9%	22
	Strathallan Street (Otaki to Portsmouth Drive)	85	14%	85	13%	94	15%	9	93	15%	9

Colour scale key:	-50
	50

Appendix D: Map of Key Routes


Otago Museum
Otago Business School
Polytechnic Hub
A
Dental School
Stadium
Existing Hospital
George St
B
Bus Hub
New Hospital
Octagon
C
Railway Station
D
Queens Gardens
Warehouse Precinct
Waterfront
E

Shaping Future Dunedin Programme Business Case

MCA Technical Assessment for Transport Choice

Rev. no	Date	Description	Prepared by	Checked by	Reviewed by	Approved by
1	12/2/21	MCA Assessment Travel Choice	DD	SL, SC	SC	GO
2	24/04/21	Final	DD	SL, SC	SC	GO

1 Overview

1.1 Purpose

The purpose of this report is to provide a technical assessment of Programme 1 and Programme 2v3. The results will be used for the Shaping Future Dunedin Programme Business Case MCA scoring.

This assessment focuses on the performance of each programme in relation to travel choice

1.2 Programme Development Process

During the short-listing process, four programmes were assessed in detail. The most significant difference between each programme was the configuration of SH1 through central Dunedin. The four programmes were as follows:

Programme	One way	Two way	Description
P1	√		Two, one-way arterials with two through lanes
P2		√	Two lane local road and arterial with two through lanes
P2v2		√	Two lane local road and arterial with four through lanes
P2v3		√	Two lane local road and arterial with following configuration: • Two through lanes north of Albany Street • Three through lanes (two southbound and one northbound) between Albany Street and Queens Gardens (in line with Burlington Street) • Four through lanes south of Queens Gardens

P1, P2 and P2v2 were assessed against the criteria. P2 went through a number of iterations. Modelling and fatal flaws analyses were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width.

Through this process, P2v3 was identified as the preferred layout for a two-way option. This assessment evaluates only P1 and P2v3.

2 Assessment Approach

2.1 Definition

For the purposes of this assessment, travel choice is defined as follows:

Project Outcome: Improve multimodal access to and within central city.
Investment Objective: Increase use of active and public transport to the central city.

The assessment considers how well the programme provides transport choice for trips to the city. It considers the impact of parking changes and congestion on relative attractiveness of different modes, as well as the likely impact of proposed changes in level of service for each mode.

2.2 Assessment Approach

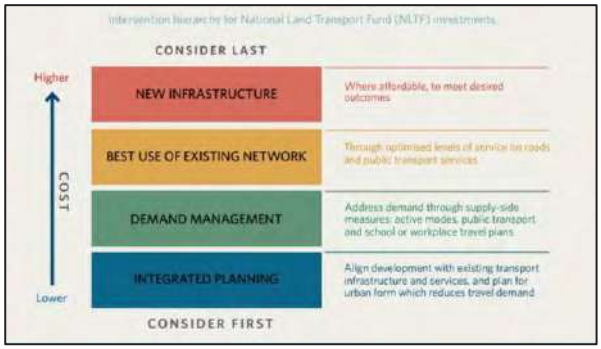
This assessment considers how well the programmes provides a choice of modes to travel to the city. It includes consideration of the impact of parking charges and congestion on the relative attractiveness of different modes. The Investment Objective also indicates that the desire is to increase use of active and public transport to the central city, so programmes which support this shift will score higher than those that do not. As such, it considers:

- the scale of choice provided, and
- the effectiveness of that choice in achieving mode shift.

In order to consider the effect of each programme, the overall travel choice criterion has been considered under two headings: scale of transport choice provided; and effectiveness in achieving mode shift. The impact of each programme on walking, cycling, public transport, driving, parking and peak spreading/working from home have been considered.

Both programmes contain very similar mode shift programmes. This is since at the first Shaping Future Dunedin Transport workshop in late 2019, there was a strong view from stakeholders that a significantly scaled mode shift

programme should be a part of any programme development and should be common to all options to the greatest extent possible.



This mode shift programme was developed and iterated in the first half of 2020 and was finalised on June 23, 2020. This programme followed the Waka Kotahi NZ Transport Agency intervention hierarchy of considering land use and planning first and investment in new infrastructure last.

Planning includes land-use change, residential intensification and city centre living; demand management includes the classic travel demand management measures; best use of existing network includes sweating existing assets and road-space reallocation in favour of more sustainable modes and new infrastructure considers new builds.

Figure 1 Waka Kotahi Intervention Hierarchy

The mode shift programme that was developed took its baseline and projected future mode share in Dunedin as follows:

Mode share (non-car)	2018 share	2030 share
Work from home	10.2%	13%
Walking	9.9%	14%
Cycling	2.1%	8%
Public Transport	3.4%	5%
Total	25.6%	40.0%
Source: 2018 Census Data, mode shift programme estimate		

Figure 2 Dunedin Mode Splits

The mode shift assessment shown in the table above was done on an option-neutral basis. That is, it was assessed on the pull factors of the elements of the mode shift programme but not on any push factors of the differences between the options. It assumed that people would change mode because attractive alternatives were provided.

For the MCA assessment, to assess the differences between the performance of the two programmes, the following approach was taken:

- Assess whether anything has changed and any new evidence that has emerged since the Mode Shift Programme was finalised.
- Analyse the differences between elements of the mode shift programme (for example, location of cycling and bus routes where these differ between the options).
- Analyse the latest round of modelling results, in particular looking for differences in the modelling results that may materially influence mode choice – by providing a push or pull influence.
- Carry out a mode-specific analysis (including car) of the likely impacts of the different options, comparing the programmes side-by-side.
- Consider how each option is likely to perform in relation to Waka Kotahi's Intervention Hierarchy.
- Validation exercise with Dunedin-based Stantec staff to test for robustness.

3 Programme Performance

3.1 Programme Descriptions

The programmes are defined in Attachment 1.

3.2 Updated evidence

The biggest single change since the mode shift programme was finalised in mid-2020 was a better understanding of the impact of the Covid-19 pandemic. This demonstrated three major effects of note:

1. **Covid-19 and working from home**: The mandatory requirement to work at home during level 4 lockdown effectively forced many people to experience working from home for the first time. For some people, this gave them the ability to better manage work-life balance; improve their ability to do concentrated work with fewer interruptions and to save the time they would have spent commuting. For others, particularly those with child-rearing duties, this put a triple

burden of being simultaneously caregiver, schoolteacher and employee while schools were closed (noting that school closure was a Covid-19 specific circumstance). The disposition to work from home has persisted long after lockdown. For example, Stantec New Zealand now records a 20% work from home rate as a proportion of working days.

2. **Impact on public transport use.** Co-incident with the Covid-19 pandemic was, due to being caught in the middle of a fare system transition, a five-month period of free public transport in Dunedin. This was followed by the trial introduction of $2 maximum bus fares on the Bee Card, recently extended to mid-2021. Partly as a result of significantly cheaper fares for two-thirds of Dunedin's bus customers, Dunedin's bus patronage has fully recovered to pre-Covid levels whereas the picture is starkly different for other New Zealand cities. Queenstown sits at 56% of pre-Covid patronage; Auckland at 70% and Wellington at 80%. This would appear to validate the hypothesis that a key lever of mode shift in Dunedin was for the real price of public transport to be cheaper than the perceived cost of driving.

3. **Impact on walking and cycling.** The level 4 lockdown in New Zealand generated a substantial increase in walking and cycling, at least partly attributable to the fact that only local recreation was permitted during level 4. But this did demonstrate a strong latent interest in walking and cycling in a low-traffic, low-noise and low-pollution environment.

3.3 Performance of Programmes

Element	Programme 1	Programme 2 v3
Car mode	Similar to current – it is already slower on the one-way system in peak periods through the central city, and the model shows little change for Programme 1. Car drivers are unlikely to perceive a degradation in their travel times and will have the added option of using an improved Harbour Arterial. Car based modes are well provided for and remain attractive.	Clear mode shift signals to drivers from the south with the obvious transition from two-lanes to one-lane northbound at Queens Gardens, noting that the Harbour Arterial will become a more attractive option for some. This is likely to encourage some peak spreading (noting that the Dunedin peaks are currently quite short and sharp); some trip re-timing and would be a stronger incentive to mode shift, given other modal improvements. Drivers will notice a degradation in their travel times in the PM peak.
Work from home	Covid-19 showed a significant jump in disposition to work from home for those who are able to do so.	For people travelling from the south, the reduction in lane capacity from Queens Gardens north, and the anticipated congestion in the evening peak, is a further nudge towards considering working from home where this is an option.
Walking	By New Zealand standards, Dunedin already has very high rates of walking but the improvements in walking environment proposed in the core city centre, and especially around the new hospital site, is likely to encourage a further uptick in walking.	In this programme, the local road is likely to be much more conducive to land-use change and intensification and would be more pedestrian friendly than the more traffic-oriented route. The local road and not the major traffic route would be between the new hospital, the bus hub and the rest of the city centre making for a more pleasant walking environment around the hospital, between the University campus and the health sciences precinct, and in the Warehouse Precinct/Queens Gardens areas.

Element	Programme 1	Programme 2 v3
Cycling	The extension of the one-way system protected cycleways to The Oval plus safe connections to the Harbour Loop cycleways to Port Chalmers and Portobello are likely to make cycling a much more attractive option for many users. Evidence from Auckland, Nelson and Christchurch attests to rapid cycling uptake when improved “all ages and abilities” facilities are in place.	The proposed improvements on cycling in programme 1 are likely to encourage cycling uptake by relatively confident cyclists but the current design of the SH1 cycleways with mixing zones and sharing at intersections (where cyclists are most vulnerable) and the fact that it is in a higher-traffic environment means that having cycling on a quieter local road environment is likely to generate further mode shift from the substantial market of “interested but concerned” potential cyclists. Of note, the current usage on the SH routes is well below what Waka Kotahi’s assessment tool predicts suggesting that the attractiveness of the current facilities is not great.
Public transport	The mode shift programme foresees considerable improvements in public transport in Dunedin including cheaper fares; more frequent service including targeted bus priority; express buses from Mosgiel; an upgraded hub and superstops and park and rides.	Increases in travel times and reductions in level of service at some key intersections over and above programme 1 are likely to further incentivise mode shift because of the combination of the increases in travel times for car drivers and improvements to public transport. There is also less severance between the bus hub and the new hospital in this option and the bus route via the local road provides better connectivity in North Dunedin.
Land Use	The relocation of the hospital to the city centre may incentivise the conversion of heritage buildings and older office stock to residential, noting enhanced Building Code requirements and market economics presents challenges. But it would be attractive for some hospital staff and other city centre workers to live and work in a vibrant downtown core.	In addition to the potential increased attractiveness of city centre residential, the local road in programme 2 v 3 is likely to be more attractive for urban regeneration and intensification than a more traffic-oriented route because the local road is likely to be a more pleasant urban environment with reduced traffic volumes, noise and speed.
Modelling results	Some diversion takes place to the Harbour Arterial. Overall network performance not too dissimilar to a do minimum scenario.	Some reasonably significant impacts on travel times and a reduction in level of service at some critical intersections, some of which are already under pressure at peak times.
Parking management	The mode shift programme calls for improved parking management and for commuter parking to be further from the city centre core. Commuter parking prices have gradually increased. But the quantum, price and location of parking around the new Dunedin Hospital will be the most crucial factor in determining mode shift as the price and availability of parking is the primary push factor, along with less competitive car travel times, for generating mode shift. The mode shifts in this technical note assume that parking provision would be on a commercial basis, noting that there is often significant conflict between providing parking for staff versus provision for patients from out of town, outpatients and visitors for many of whom their health status rules out other travel options.	

3.4 Impact of programme on mode shift

The following section outlines the evidence behind the suggested mode shift impacts of each programme. It is important to note that significant mode shift changes can and does occur in cities of all sizes and scales, not just large cities. What is important is to have clear mode shift targets in place and a clear, funded and feasible programme of investments that help drive a mode shift programme towards that target.

For example, Victoria, British Columbia, Canada, population 85,792 as at the 2016 Census, achieved a non-car mode share (combining walking, cycling and public transport) of 48.7% - noting that the Canadian Census does not record working from home in commuting data. This was achieved through a comprehensive bus network, including express buses served by park and rides and bus lanes in Douglas Street on the primary approach to Victoria City centre

(analogous to Princes Street in Dunedin) which carries 50% of the people movement in the street. While the urban core was fed by an extensive regional trail network, at the time of the 2016 Census, there were no protected cycle lanes in the city centre. In the last five years, an extensive protected cycleway network, known as Biketoria, has been developed.

In a New Zealand context, considerable mode shifts have been achieved with the right infrastructure and services in place. Auckland increased public transport patronage from 60 million in 2010 to 103 million in 2019 through investment in network, service and supporting infrastructure improvements. Cycling on the North-western Cycleway increased from around 9,000 to 30,000 trips per month over the same period, linked to a major upgrade of the route and safe, all-ages connections into the city centre core through the Light Path/ Te Ara i Whiti, Nelson Street Cycleway and the Grafton Gully Cycleway.

In Dunedin, the completion of existing cycling projects to Port Chalmers and Portobello, combined with the plugging of missing links through the mode shift programme, will lead to a critical mass of safe cycling routes which, as has been evidenced in Auckland, will generate significant network effects and likely lead to significant mode shift. The prospect of repurposing the disused Cavendish and Chain Hills rail tunnels to provide a safe cycling route from Wingatui and Mosgiel would generate significant additional bike trips.

Working from home has clearly gained in importance in the wake of the Covid-19 pandemic and evidence to date is that this is likely to be an enduring effect, for people for whom this is an option and for whom it works for them and their employer.

Walking is already very strong in Dunedin which some areas having higher walk to work and study mode shares than even inner-city residential communities in Auckland and Wellington. The improvements in walking in the mode shift programme will further improve walkability in the city centre and are likely to further push up walking mode share, noting that it is starting from a higher base so has less latent demand than for public transport and cycling.

The mode shift targets in the mode shift programme, combined with emerging evidence and a likely stronger nudge to mode shift from programme 2v3, are ambitious but achievable with the right set of measures, noting that decisions about the amount, price, location and allocation of parking around the new Dunedin Hospital is possibly the most crucial element of mode shift, and the one about which the least is known.

The table below includes estimates for mode share for each of the two programme with actual data from the 2013 and 2018 censuses for comparison. It is important to note that these are estimates and not model outputs with the assessment based on the likely impacts of the programmes.

Table 3 Dunedin Mode Shift Estimates

Dunedin Mode Share Estimate					
	Census	Census	*P 1*	*P2 V 3*	*Comments*
Mode	*2013*	*2018*	*2030*	*2030*	
Work from home	7.0%	10.2%	13.0%	16.0%	More uptake with P2v3 due to additional congestion
Bus	3.0%	3.4%	8.0%	10.0%	More uptake with P2v3 due to better connected bus hub, route proximity to University plus congestion push factor
Bike	3.0%	2.1%	5.0%	8.0%	More uptake due to cycleway on local road
Walk	11.0%	9.9%	14.0%	16.0%	More uptake due to local road amenity and potential for rezoning to achieve residential densification on local road
Total non-car mode share	24.0%	25.6%	40.0%	50.0%	

4 Programme Scores

4.1 Scoring

A seven-point scoring system was used for this assessment:

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernible or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

The scoring for the two programmes reflects how well each programme performs against the criteria, compared to the Do Minimum. The Do Minimum consists of the transport network as it currently exists with the addition of the following committed interventions:

- Permanent Barnes Dance at both Albany Street/SH1 intersections (currently a trial).
- George Street – 10 km/h for four blocks – Albany Street to Moray Place.
- Tertiary – 30km/h speeds on Union Street, Harbour Terrace, Clyde Street and Forth Street.

4.2 Programme 1 and Programme 2v3 Scores

The table presents the scores for each programme, for Travel Choice.

Programme	Score	Summary Rationale for score
Do Minimum	-2	Over time, travel conditions deteriorate slowly due to organic growth in population leading to more trips on the network, the large majority of which will be car trips. No changes in levels of service expected for active modes or public transport. If driving remains attractive, this could lead to underinvestment in other modes, leading to less travel choice over time.
Programme 1	+2	Quite significant improvement over the do minimum, largely driven by pull factors from the mode shift programme leading to more attractive walking, cycling and public transport options. Parking management will need to drive change, and there may be a lack of appetite for this.
Programme 2v3	+3	Very significant improvement over the do minimum, driven by a mixture of all the pull factors from the mode shift programme combined with the increased opportunities to enable mode shift from programme 2v3. Land use change is more facilitated by this programme and the local road is likely to be more attractive to cyclists and pedestrians. Parking management is a key uncertainty, and the underlying assumption is that demand-based pricing will apply for parking.

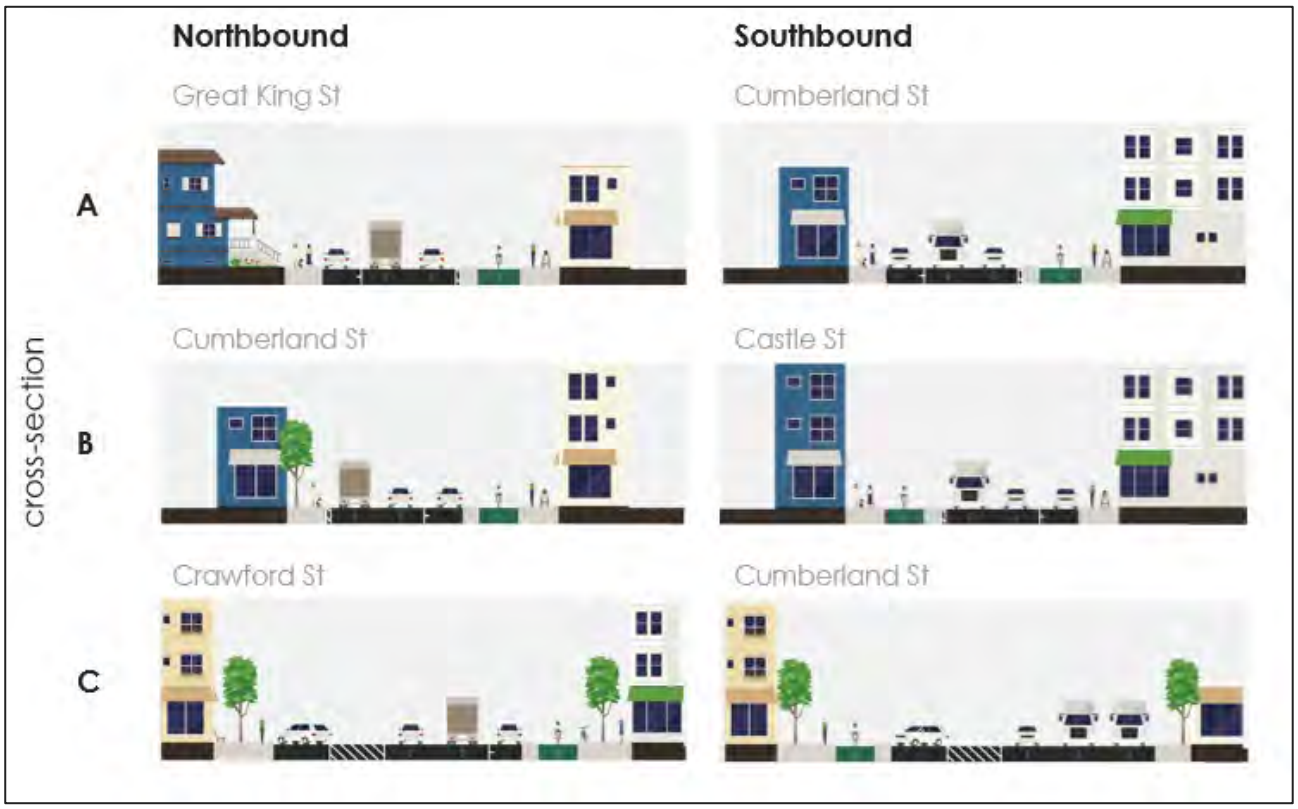
Appendix A: Programme Descriptions

Programme 1 (note items 2-7 are the same for both programmes)

1. SH1 **–** between Pine Hill Intersection and Andersons Bay Road: retain one-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route.
   - Major and minor intersection upgrades to address known safety and efficiency issues.
   - Corridor improvements to reduce side friction.
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing.

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

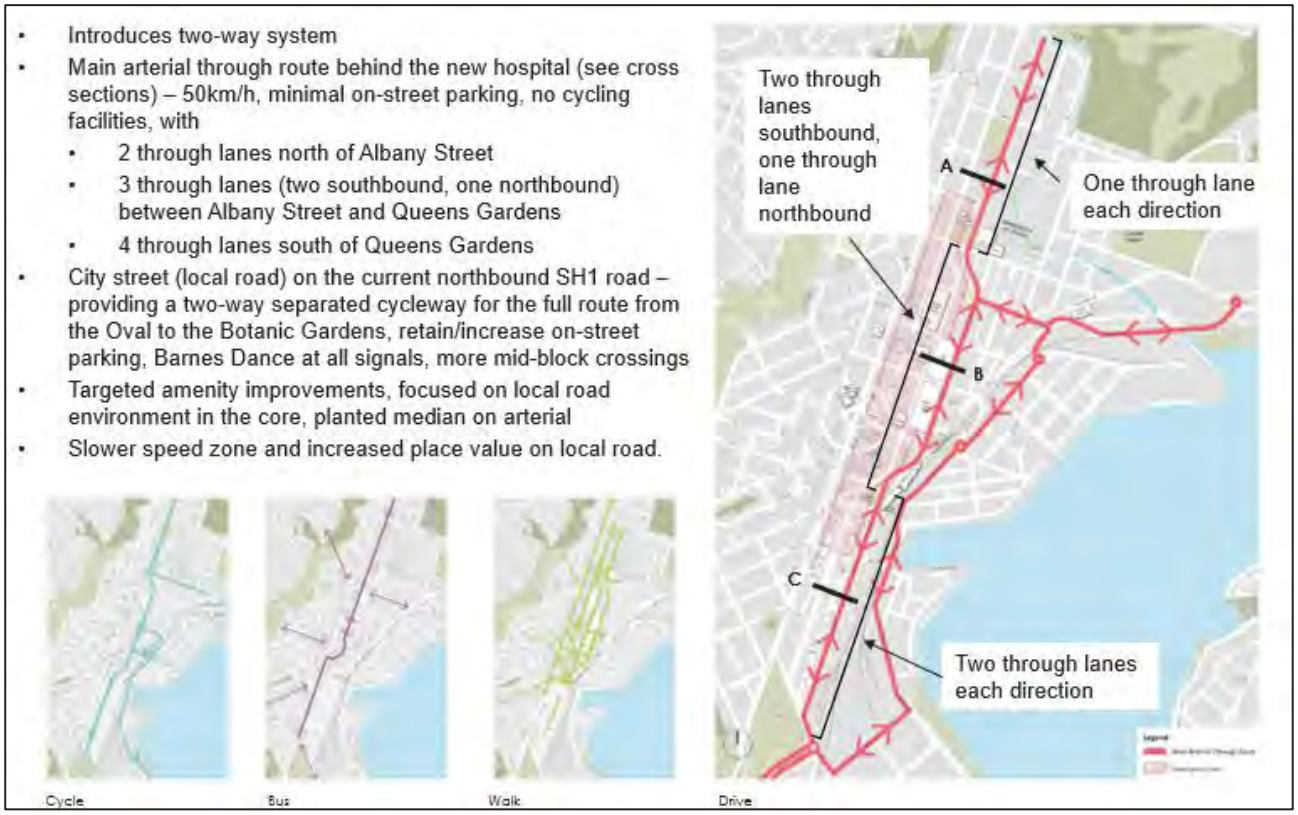
5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment, and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

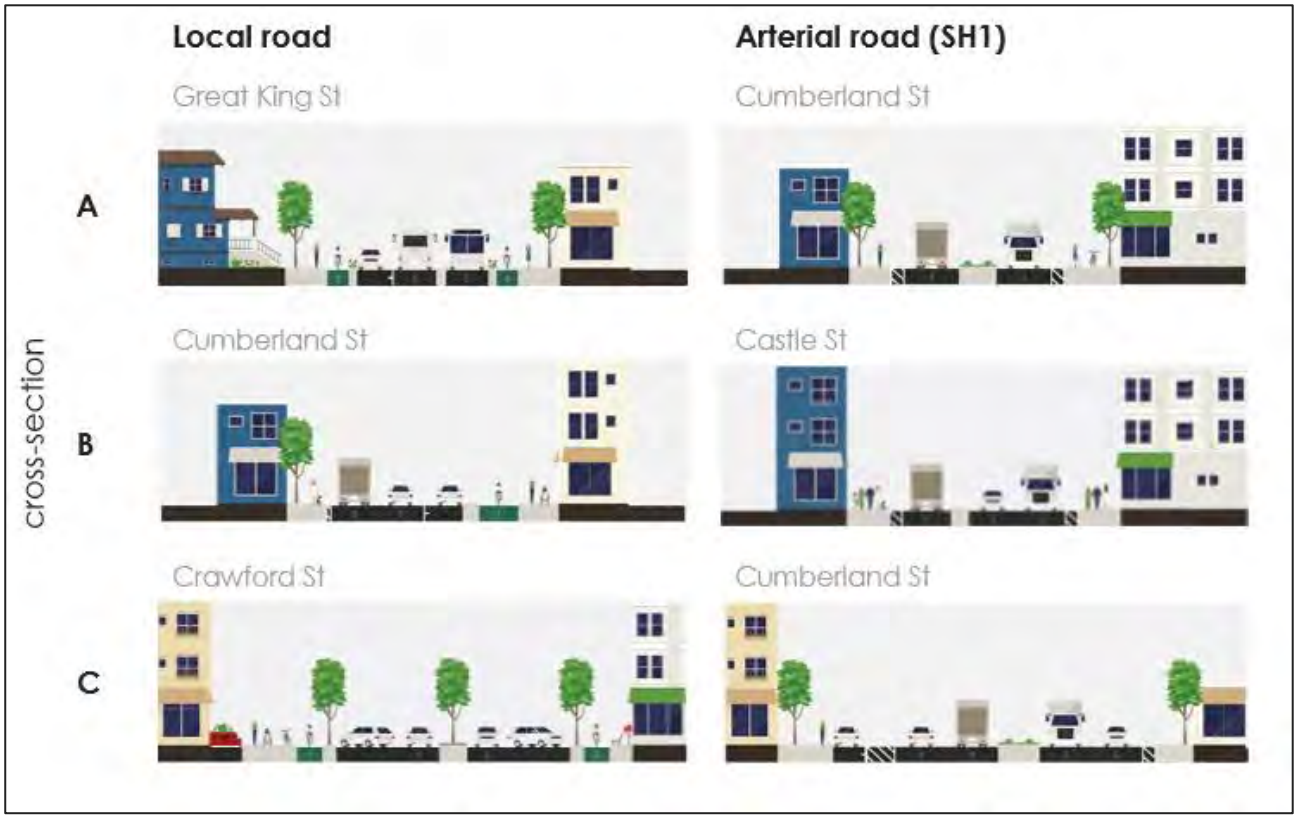
7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Programme 2v3 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: introduce two-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
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   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

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Shaping Future Dunedin Programme Business Case

MCA Technical Assessment for Technical Challenge

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This assessment focuses on the performance of each programme in relation to Technical Challenge.

1.2 Programme Development Process

During the short-listing process, four programmes were assessed in detail. The most significant difference between each programme was the configuration of SH1 through central Dunedin. The four programmes were as follows:

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P1, P2 and P2v2 were assessed against the criteria. P2 went through a number of iterations. Modelling and fatal flaws analyses were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width.

Through this process, P2v3 was identified as the preferred layout for a two-way option. This assessment evaluates only P1 and P2v3.

2 Assessment Approach

2.1 Definition

For the purposes of this assessment, Technical Challenge is defined as follows:

- How difficult the programme is to complete from an engineering and construction complexity perspective including consideration of temporary effects, staging and stakeholder impacts.

2.2 Assessment Approach

The approach adopted considers a range of factors which contribute towards the engineering and construction challenges associated to the programmes. These are defined as follows:

- **Stageability** – how easy or difficult the programme is to deliver in a staged manner. This criteria also considers how the staging of the implementation may offer benefit and/or disbenefit to the overall programme objectives.
- **Impact of temporary works** – the scale of disruption to the general public and adjacent landowners associated to the required construction works including limitations on access and/or diversions.
- **Consents and Affected Party Impacts** – the risks associated with consenting combined with the permanent impacts on adjacent properties.
- **Ground conditions and pavements** – The risks associated with any likely ground condition impacts and those associated to asset condition.
- **Stormwater and contamination risks** – the environmental impacts of the programmes with respect to stormwater impacts and potential for contamination
- **Utilities** – the adverse impacts on existing utility services and the scale of disruption anticipated as a result of the programmes.
- **Maintenance and Operational impacts** – any ongoing and increased liabilities associated to the programmes.

3 Programme Performance

3.1 Programme Descriptions

The programmes are defined in Appendix 1.

3.2 Assessment of Programme Performance

Refer to Table below.

Option	Key differentiators	Score	Stageability	Impact of temporary works	Consents and Affected Party Impacts	Ground Conditions and Pavements	Stormwater and Contamination Risks	Utilities	Impact on ongoing maintenance and operations
P1	Main difference relates to State Highways. Retain one way with online upgrades for improved urban outcomes combined with pedestrian improvements.	**+1**	**+2** Opportunity to deliver mode shift and harbour arterial components early to achieve reduced demand on private vehicle travel through CBD. Remaining works are relatively minor in nature and could be staged easily. There is opportunity to leverage the hospital construction impacts to embed some of the proposed changes.	**-1** Largely on-line construction of amenity upgrades and intersection improvements. However, this is sufficient space to complete works whilst maintaining traffic flows. Harbour Arterial and bridge works will have more telling impacts on current route users and may require diversions to be established.	**0** The vast majority of the proposed works are within road reserve with little or no impact on adjacent properties. With the exception of the Harbour Arterial works it is anticipated there will be no need for consents and/or property for the roading enhancements component of the programme. Subject to the nature of the Ward Street bridge works consenting may be necessary (building and/or resource) but this is broadly minor in nature and not out of keeping with the current bridge provision. Consents and property represent increased risk with respect to the proposed park and ride facilities which are present in both programme proposals.	**0** All of the proposed state highway enhancements are contained within the current road reserve and will largely utilise existing traffic lanes. The Ward Street bridge works will bring some risks associated to the ground conditions (if widening is required) and structural integrity (if strengthening is required).	**0** The proposals will utilise existing infrastructure with no change in stormwater surface run off. The provision of new park and ride facilities may bring stormwater risks and/or other environmental impacts but given no site has yet been identified it is not possible to mark this provision (and worth noting it would impact both programmes equally).	**0** Given retention of existing one-way operation, no significant change to services in area assumed. Whilst there may be some impacts associated to the urban enhancements (particularly build outs and planting) this is assumed to be minor in nature and easily managed during design and construction activities.	**0** Little change to existing requirements. Whilst there will be increased vegetation control required in addition to some existing infrastructure (higher quality materials, additional signal technologies and real time information signage) these are common solutions which the client stakeholders are able to easily bring into their existing operations.
P2V3	Main difference relates to State Highways: Proposed to change current one-way pair to 2, two-way roads. Current southbound will retain State Highway function with (predominantly) 3 lanes. Current northbound will become local road with one lane in each direction.	**-1**	**+1** Opportunity to stage network changes with sections of one-way routes becoming two way. However, the state highway solution would need to pre-empt the local road conversion to ensure operation and capacity is maintained. In addition, the broader aspects of the programme could be delivered during early stages of the implementation plan to ensure mode shift benefits are captured early and alternative options are in place to reduce traffic burden in CBD (Harbour Arterial). There is opportunity to leverage the hospital construction impacts to embed some of the proposed changes.	**-2** Largely on-line construction with considerable redistribution of road space likely reducing network capacity and requiring diversions. Property access is also likely to be impacted and potential restricted/reduced in some areas. Harbour Arterial and bridge works will impact current route users and may also require diversions to be established.	**-1** The vast majority of the proposed works are within road reserve and designations and as such consents are not **anticipated** with regards to the road enhancement component of the programme. However, the proposed State Highway solution is likely to require some control or restriction of some private property access (solid central median etc) which will bring stakeholder engagement and approvals risk. Whilst these impacts are unlikely to be too dissimilar to present (the one way means you can only gain access from one direction anyway), the perception of banned movements will likely result in some concern from property owners. The Harbour Arterial works are anticipated to require consent subject to the detail of the Ward Street bridge works (building and/or resource consent). This is broadly minor in nature and not out of keeping with the current bridge provision. Consents and property represent increased risk with respect to the proposed park and ride facilities which are present in both programme proposals.	**-1** The two-way operation of the state highway routes, particularly the current southbound route, will require traffic movements to shift from the current traffic lanes to existing parking lanes. The integrity of these lanes to accommodate this volume of traffic is uncertain and pavement rehabilitation is likely required. Whilst these works are not overly complex with common solutions available it does bring increased risk to the delivery of the programme. The Ward Street bridge works will bring some risks associated to the ground conditions (if widening is required) and structural integrity (if strengthening is required).	**0** The proposals will utilise existing infrastructure with no change in stormwater surface run off. The provision of new park and ride facilities may bring stormwater risks and/or other environmental impacts but given no site has yet been identified it is not possible to mark this provision (and worth noting it would impact both programmes equally).	**-1** The shift to two way will move traffic to current parking lanes and likely conflict with existing services, particularly with respect to the likely pavement enhancements proposed. The moved traffic lanes and central median is expected to require service protection and minor diversion and most likely strengthening and lifting of existing service access lids. Whilst this adds cost and some risk, these works are common practice within the industry and easily managed within normal design and construction processes.	**0** Little change to existing requirements. The asset base for Waka Kotahi NZ Transport Agency will decrease (due to the transfer in ownership of the proposed local road) whilst that of DCC will increase. Whilst the asset ownership and liability will change the ability to support and fund this is deemed achievable. The presence of 2no. two-way roads present additional resilience during unforeseen incidents which may provide a benefit in maintaining traffic flows during these periods. Whilst there will be increased vegetation control required in addition to some existing infrastructure (higher quality materials, additional signal technologies and real time information signage) these are common solutions which the client stakeholders are able to easily bring into their existing operations.

4 Programme Scores

4.1 Scoring

A seven-point scoring system was used for this assessment:

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
Neutral	No discernible or predicted positive or negative impact	0
Slightly adverse	Minor adverse impact, probably short-term, which can be mitigated	-1
Moderately adverse	Moderate adverse impact, may be short, medium or long term, and impact will most likely be able to be mitigated or managed	-2
Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

The scoring for the two programmes reflects how well each programme performs against the criteria, compared to the Do Minimum. The Do Minimum consists of the transport network as it currently exists with the addition of the following committed interventions:

- Permanent Barnes Dance at both Albany Street/SH1 intersections (currently a trial)
- George Street – 10 km/h for four blocks - Albany to Moray Place
- Tertiary – 30km/h speeds on Union Street, Harbour Terrace, Clyde Street and Forth Street.

4.2 Programme 1 and Programme 2v3 Scores

The table presents the scores for each programme, for technical challenge

Programme	Score	Summary Rationale for score
Do Minimum	+2	Assumed improved performance over P1 due to lack of construction impacts (noting not building anything is a benefit from a technical challenge perspective).
Programme 1	+1	Minor impacts associated to construction and staging with positive outcomes able to be achieved early allowing more intrusive works to follow later.
Programme 2v3	-1	Increased challenge associated to staging in addition to additional adverse impacts during construction. Increased risks associated to adjacent land uses and with regards to asset condition.

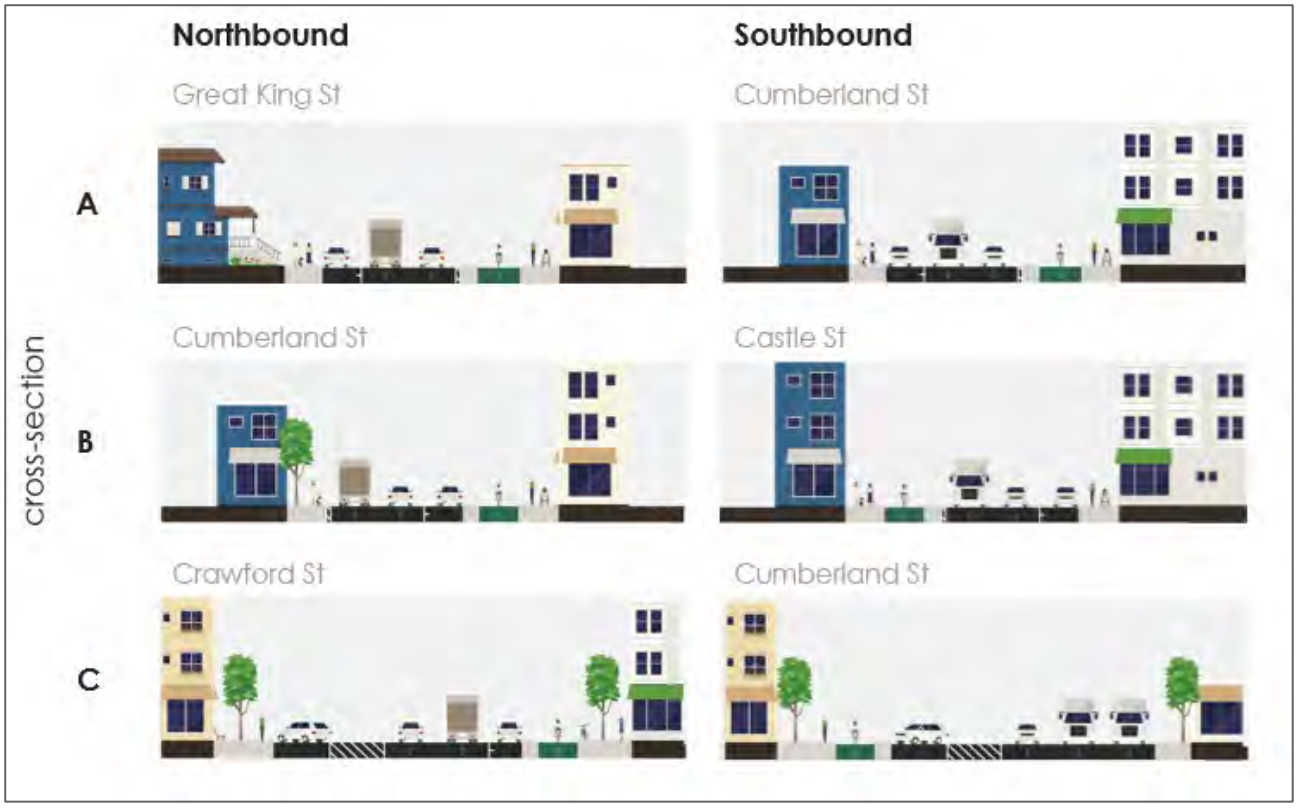
Appendix A: Programme Descriptions

Programme 1 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: retain one way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

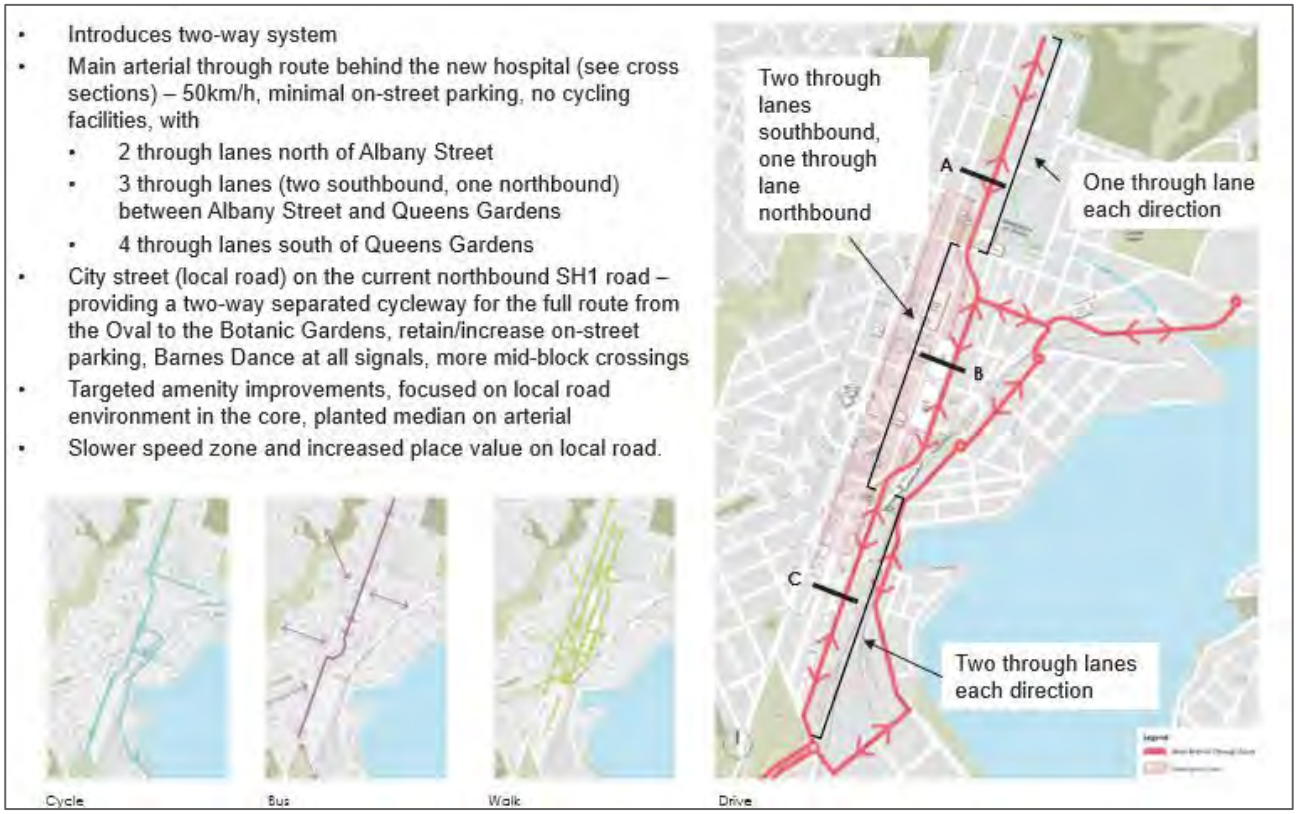
5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

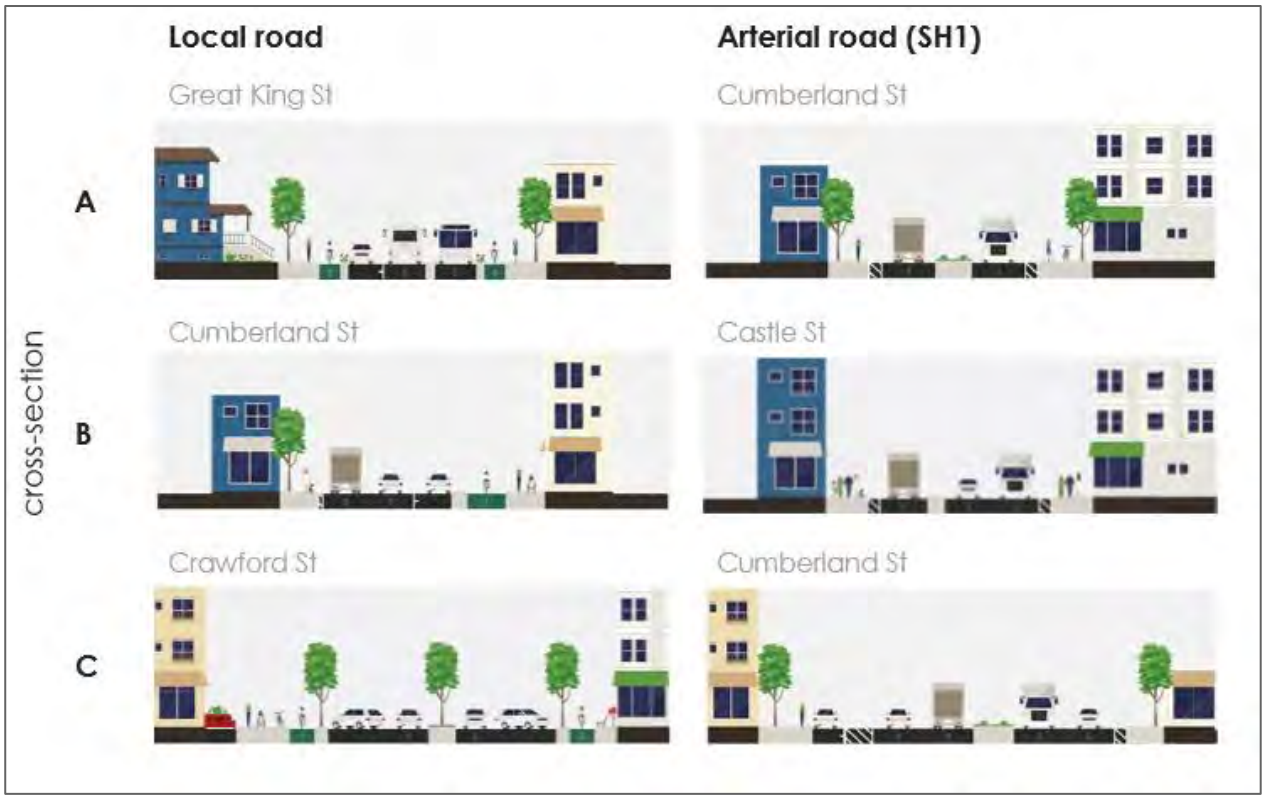
7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Programme 2v3 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: introduce two-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

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   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Shaping Future Dunedin Programme Business Case

MCA Technical Assessment for Reliable Journey Times

Rev. no	Date	Description	Prepared by	Checked by	Reviewed by	Approved by
1	15/02/21	MCA, Technical Assessment for Reliable Journey Times	BW	SC	GO	GO
2	29/04/21	Final	BW	SC	GO	GO

1 Overview

1.1 Purpose

The purpose of this report is to provide a technical assessment of Programme 1 and Programme 2v3. The results will be used for the Shaping Future Dunedin Programme Business Case MCA scoring.

This assessment focuses on the performance of each programme in relation to Reliable Journey Times.

1.2 Programme Development Process

During the short-listing process, four programmes were assessed in detail. The most significant difference between each programme was the configuration of SH1 through central Dunedin. The four programmes were as follows:

Programme	One way	Two way	Description
P1	√		Two, one-way arterials with two through lanes
P2		√	Two lane local road and arterial with two through lanes
P2v2		√	Two lane local road and arterial with four through lanes
P2v3		√	Two lane local road and arterial with following configuration: • Two through lanes north of Albany Street • Three through lanes (two southbound and one northbound) between Albany Street and Queens Gardens (in line with Burlington Street) • Four through lanes south of Queens Gardens

P1, P2 and P2v2 were assessed against the criteria P2 went through a number of iterations. Modelling and fatal flaws analyses were used to understand more specifically where additional capacity was required, and to understand corridor constraints, including available width.

Through this process, P2v3 was identified as the preferred layout for a two-way option. This assessment evaluates only P1 and P2v3.

2 Assessment Approach

2.1 Definition

For the purposes of this assessment, Reliable Journey Times is defined as follows:

Project Outcome: Improve attractiveness of city as place to invest, live, work and play.
Investment Objective: Maintain consistent reliable journey times on key arterials.

The assessment considers how well the programme contributes to maintaining movement of people/goods and provides reliable journey times on key arterials – harbour arterial, SH1 and SH88.

2.2 Assessment Approach

The investment objective is described as “Maintain consistent reliable journey times on key arterials” and the assessment is based on how well the programme “Contributes to maintaining movement of people/goods and provides reliable journey times”.

‘Providing reliable journey times’ and ‘maintaining consistent reliable journey times’ is typically linked with managing or mitigating high levels of delay, congestion and queuing. Although ‘reliability’ may be thought of in relation to the consistency or variation in travel times day-to-day, it is well established that high levels of delay and congestion lead to poor travel time reliability.

Therefore, the approach to assessing this objective is based around how well the Programme limits or reduces larger increases in travel time and delay.

The key measures for this assessment have been provided from the Dunedin city centre microsimulation model. The assessment focusses on interpreting the estimated relative differences in these measure between the Do Minimum and the two Programmes, and between the two Programmes themselves.

The key model outputs reviewed for this assessment include:

- **Network-wide average travel times and distances**. This provides a measure of the overall average time and distance of all the vehicle trips made within the city centre study area. It is an important measure of the general broad outcomes and balance of the Programme.
- **Key route travel times**. These provide travel time results concentrated on sections of key corridors between major locations in the network. The more notable routes include Stage Highway 1, the Harbour Arterial, and State Highway 88. East-west routes across the CBD have also been considered.
- **Intersection operational outcomes**. The delays at each movement at intersections throughout the network can be estimated from the traffic model. These delays can be used to determine the 'Level of Service' (LOS) for each intersection. LOS is specified in categories from LOS A no delay, up to LOS F high delay. The measure considered is the number of intersections in the study area with LOS D or higher. LOS D or higher means intersection delays at signalised intersections and roundabouts of around 40-seconds and higher.

3 Programme Performance

3.1 Programme Descriptions

The programmes are defined in Attachment 1.

3.2 Key Aspects of the Do Minimum

The 'Do Minimum' scenario is the likely future traffic and transport environment without any SFDT Programme intervention. The modelled Do Minimum is similar to the current existing network, with the addition of a slow speed zone on George Street, 30kph speed limits in the tertiary precinct area, and permanent Barnes Dance pedestrian signal phases at the two Albany Street/SH1 intersections.

From the traffic modelling, key observations relating to the future Do Minimum scenario relative to the operation of the current network include:

- Increased delays at the 5-arm George Street/London Street/Frederick Street intersection. This intersection is a notable constraint/pressure point in the network. This is due to the signal phasing required at this intersection as a result of the number of approaches and movements allowed. Delays, and this constraint at this intersection, are also observed for all SFDT Programme scenarios.
- Intersections located in the central city to the north of the Octagon are strained due to the Barnes Dance pedestrian phases added on both State Highway routes along with the cycle-way signal phasing.
- Eastbound and westbound traffic going in and out of the city centre is affected and delayed by the requirement to cross one of the one-way routes in order to access the other. A particular and notable example is during the weekday evening peak period when vehicles travelling south must cross the northbound one-way in the eastbound direction and can be delayed turning right onto the southbound one-way. This is also apparent in Programme 1.
- In general terms, and related to each of the above points, traffic moving through the area of the network to the northeast of the Octagon is constrained and experiences delays particularly in the weekday evening peak period.

3.3 Performance of Programme 1

Programme 1 has a similar network layout to the Do Minimum and largely experiences the same issues as those noted above. Two key observations are noted:

- The Harbour Arterial aspect of the SFDT programmes increases traffic along Frederick Street, adding to pressure along Frederick Street and at the 5-arm George Street/London Street/Frederick Street intersection.
- The addition of several more Barnes Dance signal phases increases the general pressure/delays to vehicle traffic.

3.4 Performance of Programme 2v3

Programme 2v3 includes several of the aspects and elements described above relating to the Do Minimum and Programme 1. In addition, key observations include:

- Intersections in the central area of the network along the two-way arterial route are under increased vehicle delay pressure as the overall intersection volume at these locations is increased.
- As per Programme 1, increased flow along Frederick Street increases vehicle delays and pressures along this route.

- In the weekday evening peak the Frederick Street/Castle Street (two-way arterial) and Hanover Street/Castle Street (two-way arterial) intersections are key network pressure points. The confluence of traffic movements and volumes at these locations places the intersection operation (signal phases and timings) under pressure and leads to some delays and queueing around this area of the network.

4 Programme Scores

4.1 Scoring

A seven-point scoring system was used for this assessment:

Description	Definition	Score
Significantly positive	Significant positive impact, likely resulting in substantial and long-term improvements or enhancements	+3
Moderately positive	Moderate positive impact, which may provide improvements or enhancements, and new opportunities of short, medium- or long-term duration.	+2
Slightly positive	Minor positive impact, may be confined to limited area, possibly only short term	+1
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Significantly adverse	Significant and serious adverse impact with serious long-term effects on the physical, economic or social environment.	-3

The scoring for the two programmes reflects how well each programme performs against the criteria, compared to the Do Minimum. The Do Minimum consists of the transport network as it currently exists with the addition of the following committed interventions:

- Permanent Barnes Dance at both Albany Street/SH1 intersections (currently a trial)
- George Street – 10 km/h for four blocks - Albany to Moray Place
- Tertiary – 30km/h speeds on Union Street, Harbour Terrace, Clyde Street and Forth Street.

4.2 Programme 1 and Programme 2v3 Scores

There are four tables presented below. The first three correspond to the key model outputs reviewed for this assessment. The final table represents a combined score for each programme, based on the three key model outputs scores.

This table presents the scores for each programme, for ***overall average network travel time and distance***.

Programme	Score	Summary Rationale for score
Do Minimum	+1	Does not lead to any significant increase in network-wide travel times, congestion and delays.
Programme 1	+1	Across the weekday morning, inter-peak, and evening time periods the overall network-wide measures are effectively neutral compared to the Do Minimum. The programme maintains journey times and, as per the Do Minimum, does not lead to significant increases in network-wide travel times, congestion and delays.
Programme 2v3	-1	Low level increase in network travel time in the weekday morning and inter-peak periods, these increases would be unlikely to be noticeable after a short period of time. In the evening period there is an overall increase in travel time of around 1-minute (approximate 15%) on average for all trips across the network. This would be noticeable to the vehicle movements experiencing higher travel times for a short period (weeks to months). Over time, people's adjustment and adaption to the change would reduce this effect.

This table presents the scores for each programme, for ***key route travel times***.

Programme	Score	Summary Rationale for score
Do Minimum	+1	Does not lead to any significant increases in travel times on key routes and limits the potential for key route travel times to increase.
Programme 1	0	Slower speed limits on key corridors, notably SH1, increase route travel times by 1-to-2 minutes across weekday periods.
Programme 2v3	-1	Increase in travel times on key routes are similar to Programme 1. The exception is the weekday evening peak period where SH1 travel times increase by 2-to-4 minutes.

This table presents the scores for each programme, for ***overall intersection delays and Level of Service (LOS) changes***.

Programme	Score	Summary Rationale for score
Do Minimum	+1	In the weekday morning and inter-peak, overall there are few intersections demonstrating higher delays and LOS D or higher. This increases in the weekday evening peak, although the number of intersections with LOS E & F is limited (6 E, 3 F). Generally higher delays are limited.
Programme 1	+1	Little difference in the overall intersection delay and LOS outcomes in Programme 1 compared to the Do Minimum. Programme 1 achieves a similar result to the Do Minimum and limits the potential for larger increases in delays and queuing.
Programme 2v3	-1	Little-to-no significant change in intersection delays and LOS outcomes in the weekday morning and inter-peak. In the weekday PM peak period although the number of intersections that reach LOS D increases, the majority (6 of 8) have shifted one threshold level (from C to D). The number of intersections at LOS E and F remains the same as the Do Minimum.

This final table presents the scores for each programme, for ***Reliable journey times, overall outcome***.

Programme	Score	Summary Rationale for score
Do Minimum	+1	Limits the overall potential for larger increases in delay, congestion and queueing in the weekday peak and inter-peak periods.
Programme 1	+1	Achieves similar outcomes to the Do Minimum and limits the potential for larger increases in travel times, delays, and congestion.
Programme 2v3	-1	Expected to lead to a minor level of increased travel time and delay. This is likely to be most noticeable in the weekday evening peak period.

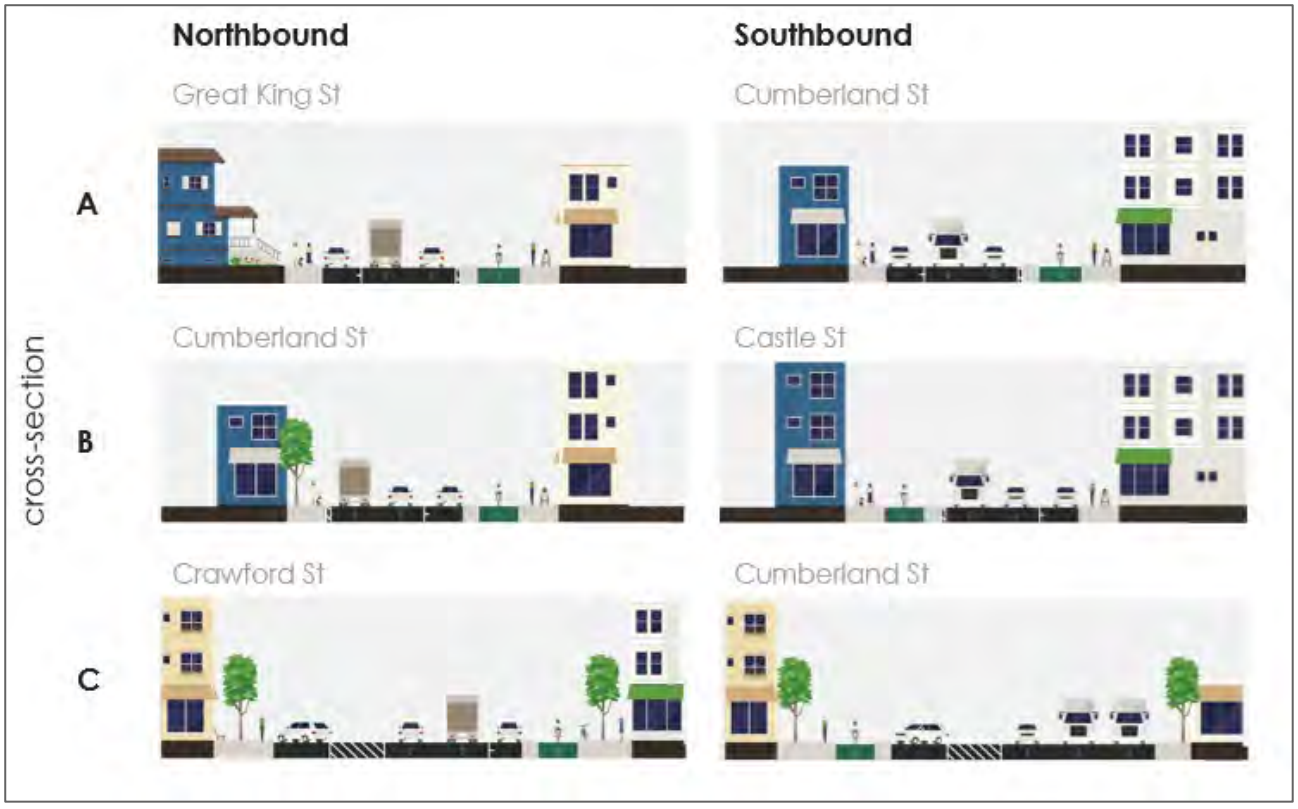
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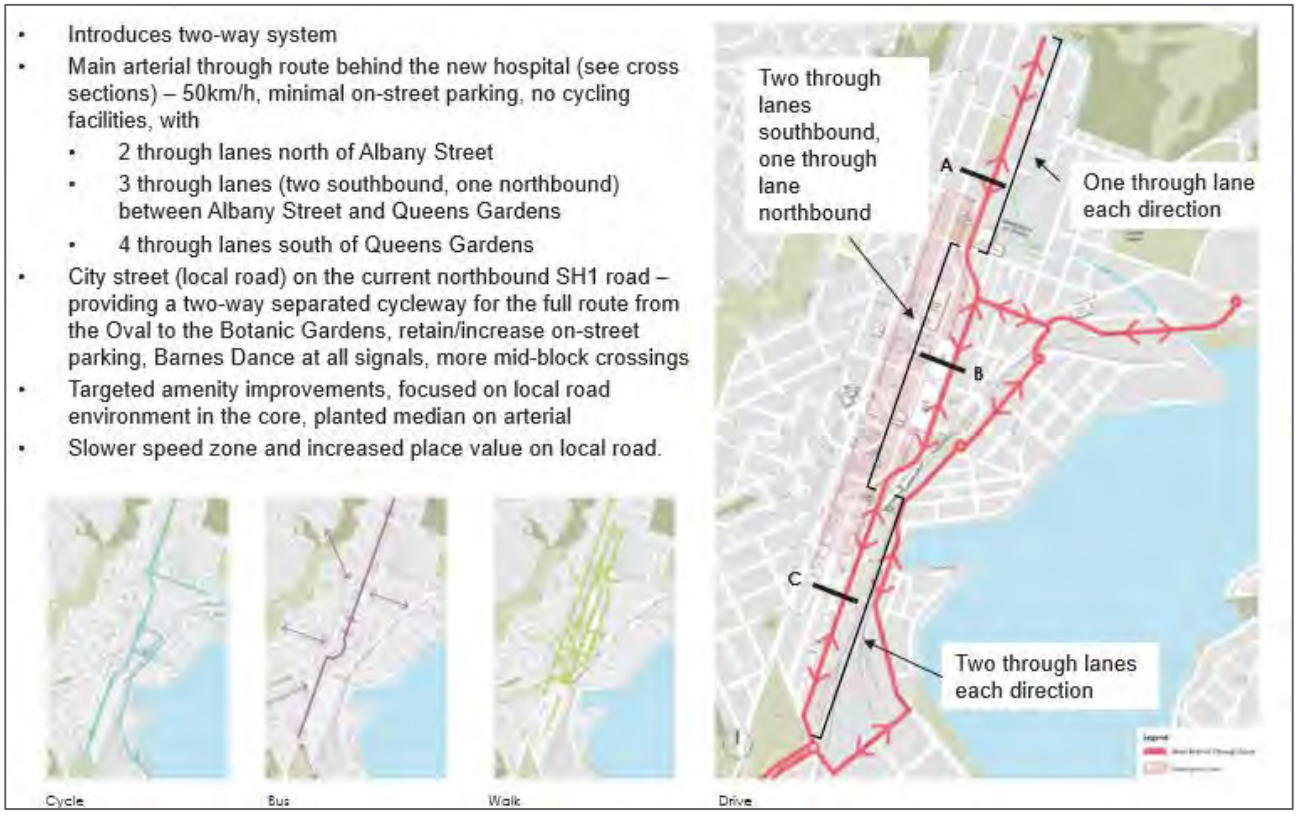
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   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
   - Slow Speed Zone: from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the zone, Barnes Dances will be installed at traffic signals.
   - Princes Street: slower speeds to create a more pleasant, welcoming environment, improved pedestrian connections to bus stops, additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads, Barnes Dance phasing at traffic signals, cycle facilities that provide for connections to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, and Central City.
   - Albany Street North/South Extensions: A complete cycle route from the Harbour/SH88 cycleway to George Street via the Tertiary area, and pedestrian improvements including additional crossing points and intersection changes.
   - St Andrew Street: a pedestrian focused zone between the new hospital sites. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment. A safe route will be provided on St Andrew Street for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city.
   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

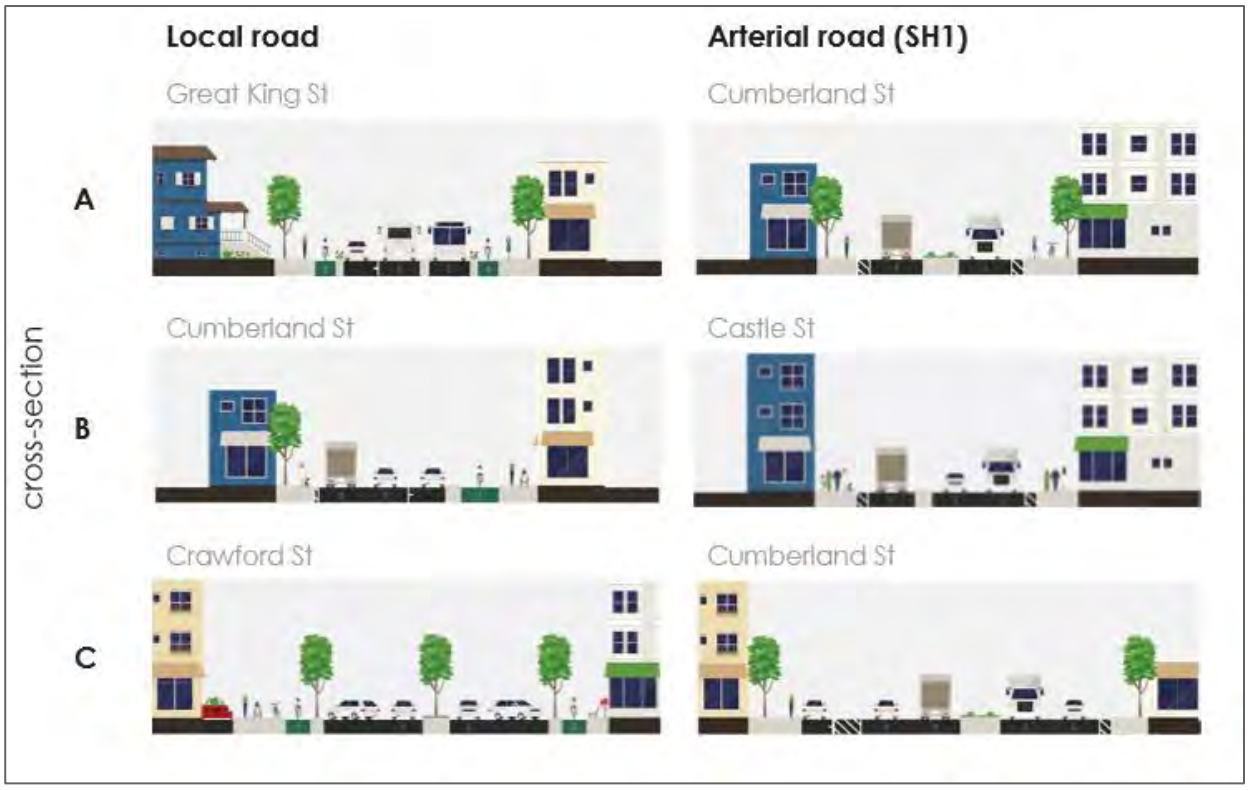
7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Programme 2v3 (note items 2-7 are the same for both programmes)

1. SH1 – between Pine Hill Intersection and Andersons Bay Road: introduce two-way system as follows:



Indicative cross sections at points A, B and C on the map above are shown below:



2. Harbour Arterial Upgrade: Improve the Harbour Arterial route to reduce peak travel time by 30% and address safety and efficiency issues through:
   - Direction signage and real time information promoting the route
   - Major and minor intersection upgrades to address known safety and efficiency issues
   - Corridor improvements to reduce side friction
   - Upgrade Ward Street overbridge and Ward/Anzac/Frederick Street intersection to avoid at grade rail crossing

3. Public Transport Improvements: Improve services, frequencies and fares to provide a more attractive public transport network through:
   - Central City Bus Hub and four superstop upgrades (Tertiary, South Dunedin, Green Island and Gardens) to provide Real Time Passenger Information signs and improvements to seating, shelter and driver facilities.
   - Frequency and fare review to provide significantly improved service/frequency improvements particularly from southern residential areas and express services from Mosgiel. Current attractive $2 fares to be continued. Timetable improvements for faster services.
   - Southern Bus Priority: Bus priority route on Princes Street to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. Includes bus lanes, priority at signals, and clearways. The bus priority route aims to improve travel time by 20% and attract an additional 500 users per day.

4. Parking Management: Develop a Parking Management Policy to guide the supply and management of parking to ensure it meets community needs, aligns with strategic objectives and supports businesses and visitors to the city, through:
   - Demand responsive pricing to which will reduce congestion caused by circulating traffic.
   - Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
   - Parking Wayfinding System to direct drivers to selected off street parking locations.
   - Replace parking meters with more efficient parking technologies for payment and enforcement.
   - Install sensors for data collection and easy analysis of information.
   - Longer term – consolidate existing off-street carparking and explore potential new parking areas.

5. Park and Ride: Develop 2 Park and Ride facilities to provide an attractive alternative to driving and reduce parking demand and traffic in the central city:
   - Mosgiel Park and Ride will serve the rural hinterland around Mosgiel, including Outram.
   - Burnside Park and Ride will serve all city-bound traffic from further south. This is a very large catchment and the site could be very popular, particularly if parking is constrained in the central city. A site has not been identified however it would be desirable for it to be as close as possible to SH1 so there is minimal diversion for drivers.

6. Cycle and Pedestrian Networks: Complete gaps and address safety issues through:
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   - Bicycle Hubs: Three bike hubs – located near the Octagon, the Exchange and The Tertiary Precinct, providing sheltered secure cycle storage, other facilities and information.

7. Behaviour Change: The Council will work with the employers and schools to support and incentivise walking, cycling and public transport use.

Appendix N Economic Evaluation

Benefits

40 Years Discounted

Option	TT/VOC	Emissions	WEBS	SAFETY	WALKING & CYCLING	Total	TT/VOC	Emissions	WEBS	SAFETY	WALKING & CYCLING	Total
Do Minimim	$2,147,608,317	$159,095,255	$0	$162,595,560	$109,116,739	$2,469,299,131						
Programme 1	$2,109,598,672	$155,995,451	$109,329,456	$67,573,168	$36,089,142	$2,442,496,747	$38,009,645	$3,099,805	$109,329,456	$95,022,391	$36,089,142	$281,550,438
Programme 2v3	$2,193,962,191	$156,020,346	$213,615,567	$83,534,132	$38,673,139	$2,647,132,237	-$46,353,874	$3,074,909	$213,615,567	$79,061,427	$38,673,139	$288,071,169

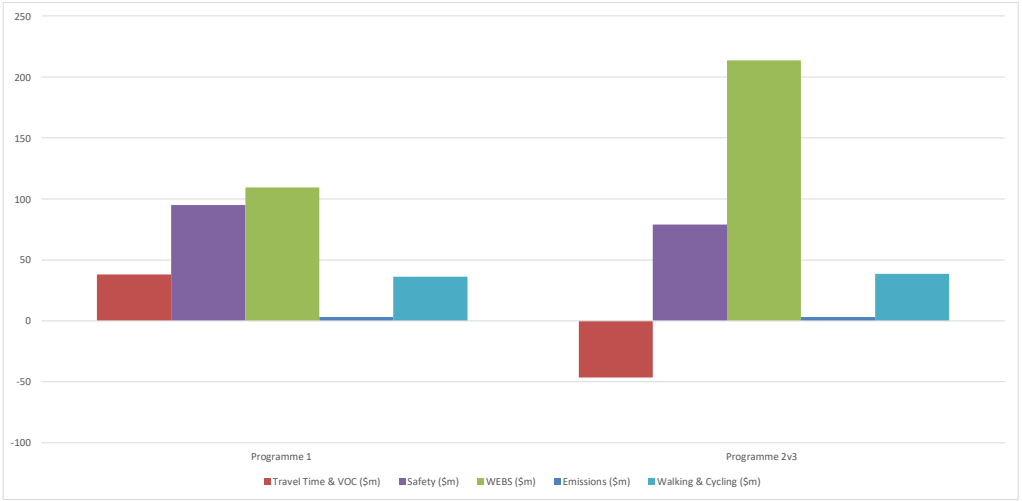
REPORTING

40 Years Discounted

Option	Benefits						Costs		BCR Range		
	Travel Time & VOC ($m)	Emissions ($m)	WEBS ($m)	Safety ($m)	Walking & Cycling ($m)	TOTAL PV BENEFIT ($m)	Capital Cost (undiscounted) ($m)	Discounted Cost ($m)	TOTAL COST PV ($m)	BCR	BCR (WITHOUT WEBS)
Programme 1	38	3	109	95	36	282	123,885,588	88,207,796	88	3.2	2.0
Programme 2v3	-46	3	214	79	39	288	152,445,588	108,542,805	109	2.7	0.7

SUMMARY

Option	Including WEBS	Excluding WEBs
Programme 1	3.2	2.0
Programme 2v3	2.7	0.7



2017

Benefit	Total Vehicles												Weekday		Annually	
	AM				INTERPEAK				PM							
	# of Trips	Average Travel Time (min)	Average Travel Time (secs)	Average Distance (km)	# of Trips	Average Travel Time (min)	Average Travel Time (secs)	Average Distance (km)	# of Trips	Average Travel Time (min)	Average Travel Time (secs)	Average Distance (km)	Veh-kms	Veh-hrs	Veh-kms	Veh-hrs
Do Minimum	43130	5.01	300.60	2.51	36554	4.34	260.40	2.25	73712	5.05	303.00	2.34	362,989	12,450	88,932,276	3,050,133
Programme 1	43130	5.01	300.60	2.51	36554	4.34	260.40	2.25	73712	5.05	303.00	2.36	364,463	12,450	89,293,464	3,050,133
Programme 2v3	43130	5.01	300.60	2.51	36554	4.34	260.40	2.25	73712	5.05	303.00	2.39	366,674	12,450	89,835,248	3,050,133

2038 2729

Benefit	Total Vehicles												Weekday		Annually	
	AM				INTERPEAK				PM							
	# of Trips	Average Travel Time (min)	Average Travel Time (secs)	Average Distance (km)	# of Trips	Average Travel Time (min)	Average Travel Time (secs)	Average Distance (km)	# of Trips	Average Travel Time (min)	Average Travel Time (secs)	Average Distance (km)	Veh-kms	Veh-hrs	Veh-kms	Veh-hrs
Do Minimum	45859	5.14	308.40	2.49	38991	4.38	262.80	2.24	78347	5.48	328.80	2.34	384,861	13,931	94,290,879	3,413,003
Programme 1	43770	5.18	310.80	2.49	38122	4.56	273.60	2.25	76200	5.42	325.20	2.33	372,308	13,559	91,215,411	3,322,073
Programme 2v3	43773	5.32	319.20	2.47	38141	4.52	271.20	2.23	76219	6.27	376.20	2.33	370,764	14,719	90,837,182	3,606,248

Note:

	Interpolation	Do Minimum				Programme 1				Programme 2v3				Year		SPPWF (6%)	SPPWF (4%)	
		Travel Distance ($)	Travel Time ($)		TOTAL	Travel Distance ($)	Travel Time ($)		TOTAL	Travel Distance ($)	Travel Time ($)		TOTAL					
		Annual	Weekday	Annual	$	Annual	Weekday	Annual	$	Annual	Weekday	Annual	$					
0	2017	$27,903,391	$328,955	$80,593,960	**$108,497,351**	$28,016,717	$328,955	$80,593,960	**$108,610,677**	$28,186,707	$328,955	$80,593,960	**$108,780,667**	2017	0	1.000	1.000	
	2018	$27,883,453	$330,819	$81,050,539	**$109,033,992**	$28,045,433	$330,352	$80,936,127	**$108,981,560**	$28,201,677	$331,811	$81,293,688	**$109,495,365**	2018	1	0.943	0.962	
	2019	$28,063,516	$332,682	$81,507,117	**$109,570,633**	$28,074,149	$331,748	$81,278,294	**$109,352,443**	$28,216,647	$334,667	$81,993,417	**$110,210,064**	2019	2	0.890	0.925	
	2020	$28,143,579	$334,546	$81,963,696	**$110,107,275**	$28,102,865	$333,145	$81,620,461	**$109,723,326**	$28,231,617	$337,523	$82,693,145	**$110,924,762**	2020	3	0.840	0.889	
	2021	$28,223,641	$336,409	$82,420,275	**$110,643,916**	$28,131,580	$334,541	$81,962,628	**$110,094,209**	$28,246,587	$340,379	$83,392,873	**$111,639,460**	2021	4	0.792	0.855	
	2022	$28,303,704	$338,273	$82,876,853	**$111,180,557**	$28,160,296	$335,938	$82,304,796	**$110,465,091**	$28,261,557	$343,235	$84,092,602	**$112,354,158**	2022	5	0.747	0.822	
	2023	$28,383,767	$340,136	$83,333,432	**$111,717,199**	$28,189,012	$337,335	$82,646,963	**$110,835,974**	$28,276,526	$346,091	$84,792,330	**$113,068,856**	2023	6	0.705	0.790	
	2024	$28,463,829	$342,000	$83,790,011	**$112,253,840**	$28,217,727	$338,731	$82,989,130	**$111,206,857**	$28,291,496	$348,947	$85,492,058	**$113,783,555**	2024	7	0.665	0.760	
	2025	$28,543,892	$343,864	$84,246,589	**$112,790,481**	$28,246,443	$340,128	$83,331,297	**$111,577,740**	$28,306,466	$351,803	$86,191,787	**$114,498,253**	2025	8	0.627	0.731	
	2026	$28,623,955	$345,727	$84,703,168	**$113,327,122**	$28,275,159	$341,524	$83,673,464	**$111,948,623**	$28,321,436	$354,659	$86,891,515	**$115,212,951**	2026	9	0.592	0.703	
	2027	$28,704,017	$347,591	$85,159,747	**$113,863,764**	$28,303,875	$342,921	$84,015,631	**$112,319,506**	$28,336,406	$357,515	$87,591,243	**$115,927,649**	2027	10	0.558	0.676	
	2028	$28,784,080	$349,454	$85,616,325	**$114,400,405**	$28,332,590	$344,318	$84,357,798	**$112,690,388**	$28,351,376	$360,371	$88,290,972	**$116,642,348**	2028	11	0.527	0.650	
	2029	$28,864,142	$351,318	$86,072,904	**$114,937,046**	$28,361,306	$345,714	$84,699,965	**$113,061,271**	$28,366,346	$363,227	$88,990,700	**$117,357,046**	2029	12	0.497	0.625	
	2030	$28,944,205	$353,182	$86,529,483	**$115,473,688**	$28,390,022	$347,111	$85,042,132	**$113,432,154**	$28,381,315	$366,083	$89,690,428	**$118,071,744**	2030	13	0.469	0.601	
	2031	$29,024,268	$355,045	$86,986,061	**$116,010,329**	$28,418,737	$348,507	$85,384,300	**$113,803,037**	$28,396,285	$368,939	$90,390,157	**$118,786,442**	2031	14	0.442	0.577	
	2032	$29,104,330	$356,909	$87,442,640	**$116,546,970**	$28,447,453	$349,904	$85,726,467	**$114,173,820**	$28,411,255	$371,795	$91,089,885	**$119,501,140**	2032	15	0.417	0.555	
	2033	$29,184,393	$358,772	$87,899,219	**$117,083,612**	$28,476,169	$351,301	$86,068,634	**$114,544,803**	$28,426,225	$374,651	$91,789,613	**$120,215,839**	2033	16	0.394	0.534	
	2034	$29,264,456	$360,636	$88,355,797	**$117,620,253**	$28,504,885	$352,697	$86,410,801	**$114,915,685**	$28,441,195	$377,508	$92,489,342	**$120,930,537**	2034	17	0.371	0.513	
	2035	$29,344,518	$362,499	$88,812,376	**$118,156,894**	$28,533,600	$354,094	$86,752,968	**$115,286,568**	$28,456,165	$380,364	$93,189,070	**$121,645,235**	2035	18	0.350	0.494	
	2036	$29,424,581	$364,363	$89,268,955	**$118,693,536**	$28,562,316	$355,490	$87,095,135	**$115,657,451**	$28,471,135	$383,220	$93,888,799	**$122,359,933**	2036	19	0.331	0.475	
	2037	$29,504,644	$366,227	$89,725,533	**$119,230,177**	$28,591,032	$356,887	$87,437,302	**$116,028,334**	$28,486,105	$386,076	$94,588,527	**$123,074,631**	2037	20	0.312	0.456	
0	2038	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2038	21	0.294	0.439	
	2039	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2039	22	0.278	0.422	Flatlining of benefits post 2038
	2040	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2040	23	0.262	0.406	
	2041	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2041	24	0.247	0.390	
	2042	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2042	25	0.233	0.375	
	2043	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2043	26	0.220	0.361	
	2044	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2044	27	0.207	0.347	
	2045	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2045	28	0.196	0.333	
	2046	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2046	29	0.185	0.321	
	2047	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2047	30	0.174	0.308	
	2048	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2048	31	0.164	0.296	
	2049	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2049	32	0.155	0.285	
	2050	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2050	33	0.146	0.274	
	2051	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2051	34	0.138	0.264	
	2052	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2052	35	0.130	0.253	
	2053	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2053	36	0.123	0.244	
	2054	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2054	37	0.116	0.234	
	2055	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2055	38	0.109	0.225	
	2056	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2056	39	0.103	0.217	
	2057	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2057	40	0.097	0.208	
	2058	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2058	41	0.092	0.200	
	2059	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2059	42	0.087	0.193	
	2060	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2060	43	0.082	0.185	
	2061	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2061	44	0.077	0.178	
	2062	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2062	45	0.073	0.171	
	2063	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2063	46	0.069	0.165	
	2064	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2064	47	0.065	0.158	
	2065	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2065	48	0.061	0.152	
	2066	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2066	49	0.058	0.146	
	2067	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2067	50	0.054	0.141	
	2068	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2068	51	0.051	0.135	
	2069	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2069	52	0.048	0.130	
	2070	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2070	53	0.046	0.125	
	2071	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2071	54	0.043	0.120	
	2072	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2072	55	0.041	0.116	
	2073	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2073	56	0.038	0.111	
	2074	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2074	57	0.036	0.107	
	2075	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2075	58	0.034	0.103	
	2076	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2076	59	0.032	0.099	
	2077	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2077	60	0.030	0.095	
	2078	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2078	61	0.029	0.091	
	2079	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2079	62	0.027	0.088	
	2080	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2080	63	0.025	0.085	
	2081	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2081	64	0.024	0.081	
	2082	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2082	65	0.023	0.078	
	2083	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2083	66	0.021	0.075	
	2084	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2084	67	0.020	0.072	
	2085	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2085	68	0.019	0.069	
	2086	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2086	69	0.018	0.067	
	2087	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2087	70	0.017	0.064	
	2088	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2088	71	0.016	0.062	
	2089	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2089	72	0.015	0.059	
	2090	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2090	73	0.014	0.057	
	2091	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2091	74	0.013	0.055	
	2092	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2092	75	0.013	0.053	
	2093	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2093	76	0.012	0.051	
	2094	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2094	77	0.011	0.049	
	2095	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2095	78	0.011	0.047	
	2096	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2096	79	0.010	0.045	
	2097	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2097	80	0.009	0.043	
	2098	$29,584,706	$368,090	$90,182,112	**$119,766,818**	$28,619,747	$358,284	$87,779,469	**$116,399,217**	$28,501,074	$388,932	$95,288,255	**$123,789,330**	2098	81	0.009	0.042	

Travel Time and Vehicle Operating Costs Discounting and Timestream

								40 Years		
	Do Minimum	Programme 1	Programme 2	Year		SPPWF (4%)	Update Factor	Do Minimum	Programme 1	Programme 2
2017	$108,497,351	$108,497,351	$108,497,351	2017	0	1.000	1.00	$108,497,351	$108,497,351	$108,497,351
2018	$109,033,992	$109,033,992	$109,033,992	2018	1	0.962	1.00	$104,840,377	$104,840,377	$104,840,377
2019	$109,570,633	$109,570,633	$109,570,633	2019	2	0.925	1.00	$101,304,210	$101,304,210	$101,304,210
2020	$110,107,275	$110,107,275	$110,107,275	2020	3	0.889	1.00	$97,884,966	$97,884,966	$97,884,966
2021	$110,643,916	$110,643,916	$110,643,916	2021	4	0.855	1.00	$94,578,883	$94,578,883	$94,578,883
2022	$111,180,557	$111,180,557	$111,180,557	2022	5	0.822	1.00	$91,382,314	$91,382,314	$91,382,314
2023	$111,717,199	$111,717,199	$111,717,199	2023	6	0.790	1.00	$88,291,725	$88,291,725	$88,291,725
2024	$112,253,840	$112,253,840	$112,253,840	2024	7	0.760	1.00	$85,303,693	$85,303,693	$85,303,693
2025	$112,790,481	$112,790,481	$112,790,481	2025	8	0.731	1.00	$82,414,900	$82,414,900	$82,414,900
2026	$113,327,122	$111,948,623	$115,212,951	2026	9	0.703	1.00	$79,622,133	$78,653,617	$80,947,091
2027	$113,863,764	$112,319,506	$115,927,649	2027	10	0.676	1.00	$76,922,279	$75,879,033	$78,316,566
2028	$114,400,405	$112,690,388	$116,642,348	2028	11	0.650	1.00	$74,312,322	$73,201,528	$75,768,645
2029	$114,937,046	$113,061,271	$117,357,046	2029	12	0.625	1.00	$71,789,340	$70,617,736	$73,300,865
2030	$115,473,688	$113,432,154	$118,071,744	2030	13	0.601	1.00	$69,350,504	$68,124,412	$70,910,830
2031	$116,010,329	$113,803,037	$118,786,442	2031	14	0.577	1.00	$66,993,074	$65,718,418	$68,596,211
2032	$116,546,970	$114,173,920	$119,501,140	2032	15	0.555	1.00	$64,714,396	$63,396,725	$66,354,741
2033	$117,083,612	$114,544,803	$120,215,839	2033	16	0.534	1.00	$62,511,898	$61,156,407	$64,184,219
2034	$117,620,253	$114,915,685	$120,930,537	2034	17	0.513	1.00	$60,383,091	$58,994,638	$62,082,502
2035	$118,156,894	$115,286,568	$121,645,235	2035	18	0.494	1.00	$58,325,566	$56,908,692	$60,047,509
2036	$118,693,536	$115,657,451	$122,359,933	2036	19	0.475	1.00	$56,336,987	$54,895,933	$58,077,215
2037	$119,230,177	$116,028,334	$123,074,631	2037	20	0.456	1.00	$54,415,096	$52,953,817	$56,169,655
2038	$119,766,818	$116,399,217	$123,789,330	2038	21	0.439	1.00	$52,557,704	$51,079,888	$54,322,917
2039	$119,766,818	$116,399,217	$123,789,330	2039	22	0.422	1.00	$50,536,254	$49,115,277	$52,233,574
2040	$119,766,818	$116,399,217	$123,789,330	2040	23	0.406	1.00	$48,592,552	$47,226,227	$50,224,591
2041	$119,766,818	$116,399,217	$123,789,330	2041	24	0.390	1.00	$46,723,608	$45,409,834	$48,292,876
2042	$119,766,818	$116,399,217	$123,789,330	2042	25	0.375	1.00	$44,926,546	$43,663,302	$46,435,457
2043	$119,766,818	$116,399,217	$123,789,330	2043	26	0.361	1.00	$43,198,602	$41,983,944	$44,649,478
2044	$119,766,818	$116,399,217	$123,789,330	2044	27	0.347	1.00	$41,537,117	$40,369,177	$42,932,191
2045	$119,766,818	$116,399,217	$123,789,330	2045	28	0.333	1.00	$39,939,536	$38,816,516	$41,280,953
2046	$119,766,818	$116,399,217	$123,789,330	2046	29	0.321	1.00	$38,403,400	$37,323,574	$39,693,224
2047	$119,766,818	$116,399,217	$123,789,330	2047	30	0.308	1.00	$36,926,346	$35,888,051	$38,166,561
2048	$119,766,818	$116,399,217	$123,789,330	2048	31	0.296	1.00	$35,506,102	$34,507,742	$36,698,617
2049	$119,766,818	$116,399,217	$123,789,330	2049	32	0.285	1.00	$34,140,482	$33,180,521	$35,287,131
2050	$119,766,818	$116,399,217	$123,789,330	2050	33	0.274	1.00	$32,827,387	$31,904,347	$33,929,934
2051	$119,766,818	$116,399,217	$123,789,330	2051	34	0.264	1.00	$31,564,795	$30,677,257	$32,624,936
2052	$119,766,818	$116,399,217	$123,789,330	2052	35	0.253	1.00	$30,350,765	$29,497,362	$31,370,131
2053	$119,766,818	$116,399,217	$123,789,330	2053	36	0.244	1.00	$29,183,428	$28,362,848	$30,163,588
2054	$119,766,818	$116,399,217	$123,789,330	2054	37	0.234	1.00	$28,060,988	$27,271,970	$29,003,450
2055	$119,766,818	$116,399,217	$123,789,330	2055	38	0.225	1.00	$26,981,719	$26,223,048	$27,887,932
2056	$119,766,818	$116,399,217	$123,789,330	2056	39	0.217	1.00	$25,943,961	$25,214,469	$26,815,320
2057	$119,766,818	$116,399,217	$123,789,330	2057	40	0.208	1.00	$24,946,116	$24,244,682	$25,783,961
2058	$119,766,818	$116,399,217	$123,789,330	2058	41	0.200	1.00	$23,986,650	$23,312,194	$24,792,270
2059	$119,766,818	$116,399,217	$123,789,330	2059	42	0.193	1.00	$23,064,087	$22,415,571	$23,838,722
2060	$119,766,818	$116,399,217	$123,789,330	2060	43	0.185	1.00	$22,177,006	$21,553,434	$22,921,848
2061	$119,766,818	$116,399,217	$123,789,330	2061	44	0.178	1.00	$21,324,045	$20,724,456	$22,040,238
2062	$119,766,818	$116,399,217	$123,789,330	2062	45	0.171	1.00	$20,503,889	$19,927,361	$21,192,537
2063	$119,766,818	$116,399,217	$123,789,330	2063	46	0.165	1.00	$19,715,278	$19,160,924	$20,377,439
2064	$119,766,818	$116,399,217	$123,789,330	2064	47	0.158	1.00	$18,956,998	$18,423,965	$19,593,691
2065	$119,766,818	$116,399,217	$123,789,330	2065	48	0.152	1.00	$18,227,883	$17,715,351	$18,840,088
2066	$119,766,818	$116,399,217	$123,789,330	2066	49	0.146	1.00	$17,526,810	$17,033,992	$18,115,469
2067	$119,766,818	$116,399,217	$123,789,330	2067	50	0.141	1.00	$16,852,702	$16,378,838	$17,418,720
2068	$119,766,818	$116,399,217	$123,789,330	2068	51	0.135	1.00	$16,204,521	$15,748,883	$16,748,770
2069	$119,766,818	$116,399,217	$123,789,330	2069	52	0.130	1.00	$15,581,271	$15,143,157	$16,104,586
2070	$119,766,818	$116,399,217	$123,789,330	2070	53	0.125	1.00	$14,981,991	$14,560,728	$15,485,179
2071	$119,766,818	$116,399,217	$123,789,330	2071	54	0.120	1.00	$14,405,760	$14,000,700	$14,889,595
2072	$119,766,818	$116,399,217	$123,789,330	2072	55	0.116	1.00	$13,851,693	$13,462,211	$14,316,918
2073	$119,766,818	$116,399,217	$123,789,330	2073	56	0.111	1.00	$13,318,935	$12,944,434	$13,766,268
2074	$119,766,818	$116,399,217	$123,789,330	2074	57	0.107	1.00	$12,806,669	$12,446,571	$13,236,796
2075	$119,766,818	$116,399,217	$123,789,330	2075	58	0.103	1.00	$12,314,104	$11,967,857	$12,727,688
2076	$119,766,818	$116,399,217	$123,789,330	2076	59	0.099	1.00	$11,840,485	$11,507,554	$12,238,162
2077	$119,766,818	$116,399,217	$123,789,330	2077	60	0.095	1.00	$11,385,082	$11,064,956	$11,767,463
2078	$119,766,818	$116,399,217	$123,789,330	2078	61	0.091	1.00	$10,947,194	$10,639,381	$11,314,869
2079	$119,766,818	$116,399,217	$123,789,330	2079	62	0.088	1.00	$10,526,148	$10,230,174	$10,879,681
2080	$119,766,818	$116,399,217	$123,789,330	2080	63	0.085	1.00	$10,121,296	$9,836,706	$10,461,232
2081	$119,766,818	$116,399,217	$123,789,330	2081	64	0.081	1.00	$9,732,016	$9,458,371	$10,058,877
2082	$119,766,818	$116,399,217	$123,789,330	2082	65	0.078	1.00	$9,357,707	$9,094,587	$9,671,997
2083	$119,766,818	$116,399,217	$123,789,330	2083	66	0.075	1.00	$8,997,795	$8,744,796	$9,299,997
2084	$119,766,818	$116,399,217	$123,789,330	2084	67	0.072	1.00	$8,651,726	$8,408,457	$8,942,305
2085	$119,766,818	$116,399,217	$123,789,330	2085	68	0.069	1.00	$8,318,968	$8,085,055	$8,598,370
2086	$119,766,818	$116,399,217	$123,789,330	2086	69	0.067	1.00	$7,999,007	$7,774,091	$8,267,664
2087	$119,766,818	$116,399,217	$123,789,330	2087	70	0.064	1.00	$7,691,353	$7,475,088	$7,949,677
2088	$119,766,818	$116,399,217	$123,789,330	2088	71	0.062	1.00	$7,395,532	$7,187,585	$7,643,920
2089	$119,766,818	$116,399,217	$123,789,330	2089	72	0.059	1.00	$7,111,088	$6,911,139	$7,349,923
2090	$119,766,818	$116,399,217	$123,789,330	2090	73	0.057	1.00	$6,837,585	$6,645,326	$7,067,234
2091	$119,766,818	$116,399,217	$123,789,330	2091	74	0.055	1.00	$6,574,601	$6,389,737	$6,795,417
2092	$119,766,818	$116,399,217	$123,789,330	2092	75	0.053	1.00	$6,321,732	$6,143,977	$6,534,055
2093	$119,766,818	$116,399,217	$123,789,330	2093	76	0.051	1.00	$6,078,588	$5,907,671	$6,282,745
2094	$119,766,818	$116,399,217	$123,789,330	2094	77	0.049	1.00	$5,844,796	$5,680,452	$6,041,101
2095	$119,766,818	$116,399,217	$123,789,330	2095	78	0.047	1.00	$5,619,997	$5,461,974	$5,808,751
2096	$119,766,818	$116,399,217	$123,789,330	2096	79	0.045	1.00	$5,403,843	$5,251,898	$5,585,337
2097	$119,766,818	$116,399,217	$123,789,330	2097	80	0.043	1.00	$5,196,003	$5,049,902	$5,370,517
2098	$119,766,818	$116,399,217	$123,789,330	2098	81	0.042	1.00	$4,996,156	$4,855,675	$5,163,958

Discounted TTC & VOC Benefits

	40 Years	
Do Min	$2,147,608,317	
Programme 1	$2,109,598,672	$38,009,645
Programme 2	$2,193,962,191	-$46,353,874

Emissions Discounting and Timestream

40 Years

	Do Minimum	Programme 1	Programme 2v3	Year		SPPWF (4%)	Update Factor	Do Minimum	Programme 1	Programme 2v3
2017	$7,245,718	$7,245,718	$7,245,718	2017	0	1.000	1.15	$8,332,576	$8,332,576	$8,332,576
2018	$7,267,763	$7,267,763	$7,267,763	2018	1	0.962	1.15	$8,036,469	$8,036,469	$8,036,469
2019	$7,289,809	$7,289,809	$7,289,809	2019	2	0.925	1.15	$7,750,814	$7,750,814	$7,750,814
2020	$7,311,854	$7,311,854	$7,311,854	2020	3	0.889	1.15	$7,475,243	$7,475,243	$7,475,243
2021	$7,333,900	$7,333,900	$7,333,900	2021	4	0.855	1.15	$7,209,405	$7,209,405	$7,209,405
2022	$7,355,945	$7,355,945	$7,355,945	2022	5	0.822	1.15	$6,952,958	$6,952,958	$6,952,958
2023	$7,377,990	$7,377,990	$7,377,990	2023	6	0.790	1.15	$6,705,573	$6,705,573	$6,705,573
2024	$7,400,036	$7,400,036	$7,400,036	2024	7	0.760	1.15	$6,466,932	$6,466,932	$6,466,932
2025	$7,422,081	$7,422,081	$7,422,081	2025	8	0.731	1.15	$6,236,728	$6,236,728	$6,236,728
2026	$7,444,127	$7,340,782	$7,341,612	2026	9	0.703	1.15	$6,014,666	$5,931,167	$5,931,837
2027	$7,466,172	$7,351,345	$7,352,267	2027	10	0.676	1.15	$5,800,460	$5,711,251	$5,711,968
2028	$7,488,218	$7,361,908	$7,362,922	2028	11	0.650	1.15	$5,593,834	$5,499,478	$5,500,236
2029	$7,510,263	$7,372,471	$7,373,577	2029	12	0.625	1.15	$5,394,521	$5,295,547	$5,296,342
2030	$7,532,308	$7,383,033	$7,384,232	2030	13	0.601	1.15	$5,202,266	$5,099,167	$5,099,995
2031	$7,554,354	$7,393,596	$7,394,887	2031	14	0.577	1.15	$5,016,819	$4,910,060	$4,910,918
2032	$7,576,399	$7,404,159	$7,405,542	2032	15	0.555	1.15	$4,837,941	$4,727,957	$4,728,840
2033	$7,598,445	$7,414,722	$7,416,197	2033	16	0.534	1.15	$4,665,402	$4,552,598	$4,553,503
2034	$7,620,490	$7,425,284	$7,426,852	2034	17	0.513	1.15	$4,498,979	$4,383,734	$4,384,659
2035	$7,642,536	$7,435,847	$7,437,507	2035	18	0.494	1.15	$4,338,456	$4,221,125	$4,222,067
2036	$7,664,581	$7,446,410	$7,448,162	2036	19	0.475	1.15	$4,183,626	$4,064,539	$4,065,496
2037	$7,686,626	$7,456,972	$7,458,817	2037	20	0.456	1.15	$4,034,287	$3,913,755	$3,914,723
2038	$7,708,672	$7,467,535	$7,469,472	2038	21	0.439	1.15	$3,890,248	$3,768,556	$3,769,534
2039	$7,708,672	$7,467,535	$7,469,472	2039	22	0.422	1.15	$3,740,623	$3,623,612	$3,624,551
2040	$7,708,672	$7,467,535	$7,469,472	2040	23	0.406	1.15	$3,596,753	$3,484,242	$3,485,146
2041	$7,708,672	$7,467,535	$7,469,472	2041	24	0.390	1.15	$3,458,416	$3,350,233	$3,351,102
2042	$7,708,672	$7,467,535	$7,469,472	2042	25	0.375	1.15	$3,325,400	$3,221,378	$3,222,213
2043	$7,708,672	$7,467,535	$7,469,472	2043	26	0.361	1.15	$3,197,500	$3,097,478	$3,098,282
2044	$7,708,672	$7,467,535	$7,469,472	2044	27	0.347	1.15	$3,074,519	$2,978,345	$2,979,117
2045	$7,708,672	$7,467,535	$7,469,472	2045	28	0.333	1.15	$2,956,269	$2,863,793	$2,864,536
2046	$7,708,672	$7,467,535	$7,469,472	2046	29	0.321	1.15	$2,842,566	$2,753,647	$2,754,361
2047	$7,708,672	$7,467,535	$7,469,472	2047	30	0.308	1.15	$2,733,237	$2,647,738	$2,648,424
2048	$7,708,672	$7,467,535	$7,469,472	2048	31	0.296	1.15	$2,628,112	$2,545,902	$2,546,562
2049	$7,708,672	$7,467,535	$7,469,472	2049	32	0.285	1.15	$2,527,031	$2,447,982	$2,448,617
2050	$7,708,672	$7,467,535	$7,469,472	2050	33	0.274	1.15	$2,429,837	$2,353,829	$2,354,440
2051	$7,708,672	$7,467,535	$7,469,472	2051	34	0.264	1.15	$2,336,382	$2,263,297	$2,263,884
2052	$7,708,672	$7,467,535	$7,469,472	2052	35	0.253	1.15	$2,246,521	$2,176,247	$2,176,812
2053	$7,708,672	$7,467,535	$7,469,472	2053	36	0.244	1.15	$2,160,117	$2,092,545	$2,093,088
2054	$7,708,672	$7,467,535	$7,469,472	2054	37	0.234	1.15	$2,077,035	$2,012,063	$2,012,585
2055	$7,708,672	$7,467,535	$7,469,472	2055	38	0.225	1.15	$1,997,149	$1,934,676	$1,935,178
2056	$7,708,672	$7,467,535	$7,469,472	2056	39	0.217	1.15	$1,920,336	$1,860,265	$1,860,748
2057	$7,708,672	$7,467,535	$7,469,472	2057	40	0.208	1.15	$1,846,477	$1,788,717	$1,789,181
2058	$7,708,672	$7,467,535	$7,469,472	2058	41	0.200	1.15	$1,775,458	$1,719,920	$1,720,366
2059	$7,708,672	$7,467,535	$7,469,472	2059	42	0.193	1.15	$1,707,171	$1,653,769	$1,654,198
2060	$7,708,672	$7,467,535	$7,469,472	2060	43	0.185	1.15	$1,641,511	$1,590,163	$1,590,575
2061	$7,708,672	$7,467,535	$7,469,472	2061	44	0.178	1.15	$1,578,376	$1,529,002	$1,529,399
2062	$7,708,672	$7,467,535	$7,469,472	2062	45	0.171	1.15	$1,517,669	$1,470,195	$1,470,576
2063	$7,708,672	$7,467,535	$7,469,472	2063	46	0.165	1.15	$1,459,297	$1,413,649	$1,414,015
2064	$7,708,672	$7,467,535	$7,469,472	2064	47	0.158	1.15	$1,403,171	$1,359,278	$1,359,630
2065	$7,708,672	$7,467,535	$7,469,472	2065	48	0.152	1.15	$1,349,202	$1,306,998	$1,307,337
2066	$7,708,672	$7,467,535	$7,469,472	2066	49	0.146	1.15	$1,297,310	$1,256,729	$1,257,055
2067	$7,708,672	$7,467,535	$7,469,472	2067	50	0.141	1.15	$1,247,413	$1,208,393	$1,208,706
2068	$7,708,672	$7,467,535	$7,469,472	2068	51	0.135	1.15	$1,199,436	$1,161,916	$1,162,218
2069	$7,708,672	$7,467,535	$7,469,472	2069	52	0.130	1.15	$1,153,304	$1,117,227	$1,117,517
2070	$7,708,672	$7,467,535	$7,469,472	2070	53	0.125	1.15	$1,108,946	$1,074,257	$1,074,535
2071	$7,708,672	$7,467,535	$7,469,472	2071	54	0.120	1.15	$1,066,294	$1,032,939	$1,033,207
2072	$7,708,672	$7,467,535	$7,469,472	2072	55	0.116	1.15	$1,025,283	$993,211	$993,468
2073	$7,708,672	$7,467,535	$7,469,472	2073	56	0.111	1.15	$985,849	$955,010	$955,258
2074	$7,708,672	$7,467,535	$7,469,472	2074	57	0.107	1.15	$947,932	$918,279	$918,517
2075	$7,708,672	$7,467,535	$7,469,472	2075	58	0.103	1.15	$911,473	$882,961	$883,190
2076	$7,708,672	$7,467,535	$7,469,472	2076	59	0.099	1.15	$876,416	$849,001	$849,221
2077	$7,708,672	$7,467,535	$7,469,472	2077	60	0.095	1.15	$842,708	$816,347	$816,559
2078	$7,708,672	$7,467,535	$7,469,472	2078	61	0.091	1.15	$810,296	$784,949	$785,153
2079	$7,708,672	$7,467,535	$7,469,472	2079	62	0.088	1.15	$779,131	$754,759	$754,954
2080	$7,708,672	$7,467,535	$7,469,472	2080	63	0.085	1.15	$749,164	$725,729	$725,918
2081	$7,708,672	$7,467,535	$7,469,472	2081	64	0.081	1.15	$720,350	$697,817	$697,998
2082	$7,708,672	$7,467,535	$7,469,472	2082	65	0.078	1.15	$692,644	$670,978	$671,152
2083	$7,708,672	$7,467,535	$7,469,472	2083	66	0.075	1.15	$666,004	$645,171	$645,338
2084	$7,708,672	$7,467,535	$7,469,472	2084	67	0.072	1.15	$640,389	$620,357	$620,517
2085	$7,708,672	$7,467,535	$7,469,472	2085	68	0.069	1.15	$615,758	$596,497	$596,651
2086	$7,708,672	$7,467,535	$7,469,472	2086	69	0.067	1.15	$592,075	$573,555	$573,703
2087	$7,708,672	$7,467,535	$7,469,472	2087	70	0.064	1.15	$569,303	$551,495	$551,638
2088	$7,708,672	$7,467,535	$7,469,472	2088	71	0.062	1.15	$547,407	$530,283	$530,421
2089	$7,708,672	$7,467,535	$7,469,472	2089	72	0.059	1.15	$526,353	$509,888	$510,020
2090	$7,708,672	$7,467,535	$7,469,472	2090	73	0.057	1.15	$506,108	$490,277	$490,404
2091	$7,708,672	$7,467,535	$7,469,472	2091	74	0.055	1.15	$486,643	$471,420	$471,542
2092	$7,708,672	$7,467,535	$7,469,472	2092	75	0.053	1.15	$467,926	$453,288	$453,406
2093	$7,708,672	$7,467,535	$7,469,472	2093	76	0.051	1.15	$449,929	$435,854	$435,967
2094	$7,708,672	$7,467,535	$7,469,472	2094	77	0.049	1.15	$432,624	$419,091	$419,199
2095	$7,708,672	$7,467,535	$7,469,472	2095	78	0.047	1.15	$415,984	$402,972	$403,076
2096	$7,708,672	$7,467,535	$7,469,472	2096	79	0.045	1.15	$399,985	$387,473	$387,573
2097	$7,708,672	$7,467,535	$7,469,472	2097	80	0.043	1.15	$384,601	$372,570	$372,667
2098	$7,708,672	$7,467,535	$7,469,472	2098	81	0.042	1.15	$369,809	$358,240	$358,333

	Do Min	Programme 1	Programme 2v3
Emissions 2017	$7,245,718	$7,245,718	$7,245,718
Emissions 2038	$7,708,672	$7,467,535	$7,469,472

Discounted Emissions Benefit

	40 Years	
Do Min	$159,095,255	
Programme 1	$155,995,451	$3,099,805
Programme 2v3	$156,020,346	$3,074,909

Safety Discounting and Timestream

40 Years

	Do Minimum	Programme 1	Programme 2v3	Year		SPPWF (4%)	Update Factor	Do Minimum	Programme 1	Programme 2v3
2017	$7,794,062	$7,794,062	$7,794,062	2017	0	1.000	1.14	$8,885,230	$8,885,230	$8,885,230
2018	$7,794,062	$7,794,062	$7,794,062	2018	1	0.962	1.14	$8,543,491	$8,543,491	$8,543,491
2019	$7,794,062	$7,794,062	$7,794,062	2019	2	0.925	1.14	$8,214,895	$8,214,895	$8,214,895
2020	$7,794,062	$7,794,062	$7,794,062	2020	3	0.889	1.14	$7,898,938	$7,898,938	$7,898,938
2021	$7,794,062	$7,794,062	$7,794,062	2021	4	0.855	1.14	$7,595,132	$7,595,132	$7,595,132
2022	$7,794,062	$7,794,062	$7,794,062	2022	5	0.822	1.14	$7,303,012	$7,303,012	$7,303,012
2023	$7,794,062	$7,794,062	$7,794,062	2023	6	0.790	1.14	$7,022,127	$7,022,127	$7,022,127
2024	$7,794,062	$7,794,062	$7,794,062	2024	7	0.760	1.14	$6,752,045	$6,752,045	$6,752,045
2025	$7,794,062	$7,794,062	$7,794,062	2025	8	0.731	1.14	$6,492,351	$6,492,351	$6,492,351
2026	$7,794,062	$1,598,142	$2,638,874	2026	9	0.703	1.14	$6,242,645	$1,280,030	$2,113,603
2027	$7,794,062	$1,598,142	$2,638,874	2027	10	0.676	1.14	$6,002,543	$1,230,798	$2,032,311
2028	$7,794,062	$1,598,142	$2,638,874	2028	11	0.650	1.14	$5,771,676	$1,183,460	$1,954,145
2029	$7,794,062	$1,598,142	$2,638,874	2029	12	0.625	1.14	$5,549,689	$1,137,942	$1,878,986
2030	$7,794,062	$1,598,142	$2,638,874	2030	13	0.601	1.14	$5,336,239	$1,094,175	$1,806,717
2031	$7,794,062	$1,598,142	$2,638,874	2031	14	0.577	1.14	$5,130,999	$1,052,092	$1,737,228
2032	$7,794,062	$1,598,142	$2,638,874	2032	15	0.555	1.14	$4,933,653	$1,011,626	$1,670,411
2033	$7,794,062	$1,598,142	$2,638,874	2033	16	0.534	1.14	$4,743,897	$972,718	$1,606,165
2034	$7,794,062	$1,598,142	$2,638,874	2034	17	0.513	1.14	$4,561,440	$935,306	$1,544,389
2035	$7,794,062	$1,598,142	$2,638,874	2035	18	0.494	1.14	$4,386,000	$899,332	$1,484,990
2036	$7,794,062	$1,598,142	$2,638,874	2036	19	0.475	1.14	$4,217,307	$864,743	$1,427,875
2037	$7,794,062	$1,598,142	$2,638,874	2037	20	0.456	1.14	$4,055,103	$831,483	$1,372,956
2038	$7,794,062	$1,598,142	$2,638,874	2038	21	0.439	1.14	$3,899,138	$799,503	$1,320,150
2039	$7,794,062	$1,598,142	$2,638,874	2039	22	0.422	1.14	$3,749,171	$768,753	$1,269,375
2040	$7,794,062	$1,598,142	$2,638,874	2040	23	0.406	1.14	$3,604,972	$739,186	$1,220,553
2041	$7,794,062	$1,598,142	$2,638,874	2041	24	0.390	1.14	$3,466,319	$710,755	$1,173,609
2042	$7,794,062	$1,598,142	$2,638,874	2042	25	0.375	1.14	$3,332,999	$683,419	$1,128,470
2043	$7,794,062	$1,598,142	$2,638,874	2043	26	0.361	1.14	$3,204,807	$657,133	$1,085,067
2044	$7,794,062	$1,598,142	$2,638,874	2044	27	0.347	1.14	$3,081,545	$631,859	$1,043,334
2045	$7,794,062	$1,598,142	$2,638,874	2045	28	0.333	1.14	$2,963,024	$607,557	$1,003,206
2046	$7,794,062	$1,598,142	$2,638,874	2046	29	0.321	1.14	$2,849,062	$584,189	$964,621
2047	$7,794,062	$1,598,142	$2,638,874	2047	30	0.308	1.14	$2,739,482	$561,720	$927,520
2048	$7,794,062	$1,598,142	$2,638,874	2048	31	0.296	1.14	$2,634,118	$540,116	$891,846
2049	$7,794,062	$1,598,142	$2,638,874	2049	32	0.285	1.14	$2,532,805	$519,342	$857,545
2050	$7,794,062	$1,598,142	$2,638,874	2050	33	0.274	1.14	$2,435,390	$499,367	$824,562
2051	$7,794,062	$1,598,142	$2,638,874	2051	34	0.264	1.14	$2,341,721	$480,161	$792,848
2052	$7,794,062	$1,598,142	$2,638,874	2052	35	0.253	1.14	$2,251,655	$461,693	$762,354
2053	$7,794,062	$1,598,142	$2,638,874	2053	36	0.244	1.14	$2,165,053	$443,936	$733,033
2054	$7,794,062	$1,598,142	$2,638,874	2054	37	0.234	1.14	$2,081,781	$426,861	$704,839
2055	$7,794,062	$1,598,142	$2,638,874	2055	38	0.225	1.14	$2,001,713	$410,443	$677,730
2056	$7,794,062	$1,598,142	$2,638,874	2056	39	0.217	1.14	$1,924,724	$394,657	$651,663
2057	$7,794,062	$1,598,142	$2,638,874	2057	40	0.208	1.14	$1,850,696	$379,478	$626,599
2058	$7,794,062	$1,598,142	$2,638,874	2058	41	0.200	1.14	$1,779,516	$364,883	$602,499
2059	$7,794,062	$1,598,142	$2,638,874	2059	42	0.193	1.14	$1,711,073	$350,849	$579,326
2060	$7,794,062	$1,598,142	$2,638,874	2060	43	0.185	1.14	$1,645,262	$337,355	$557,045
2061	$7,794,062	$1,598,142	$2,638,874	2061	44	0.178	1.14	$1,581,983	$324,379	$535,620
2062	$7,794,062	$1,598,142	$2,638,874	2062	45	0.171	1.14	$1,521,137	$311,903	$515,019
2063	$7,794,062	$1,598,142	$2,638,874	2063	46	0.165	1.14	$1,462,632	$299,907	$495,211
2064	$7,794,062	$1,598,142	$2,638,874	2064	47	0.158	1.14	$1,406,377	$288,372	$476,164
2065	$7,794,062	$1,598,142	$2,638,874	2065	48	0.152	1.14	$1,352,286	$277,281	$457,850
2066	$7,794,062	$1,598,142	$2,638,874	2066	49	0.146	1.14	$1,300,275	$266,616	$440,240
2067	$7,794,062	$1,598,142	$2,638,874	2067	50	0.141	1.14	$1,250,264	$256,362	$423,308
2068	$7,794,062	$1,598,142	$2,638,874	2068	51	0.135	1.14	$1,202,177	$246,502	$407,027
2069	$7,794,062	$1,598,142	$2,638,874	2069	52	0.130	1.14	$1,155,939	$237,021	$391,372
2070	$7,794,062	$1,598,142	$2,638,874	2070	53	0.125	1.14	$1,111,480	$227,905	$376,319
2071	$7,794,062	$1,598,142	$2,638,874	2071	54	0.120	1.14	$1,068,731	$219,139	$361,846
2072	$7,794,062	$1,598,142	$2,638,874	2072	55	0.116	1.14	$1,027,626	$210,711	$347,928
2073	$7,794,062	$1,598,142	$2,638,874	2073	56	0.111	1.14	$988,102	$202,606	$334,547
2074	$7,794,062	$1,598,142	$2,638,874	2074	57	0.107	1.14	$950,098	$194,814	$321,679
2075	$7,794,062	$1,598,142	$2,638,874	2075	58	0.103	1.14	$913,556	$187,321	$309,307
2076	$7,794,062	$1,598,142	$2,638,874	2076	59	0.099	1.14	$878,419	$180,116	$297,411
2077	$7,794,062	$1,598,142	$2,638,874	2077	60	0.095	1.14	$844,634	$173,189	$285,972
2078	$7,794,062	$1,598,142	$2,638,874	2078	61	0.091	1.14	$812,148	$166,528	$274,973
2079	$7,794,062	$1,598,142	$2,638,874	2079	62	0.088	1.14	$780,911	$160,123	$264,397
2080	$7,794,062	$1,598,142	$2,638,874	2080	63	0.085	1.14	$750,876	$153,964	$254,228
2081	$7,794,062	$1,598,142	$2,638,874	2081	64	0.081	1.14	$721,996	$148,043	$244,450
2082	$7,794,062	$1,598,142	$2,638,874	2082	65	0.078	1.14	$694,227	$142,349	$235,048
2083	$7,794,062	$1,598,142	$2,638,874	2083	66	0.075	1.14	$667,526	$136,874	$226,008
2084	$7,794,062	$1,598,142	$2,638,874	2084	67	0.072	1.14	$641,852	$131,609	$217,315
2085	$7,794,062	$1,598,142	$2,638,874	2085	68	0.069	1.14	$617,165	$126,547	$208,957
2086	$7,794,062	$1,598,142	$2,638,874	2086	69	0.067	1.14	$593,428	$121,680	$200,920
2087	$7,794,062	$1,598,142	$2,638,874	2087	70	0.064	1.14	$570,604	$117,000	$193,192
2088	$7,794,062	$1,598,142	$2,638,874	2088	71	0.062	1.14	$548,658	$112,500	$185,762
2089	$7,794,062	$1,598,142	$2,638,874	2089	72	0.059	1.14	$527,556	$108,173	$178,617
2090	$7,794,062	$1,598,142	$2,638,874	2090	73	0.057	1.14	$507,265	$104,013	$171,747
2091	$7,794,062	$1,598,142	$2,638,874	2091	74	0.055	1.14	$487,755	$100,012	$165,142
2092	$7,794,062	$1,598,142	$2,638,874	2092	75	0.053	1.14	$468,995	$96,166	$158,790
2093	$7,794,062	$1,598,142	$2,638,874	2093	76	0.051	1.14	$450,957	$92,467	$152,683
2094	$7,794,062	$1,598,142	$2,638,874	2094	77	0.049	1.14	$433,612	$88,911	$146,810
2095	$7,794,062	$1,598,142	$2,638,874	2095	78	0.047	1.14	$416,935	$85,491	$141,164
2096	$7,794,062	$1,598,142	$2,638,874	2096	79	0.045	1.14	$400,899	$82,203	$135,734
2097	$7,794,062	$1,598,142	$2,638,874	2097	80	0.043	1.14	$385,480	$79,041	$130,514
2098	$7,794,062	$1,598,142	$2,638,874	2098	81	0.042	1.14	$370,654	$76,001	$125,494

	Do Min	Programme 1	Programme 2v3
Crash Benefit	$7,794,062	$1,598,142	$2,638,874

Discounted Crash Benefit

	40 Years	
Do Min	$162,595,560	
Programme 1	$67,573,168	$95,022,391
Programme 2v3	$83,534,132	$79,061,427

Cyclist and Pedestrian Benefits Discounting and Timestream

40 Years

	Do Minimum	Programme 1	Programme 2v3	Year		SPPWF (4%)	Update Factor	Do Minimum	Programme 1	Programme 2v3
2017	$5,733,477	$5,733,477	$5,733,477	2017	0	1.000	1.04	$5,962,816	$5,962,816	$5,962,816
2018	$5,733,477	$5,733,477	$5,733,477	2018	1	0.962	1.04	$5,733,477	$5,733,477	$5,733,477
2019	$5,733,477	$5,733,477	$5,733,477	2019	2	0.925	1.04	$5,512,958	$5,512,958	$5,512,958
2020	$5,733,477	$5,733,477	$5,733,477	2020	3	0.889	1.04	$5,300,922	$5,300,922	$5,300,922
2021	$5,733,477	$5,733,477	$5,733,477	2021	4	0.855	1.04	$5,097,040	$5,097,040	$5,097,040
2022	$5,733,477	$5,733,477	$5,733,477	2022	5	0.822	1.04	$4,901,000	$4,901,000	$4,901,000
2023	$5,733,477	$5,733,477	$5,733,477	2023	6	0.790	1.04	$4,712,500	$4,712,500	$4,712,500
2024	$5,733,477	$5,733,477	$5,733,477	2024	7	0.760	1.04	$4,531,250	$4,531,250	$4,531,250
2025	$5,733,477	$5,733,477	$5,733,477	2025	8	0.731	1.04	$4,356,971	$4,356,971	$4,356,971
2026	$5,733,477	$513,863	$698,553	2026	9	0.703	1.04	$4,189,395	$375,475	$510,426
2027	$5,733,477	$513,863	$698,553	2027	10	0.676	1.04	$4,028,265	$361,034	$490,794
2028	$5,733,477	$513,863	$698,553	2028	11	0.650	1.04	$3,873,331	$347,148	$471,918
2029	$5,733,477	$513,863	$698,553	2029	12	0.625	1.04	$3,724,357	$333,796	$453,767
2030	$5,733,477	$513,863	$698,553	2030	13	0.601	1.04	$3,581,113	$320,957	$436,314
2031	$5,733,477	$513,863	$698,553	2031	14	0.577	1.04	$3,443,378	$308,613	$419,533
2032	$5,733,477	$513,863	$698,553	2032	15	0.555	1.04	$3,310,940	$296,743	$403,397
2033	$5,733,477	$513,863	$698,553	2033	16	0.534	1.04	$3,183,596	$285,330	$387,882
2034	$5,733,477	$513,863	$698,553	2034	17	0.513	1.04	$3,061,150	$274,356	$372,963
2035	$5,733,477	$513,863	$698,553	2035	18	0.494	1.04	$2,943,414	$263,804	$358,619
2036	$5,733,477	$513,863	$698,553	2036	19	0.475	1.04	$2,830,205	$253,657	$344,826
2037	$5,733,477	$513,863	$698,553	2037	20	0.456	1.04	$2,721,351	$243,901	$331,563
2038	$5,733,477	$513,863	$698,553	2038	21	0.439	1.04	$2,616,684	$234,520	$318,811
2039	$5,733,477	$513,863	$698,553	2039	22	0.422	1.04	$2,516,042	$225,500	$306,549
2040	$5,733,477	$513,863	$698,553	2040	23	0.406	1.04	$2,419,271	$216,827	$294,758
2041	$5,733,477	$513,863	$698,553	2041	24	0.390	1.04	$2,326,222	$208,488	$283,421
2042	$5,733,477	$513,863	$698,553	2042	25	0.375	1.04	$2,236,752	$200,469	$272,521
2043	$5,733,477	$513,863	$698,553	2043	26	0.361	1.04	$2,150,723	$192,759	$262,039
2044	$5,733,477	$513,863	$698,553	2044	27	0.347	1.04	$2,068,003	$185,345	$251,961
2045	$5,733,477	$513,863	$698,553	2045	28	0.333	1.04	$1,988,465	$178,216	$242,270
2046	$5,733,477	$513,863	$698,553	2046	29	0.321	1.04	$1,911,985	$171,362	$232,952
2047	$5,733,477	$513,863	$698,553	2047	30	0.308	1.04	$1,838,447	$164,771	$223,992
2048	$5,733,477	$513,863	$698,553	2048	31	0.296	1.04	$1,767,738	$158,434	$215,377
2049	$5,733,477	$513,863	$698,553	2049	32	0.285	1.04	$1,699,748	$152,340	$207,093
2050	$5,733,477	$513,863	$698,553	2050	33	0.274	1.04	$1,634,373	$146,481	$199,128
2051	$5,733,477	$513,863	$698,553	2051	34	0.264	1.04	$1,571,513	$140,847	$191,469
2052	$5,733,477	$513,863	$698,553	2052	35	0.253	1.04	$1,511,070	$135,430	$184,105
2053	$5,733,477	$513,863	$698,553	2053	36	0.244	1.04	$1,452,952	$130,221	$177,024
2054	$5,733,477	$513,863	$698,553	2054	37	0.234	1.04	$1,397,069	$125,212	$170,216
2055	$5,733,477	$513,863	$698,553	2055	38	0.225	1.04	$1,343,336	$120,397	$163,669
2056	$5,733,477	$513,863	$698,553	2056	39	0.217	1.04	$1,291,669	$115,766	$157,374
2057	$5,733,477	$513,863	$698,553	2057	40	0.208	1.04	$1,241,989	$111,313	$151,321
2058	$5,733,477	$513,863	$698,553	2058	41	0.200	1.04	$1,194,220	$107,032	$145,501
2059	$5,733,477	$513,863	$698,553	2059	42	0.193	1.04	$1,148,289	$102,915	$139,905
2060	$5,733,477	$513,863	$698,553	2060	43	0.185	1.04	$1,104,124	$98,957	$134,524
2061	$5,733,477	$513,863	$698,553	2061	44	0.178	1.04	$1,061,658	$95,151	$129,350
2062	$5,733,477	$513,863	$698,553	2062	45	0.171	1.04	$1,020,825	$91,491	$124,375
2063	$5,733,477	$513,863	$698,553	2063	46	0.165	1.04	$981,562	$87,973	$119,591
2064	$5,733,477	$513,863	$698,553	2064	47	0.158	1.04	$943,810	$84,589	$114,992
2065	$5,733,477	$513,863	$698,553	2065	48	0.152	1.04	$907,509	$81,336	$110,569
2066	$5,733,477	$513,863	$698,553	2066	49	0.146	1.04	$872,605	$78,207	$106,316
2067	$5,733,477	$513,863	$698,553	2067	50	0.141	1.04	$839,043	$75,199	$102,227
2068	$5,733,477	$513,863	$698,553	2068	51	0.135	1.04	$806,773	$72,307	$98,295
2069	$5,733,477	$513,863	$698,553	2069	52	0.130	1.04	$775,743	$69,526	$94,515
2070	$5,733,477	$513,863	$698,553	2070	53	0.125	1.04	$745,907	$66,852	$90,879
2071	$5,733,477	$513,863	$698,553	2071	54	0.120	1.04	$717,218	$64,281	$87,384
2072	$5,733,477	$513,863	$698,553	2072	55	0.116	1.04	$689,633	$61,808	$84,023
2073	$5,733,477	$513,863	$698,553	2073	56	0.111	1.04	$663,108	$59,431	$80,792
2074	$5,733,477	$513,863	$698,553	2074	57	0.107	1.04	$637,604	$57,145	$77,684
2075	$5,733,477	$513,863	$698,553	2075	58	0.103	1.04	$613,081	$54,947	$74,696
2076	$5,733,477	$513,863	$698,553	2076	59	0.099	1.04	$589,501	$52,834	$71,823
2077	$5,733,477	$513,863	$698,553	2077	60	0.095	1.04	$566,828	$50,802	$69,061
2078	$5,733,477	$513,863	$698,553	2078	61	0.091	1.04	$545,027	$48,848	$66,405
2079	$5,733,477	$513,863	$698,553	2079	62	0.088	1.04	$524,064	$46,969	$63,851
2080	$5,733,477	$513,863	$698,553	2080	63	0.085	1.04	$503,908	$45,163	$61,395
2081	$5,733,477	$513,863	$698,553	2081	64	0.081	1.04	$484,527	$43,426	$59,034
2082	$5,733,477	$513,863	$698,553	2082	65	0.078	1.04	$465,891	$41,756	$56,763
2083	$5,733,477	$513,863	$698,553	2083	66	0.075	1.04	$447,972	$40,150	$54,580
2084	$5,733,477	$513,863	$698,553	2084	67	0.072	1.04	$430,742	$38,605	$52,481
2085	$5,733,477	$513,863	$698,553	2085	68	0.069	1.04	$414,175	$37,121	$50,462
2086	$5,733,477	$513,863	$698,553	2086	69	0.067	1.04	$398,246	$35,693	$48,521
2087	$5,733,477	$513,863	$698,553	2087	70	0.064	1.04	$382,928	$34,320	$46,655
2088	$5,733,477	$513,863	$698,553	2088	71	0.062	1.04	$368,200	$33,000	$44,861
2089	$5,733,477	$513,863	$698,553	2089	72	0.059	1.04	$354,039	$31,731	$43,135
2090	$5,733,477	$513,863	$698,553	2090	73	0.057	1.04	$340,422	$30,510	$41,476
2091	$5,733,477	$513,863	$698,553	2091	74	0.055	1.04	$327,329	$29,337	$39,881
2092	$5,733,477	$513,863	$698,553	2092	75	0.053	1.04	$314,739	$28,209	$38,347
2093	$5,733,477	$513,863	$698,553	2093	76	0.051	1.04	$302,634	$27,124	$36,872
2094	$5,733,477	$513,863	$698,553	2094	77	0.049	1.04	$290,994	$26,080	$35,454
2095	$5,733,477	$513,863	$698,553	2095	78	0.047	1.04	$279,802	$25,077	$34,090
2096	$5,733,477	$513,863	$698,553	2096	79	0.045	1.04	$269,040	$24,113	$32,779
2097	$5,733,477	$513,863	$698,553	2097	80	0.043	1.04	$258,693	$23,185	$31,519
2098	$5,733,477	$513,863	$698,553	2098	81	0.042	1.04	$248,743	$22,294	$30,306

	Do Min	Programme 1	Programme 2v3
Cyclist & Pedestrian Benefits	$5,733,477	$513,863	$698,553

Discounted Cyclist & Pedestrian Benefits

	40 Years	
Do Min	$109,116,739	
Programme 1	$36,089,142	$73,027,597
Programme 2v3	$38,673,139	$70,443,600

Wider Economic Benefits Discounting and Timestream

40 Years

	Do Minimum	Programme 1	Programme 2v3	Year		SPPWF (4%)	Update Factor	Do Minimum	Programme 1	Programme 2v3
2017	$0	$0	$0	2017	0	1.000	1.00	$0	$0	$0
2018	$0	$0	$0	2018	1	0.962	1.00	$0	$0	$0
2019	$0	$0	$0	2019	2	0.925	1.00	$0	$0	$0
2020	$0	$0	$0	2020	3	0.889	1.00	$0	$0	$0
2021	$0	$127,900,000	$249,900,000	2021	4	0.855	1.00	$0	$109,329,456	$213,615,567
2022	$0	$0	$0	2022	5	0.822	1.00	$0	$0	$0
2023	$0	$0	$0	2023	6	0.790	1.00	$0	$0	$0
2024	$0	$0	$0	2024	7	0.760	1.00	$0	$0	$0
2025	$0	$0	$0	2025	8	0.731	1.00	$0	$0	$0
2026	$0	$0	$0	2026	9	0.703	1.00	$0	$0	$0
2027	$0	$0	$0	2027	10	0.676	1.00	$0	$0	$0
2028	$0	$0	$0	2028	11	0.650	1.00	$0	$0	$0
2029	$0	$0	$0	2029	12	0.625	1.00	$0	$0	$0
2030	$0	$0	$0	2030	13	0.601	1.00	$0	$0	$0
2031	$0	$0	$0	2031	14	0.577	1.00	$0	$0	$0
2032	$0	$0	$0	2032	15	0.555	1.00	$0	$0	$0
2033	$0	$0	$0	2033	16	0.534	1.00	$0	$0	$0
2034	$0	$0	$0	2034	17	0.513	1.00	$0	$0	$0

Wider Economic Benefits

Programme	Shaping Future Dunedin Transport	Programme 1	Programme 2v3
Benefit	Application	Undiscounted Value	Undiscounted Value
VURT	Whole Corridor	$16,000,000	$19,900,000
Improved Wellbeing Benefits (Total)	Whole Corridor	$111,900,000	$230,000,000
Total WEBS	**All**	**$127,900,000**	**$249,900,000**

Assumptions:

VURT Benefits provided by Boffa Miskell Ltd based on the Valuing Urban Realm Toolkit (VURT) methodology. Figures taken from report dated 27 May 2020.

Improved Wellbeing benefits were calculated by NZIER, with the Total benefits used (minimum 95% confidence interval) for each Programme. Figures taken from report dated 15 June 2020.

Improved Wellbeing benefits also included the Similarities as well as the calculated Programme 1 and Programme 2v3 benefits

The annual benefit is not additive as per the notes from the NZIER report.

Discounted Crash Benefit

	40 Years	
Do Min	$0	
Programme 1	$109,329,456	-$109,329,456
Programme 2v3	$213,615,567	-$213,615,567

Cost Estimates

		Construction	Property / Design	Total
Year Cost is Incurred		2023	2022	-
SPPWF		0.70496054	0.747258173	-
Programme 1 With OPEX	Base Cost	$103,237,990	$20,647,598	$123,885,588
	Discounted Cost	$72,778,709	$15,429,086	$88,207,796
Programme 2v3 With OPEX	Base Cost	$127,037,990	$25,407,598	$152,445,588
	Discounted Cost	$89,556,770	$18,986,035	$108,542,805

INPUT
$103,237,990
$127,037,990

Short List Costs
1000000

	With OPEX
Programme 1	105
Programme 2 (V2)	130

Property/Design 20%

Crash Costs See READ ME right of sheet.

-READ ME-
This Crash Cost analysis follows the methodology laid out in the Waka Kotahi Monetised Benefits and Costs Manual (MBCM). The methodology was applied to the entire corridor to estimate the impact of the corridor wide improvements for each scenario.
A crash by crash analysis has been applied for the option crash cost analysis to incorporate the varying impacts on the proposed improvements for each scenario.

			Op Maximum Mean Speed (km/h)	Number of Years of typical crash rate records	Number of reported crashes over period				Fatal/serious severity ratio (table A6.4 (b)) tot(s)		Number of reported crashes adjusted by severity (4) x (5)				Crashes per year = (6)/(3)				Adjustment fac
			(1)	(3)	(4)				(5)		(6)				(7)				(8)
	Section	Length			Fatal	Serious	Minor	Non-injury	Fatal	Serious	Fatal	Serious	Minor	Non-injury	Fatal	Serious	Minor	Non-injury	1% Growth
	SH1 Northbound	4000	40	5	0	9	52	99	0.07	0.93	0.63	8.37	52	99	0.13	1.67	10.40	19.80	0.86
	SH1 Southbound	4100	40	5	0	9	44	128	0.07	0.93	0.63	8.37	44	128	0.13	1.67	8.80	25.60	0.86
	Harbour Arterial	2600	40	5	0	6	14	39	0.07	0.93	0.42	5.58	14	39	0.08	1.12	2.80	7.80	0.86
				5	0	24	110	266											
	Pedestrian and Cyclist Crashes																		
	SH1 Northbound	4000	40	5	1	3	6	3	0.08	0.092	0.32	0.368	6	3	0.06	0.07	1.20	0.60	0.93
	SH1 Southbound	4100	40	5		4	8	0	0.08	0.092	0.32	0.368	8	0	0.06	0.07	1.60	0.00	0.93
					1	7	14	3											

Cost per Crash - All Movements, All Vehicles

km/h	Fatal	Serious	Minor	No Injury
50	$ 4,600,000	$ 475,000	$ 28,000	$ 2,800
100	$ 4,850,000	$ 525,000	$ 30,000	$ 3,200

Cost per Crash - Pedestrians, All Vehicles

km/h	Fatal	Serious	Minor	No Injury
50	$ 4,100,000	$ 440,000	$ 25,000	$ 1,600
100	$ 4,250,000	$ 435,000	$ 24,000	$ 3,700

Fatal/Serious Severity Ratio - All Movements

km/h	Fatal	Serious
100	0.2	0.8
70	0.14	0.86
50	0.07	0.93

Fatal/Serious Severity Ratio - Pedestrians

km/h	Fatal	Serious
50	0.08	0.092

Traffic Growth Rates

km/h	0%	1%	2%	3%	4%	5%	6%	7%
0	0.83	0.86	0.9	0.93	0.96	0.99	1.03	1.06
70	0.95	0.98	1.02	1.06	1.1	1.14	1.17	1.21

Crash Trend Adjustment Formula given A(adjusted) = A x (1+f(y-2006)) where: f = -0.01 and y = 2020

y	f	A(adjusted)
2020	-0.01	0

Under-reporting Factors

km/h	Fatal	Serious	Minor	Non Injury
50	1	1.5	2.75	7
50 Pedestrian	1	1.5	4.5	7

Selected interventions	CMF	CRF	From the Crash Estimation Compendium
Solid Medians	0.55	45%	
Traffic Calming	0.8	20%	
Barnes dance pedestrian phases	0.45	55%	
Flush Median	0.85	15%	
Remove Parking (both sides)	0.8	20%	
Harbour Arterial Improvements (Int etc	0.7	30%	

...ors for crash trend (Table A6.1(a))	Adjusted crashes per year = (7) x (8)				Under-reporting factors (tables A6.2(a) to (d))				Total estimated crashes per year = (9) x (10)				Mean-spread adjustment = ((5) - 50)/50	Cost per crash = (13) + (14) x ((12) - (13))				Crash cost per year = (13)x (15)				Total Crash Cost	2019 Cost Adjustment	
	(9)				(10)				(11)				(14)	(15)				(16)				(17)		
	Fatal	Serious	Minor	Non-injury	Fatal	Serious	Minor	Non-injury	Fatal	Serious	Minor	Non-injury		Fatal	Serious	Minor	Non-injury	Fatal	Serious	Minor	Non-injury			
	0.11	1.44	8.94	17.03	1.00	1.50	2.75	7.00	0.11	2.16	24.60	119.20	-0.2	$ 4,550,000.00	$ 465,000.00	$ 27,600.00	$ 2,720.00	$ 493,038.00	$ 1,004,148.90	$ 678,849.60	$ 324,213.12	$ 2,500,249.62	$ 2,725,272.09	
	0.11	1.44	7.57	22.02	1.00	1.50	2.75	7.00	0.11	2.16	20.81	154.11	-0.2	$ 4,550,000.00	$ 465,000.00	$ 27,600.00	$ 2,720.00	$ 493,038.00	$ 1,004,148.90	$ 574,411.20	$ 419,184.64	$ 2,490,782.74	$ 2,714,953.19	
	0.07	0.96	2.41	6.71	1.00	1.50	2.75	7.00	0.07	1.44	6.62	46.96	-0.2	$ 4,550,000.00	$ 465,000.00	$ 27,600.00	$ 2,720.00	$ 328,692.00	$ 669,432.60	$ 182,767.20	$ 127,720.32	$ 1,308,612.12	$ 1,426,387.21	
																		$ 1,314,768.00	$ 2,677,730.40	$ 1,436,028.00	$ 871,118.08	$ 6,299,644.48	$ 6,866,612.48	$ 6,866,612.48
	0.06	0.07	1.12	0.56	1.00	1.50	4.50	7.00	0.06	0.10	5.02	3.91	-0.2	$ 4,070,000.00	$ 441,000.00	$ 25,200.00	$ 1,180.00	$ 242,246.40	$ 45,278.35	$ 126,554.40	$ 4,609.08	$ 418,688.23	$ 443,809.53	
	0.06	0.07	1.49	0.00	1.00	1.50	4.50	7.00	0.06	0.10	6.70	0.00	-0.2	$ 4,070,000.00	$ 441,000.00	$ 25,200.00	$ 1,180.00	$ 242,246.40	$ 45,278.35	$ 168,739.20	$ -	$ 456,263.95	$ 483,639.79	
																		$ 484,492.80	$ 90,556.70	$ 295,293.60	$ 4,609.08	$ 874,952.18	$ 927,449.32	$ 927,449.32

Section	CRF	Crash by Crash Method 2019 Total Crash Cost Do Minimum	Option Total Crash Cost
Programme 1			
SH1 Northbound	0.20	$ 2,725,272.09	$ 545,054.42
SH1 Southbound	0.20	$ 2,714,953.19	$ 542,990.64
SH1 NBD Pedestrians	0.55	$ 443,809.53	$ 244,095.24
SH1 SBD Pedestrians	0.55	$ 483,639.79	$ 266,001.88
Harbour Arterial	0.30	$ 1,426,387.21	$ 427,916.16
		$7,794,062	**$1,598,142**
Programme 2 (V2)			
SH1 Northbound	0.200	$ 2,725,272.09	$ 545,054.42
SH1 Southbound	0.583	$ 2,714,953.19	$ 1,583,722.69
SH1 NBD Pedestrians	0.550	$ 443,809.53	$ 244,095.24
SH1 SBD Pedestrians	0.550	$ 483,639.79	$ 266,001.88
Harbour Arterial	0.300	$ 1,426,387.21	$ 427,916.16
		$7,794,062	**$2,638,874**

DSI Calculation

Programme		Total Estimated	DSI Equivalents	DSI Equivalents
Do Min	Total Route	58.08	9.29	12.18
	Pedestrian and Cy	12.04	2.89	
Programme 1	Total Route	13.55	2.17	3.76
	Pedestrian and Cy	6.62	1.59	
Programe 2	Total Route	20.97	3.36	4.95
	Pedestrian and Cy	6.62	1.59	

*DSI equivalents = injury crashes * DSI per inj crash*

Speed limit	DSI severity factor	
	Motorised road users	Pedestrians and cyclists
≤ 50km/h	0.16	0.24
60–70km/h	0.23	0.35
80–100km/h	0.34	0.51

Cycling and Pedestrian Benefits

	Do Minimum	Programme 1	Programme 2v3
Annual Benefits	$ 5,733,476.74	$ 6,247,340.00	$ 6,432,030.00
Difference between programmes (Annual)		$ 513,863.26	$ 698,553.26

-READ ME-
This analysis uses the cycling and pedestrian demand methodology provided by the MBCM.

The method uses population density and commute share data along the length of the paths to estimate current and new demand generated by extending or improving the path.

Due to the nature of the analysis, it was decided that a separate analysis for safety interventions along the path was unnecessary, as a safety component was already included in the analysis. However, we have adapted the analysis the reflect the relative benefit of an off street path, sourced from the MBCM.

Do Minimum - Input Information

Area of interest (km^2)	20
Population - Area of Interest	40806
Population Density (people/km^2)	2040
Length of Separated Cycle Facilities (km)	5

Separated Cycle Lanes

Cycling Demand

	Buffers (km)	<0.4	0.4 to <0.8	0.8 to <=1.6
1	Area (km^2)	2	2	4
2	Density per square kilometre	2040	2040	2040
3	Population in each buffer	4081	4081	8161
4	Total Population in all buffers		16322	
5	Commute Share (Table A20.1)		4.00%	
6	Likelihood of new cyclist multiplier	1.04	0.54	0.21
7	Row 7 = Row 3 x Row 6	4244	2204	1714
8	Sum of Row 7		8161	
9	Cyclist Rate = (Row 5 x 0.96) + 0.32%		4.16%	
10	Total existing daily cyclists = Row 4 x Row 9		679	
11	Total new daily cyclists = Row 8 x Row 9		0	

Total Daily Cyclists	679
Relative Benefit for Off-street Cycle Path	1.9
Total Daily Cyclists	1290

Cycling Results

Existing Daily Cyclist Benefits	$ 2,838.27
New Daily Cyclist Benefits	$ -
Total Daily Cyclist Benefits	$ 2,838.27

Walking Demand

	Buffers (km)	<0.4	0.4 to <0.8	0.8 to <=1.6
1	Area (km^2)	2	2	4
2	Density per square kilometre	2040	2040	2040
3	Population in each buffer	4081	4081	8161
4	Total Population in all buffers		16322	
5	Commute Share (Walking)		9.00%	
6	Likelihood of new Pedestrian multiplier	1.04	0.54	0.21
7	Row 7 = Row 3 x Row 6	4244	2204	1714
8	Sum of Row 7		8161	
9	Walking Rate = (Row 5 x 0.96) + 0.32%		8.96%	
10	Total existing daily Pedestrians = Row 4 x Row 9		1462	
11	Total new daily Pedestrians = Row 8 x Row 9		0	

Total Daily Pedestrians	1462
Relative Benefit for Improved Pedestrian Crossing Facilities	2
Total Daily Pedestrians	2925

Walking Results

Existing Daily Pedestrian Benefits	$ 12,869.89
New Daily Pedestrian Benefits	$ -
Total Daily Pedestrian Benefits	$ 12,869.89

Whole of Walking and Cycling Facility Results

Total Combined Benefits	$ 15,708.16
Total Annual Benefits	$ 5,733,476.74

Programme 1 - Input Information

Area of interest (km^2)	20
Population - Area of Interest	40806
Population Density (people/km^2)	2040
Length of Separated Cycle Facilities (km)	6

Separated Cycle Lanes

Cycling Demand

	Buffers (km)	<0.4	0.4 to <0.8	0.8 to <=1.6
1	Area (km^2)	2.4	2.4	4.8
2	Density per square kilometre	2040	2040	2040
3	Population in each buffer	4897	4897	9793
4	Total Population in all buffers		19587	
5	Commute Share (Table A20.1)		4.00%	
6	Likelihood of new cyclist multiplier	1.04	0.54	0.21
7	Row 7 = Row 3 x Row 6	5093	2644	2057
8	Sum of Row 7		9793	
9	Cyclist Rate = (Row 5 x 0.96) + 0.32%		4.16%	
10	Total existing daily cyclists = Row 4 x Row 9		815	
11	Total new daily cyclists = Row 8 x Row 9		407	

Total Daily Cyclists	1222
Relative Benefit for Off-street Cycle Path	1.9
Total Daily Cyclists	2322

Cycling Results

Existing Daily Cyclist Benefits	$ 3,405.92
New Daily Cyclist Benefits	$ 851.48
Total Daily Cyclist Benefits	$ 4,257.40

Walking Demand

	Buffers (km)	<0.4	0.4 to <0.8	0.8 to <=1.6
1	Area (km^2)	2.4	2.4	4.8
2	Density per square kilometre	2040	2040	2040
3	Population in each buffer	4897	4897	9793
4	Total Population in all buffers		19587	
5	Commute Share (Walking)		9.00%	
6	Likelihood of new Pedestrian multiplier	1.04	0.54	0.21
7	Row 7 = Row 3 x Row 6	5093	2644	2057
8	Sum of Row 7		9793	
9	Walking Rate = (Row 5 x 0.96) + 0.32%		8.96%	
10	Total existing daily Pedestrians = Row 4 x Row 9		1755	
11	Total new daily Pedestrians = Row 8 x Row 9		877	

Total Daily Pedestrians	2632
Relative Benefit for Improved Pedestrian Crossing Facilities	2
Total Daily Pedestrians	5265

Walking Results

Existing Daily Pedestrian Benefits	$ 15,443.86
New Daily Pedestrian Benefits	$ 3,860.97
Total Daily Pedestrian Benefits	$ 19,304.83

Whole of Walking and Cycling Facility Results

Total Combined Benefits	$ 23,562.23
Total Annual Benefits	$ 8,600,215.11

Programme 2v3 - Input Information

Area of interest (km^2)	20
Population - Area of Interest	40806
Population Density (people/km^2)	2040
Length of Separated Cycle Facilities (km)	4

Separated Cycle Lanes

Cycling Demand

	Buffers (km)	<0.4	0.4 to <0.8	0.8 to <=1.6
1	Area (km^2)	1.6	1.6	3.2
2	Density per square kilometre	2040	2040	2040
3	Population in each buffer	3264	3264	6529
4	Total Population in all buffers		13058	
5	Commute Share (Table A20.1)		4.00%	
6	Likelihood of new cyclist multiplier	1.04	0.54	0.21
7	Row 7 = Row 3 x Row 6	3395	1763	1371
8	Sum of Row 7		6529	
9	Cyclist Rate = (Row 5 x 0.96) + 0.32%		4.16%	
10	Total existing daily cyclists = Row 4 x Row 9		543	
11	Total new daily cyclists = Row 8 x Row 9		272	

Total Daily Cyclists	815
Relative Benefit for Off-street Cycle Path	1.9
Total Daily Cyclists	1548

Cycling Results

Existing Daily Cyclist Benefits	$ 2,270.62
New Daily Cyclist Benefits	$ 567.65
Total Daily Cyclist Benefits	$ 2,838.27

Walking Demand

	Buffers (km)	<0.4	0.4 to <0.8	0.8 to <=1.6
1	Area (km^2)	2.4	2.4	4.8
2	Density per square kilometre	2040	2040	2040
3	Population in each buffer	4897	4897	9793
4	Total Population in all buffers		19587	
5	Commute Share (Walking)		9.00%	
6	Likelihood of new Pedestrian multiplier	1.04	0.54	0.21
7	Row 7 = Row 3 x Row 6	5093	2644	2057
8	Sum of Row 7		9793	
9	Walking Rate = (Row 5 x 0.96) + 0.32%		8.96%	
10	Total existing daily Pedestrians = Row 4 x Row 9		1755	
11	Total new daily Pedestrians = Row 8 x Row 9		877	

Total Daily Pedestrians	2632
Relative Benefit for Improved Pedestrian Crossing Facilities	2
Total Daily Pedestrians	5265

Walking Results

Existing Daily Pedestrian Benefits	$ 15,443.86
New Daily Pedestrian Benefits	$ 3,860.97
Total Daily Pedestrian Benefits	$ 19,304.83

Whole of Walking and Cycling Facility Results

Total Combined Benefits	$ 22,143.10
Total Annual Benefits	$ 8,082,230.92

NOT USED
NOT USED

Population - Area of Interest	Total people		
Year	2006	2013	2018
Area			
North East Valley Knox	2,337	2,562	2,682
Gardens (Dunedin City)	3,978	4,044	4,197
Royal Terrace	1,554	1,701	1,779
Arthur Street	1,437	1,464	1,524
Opoho	1,248	1,191	1,239
Campus North	3,033	2,922	3,063
Campus South	2,766	2,391	2,484
Dunedin Central	3,201	3,081	3,138
Caversham	2,247	2,190	2,244
Hillside-Portsmouth Drive	99	72	96
Forbury	1,308	1,290	1,332
Bathgate Park	2,346	2,301	2,343
St Clair	2,340	2,424	2,400
Waverley	2,592	2,556	2,610
St Kilda South	2,811	2,835	2,949
Musselburgh	1,569	1,578	1,500
St Kilda North	2,781	2,835	2,859
Andersons Bay	2,388	2,331	2,367
Dunedin City	***123,516***	***127,956***	***130,194***

data extracted on 30 Jun 2020 10:11 UTC (GMT) from NZ.Stat

Total Population - within walking/cycling distanc	**40,035**	**39,768**	**40,806**

The annualised benefits for the Shared Use Path Extension are based on assuming that the path is used every day of the year, including weekends. This may be an issue as the cycling and walking rates used are for commutes to work, not leisure, and so there may be significantly higher numbers of non-tourist cyclists on weekends and public holidays than indicated in this analysis.

A value of $4.40 per kilometre of new facility may be applied to pedestrians using a new facility. This value is shown in Table 9.

Table 9: New pedestrian facility benefits ($/pedestrian km – 2018)

Benefit	Health benefits for new user ($/km)	Maximum annual benefit per new user (2018 $)
Composite benefit	$4.40	$1,250

Source: Waka Kotahi NZ Transport Agency (2020a)

Table 10: New cycle facility benefits ($/cyclist km – 2018)

Benefit	Health benefits for new user ($/km)	Maximum annual benefit per new user (2018 $)
Conventional cycling	$2.20	$2,500
Electric-assisted cycling	$1.00	$2,000

Source: Waka Kotahi NZ Transport Agency (2020a)

Dataset: New Zealand Household Travel Survey: Travel to work, by main urban area results (3-year moving average)

Main Urban Area	**Dunedin MUA**										
Years	**July 2011 - June 2014**										
Measure	Employed people aged 16 and over with journeys from home to work	Journeys in sample	Km per year (million)	Hours per year (million)	Journeys per year (%)	Mode's share of total km (%)	Mode's share of total hours (%)	Mode's share of journeys (%)	Average km per work journey	Average minutes per work journey	Average speed (km/hr) for work journeys
Journey modes of travel to work											
Total	259	430	65.1	2.4	9.1	100	100	100	7.1	15.7	27.3
Drive	176	301	50.9	1.6	6.5	78	67	72	7.8	14.6	31.9
Drive + walk	25	36	..	..	..	8	9	7	..	..	..
Passenger	20	24	..	..	..	6	6	5	..	..	..
Passenger + walk	4	5	..	..	..	2	2	1	..	..	..
Walk only	24	36	..	..	..	2	9	9	..	..	..
Cycle	11	15	..	..	..	2	4	4	..	..	..
Public transport with or without walk	9	11	..	..	..	1	4	2	..	..	..
Public transport + car, with or without walk	0	0	..	..	..	..	..	..	..	..	..
Other	2	2	..	..	..	1	0	0	..	..	..

data extracted on 30 Jun 2020 05:14 UTC (GMT) from NZ.Stat

HEALTH AND ENVIRONMENT BENEFITS FOR WALKING FACILITIES (using SP11 Equations)

Proposed Improvements	Length	# of Additional Pedestrians/day	Undiscounted Annual Benefit	Applied to	Assumptions
Princes Street Comprehensive Pedestrian Improvements	0.6	2500	$2,409,000	All	This increase reflects that if significant improvements occur to improve the amenity and safety of the area along and across Princes Street, particularly closer to the Octagon, then there will be an increase in pedestrians.
St Andrew Street Pedestrian Improvements	0.8	0	$0	All	Agree to remove these additional pedestrians as the numbers are not generated by the SSBC improvements but from the hospital development. These pedestrians will however benefit from the safety improvements which are considered in the crash analysis.

HEALTH AND ENVIRONMENT BENEFITS FOR CYCLING FACILITIES (Using SP11 Equations)

Proposed Improvements	Length	# of Additional Cyclists/day	Undiscounted Annual Benefit	Applied to	Assumptions
Princes Street Comprehensive Cycle Improvements	1	400	$321,200	All	Increase to 400 cyclists per day, improvements may potentially attract more cyclists with the untapped demand from South Dunedin.
Albany Street Cycle Route	1.2	400	$385,440	All	Current cycle volumes are 12 cyclists per day between 7am and 6pn as supplied by DCC. With the connection to SH88, this should attract more cyclists, hence400 per day on the basis that if the new facility is completed to a high standard it will attract cyclists heading from SH88 into the North Dunedin/tertiary area.
St Andrew Street Cycle Route	0.8	600	$385,440	All	400 per day may be conservative given that St Andrew Street provides a direct link into the CBD so have agreed to increase this to 600 per day.
Extend cycleway - Queens Gardens to Oval	2.3	400	$738,760	Prog 1	Current cycle volumes are approx. 400 cyclists per day as supplied by project team. With the connection to the existing separated cycleway to the north, this should attract more cyclists from South Dunedin, hence 400 per day used.
Existing separated cycleway on one way pair	5	500	$2,007,500	Prog 1	The slow speed zone through the core and removal of some HCVs will attract some more cyclists, with 500 additional cyclists assumed. The current counts as supplied by WK last year are 140 cyclists per day on Cumberland Street and 150 per day on Great King Street (on average). Where separated cycle facilities have been implemented well with safe crossing points over major accessways and at intersections, we've found that demands have exceeded all estimates.
Two way separated cycleway on local road	7.3	500	$2,930,950	Prog 2v3	Expect a similar uptake of new facilities on local road so have assumed 500 new cyclists per day due to the slow speeds and significant amenity improvements

Undiscounted Annual Walking and Cycling Costs

Do Minimum	$5,733,477
Programme 1	$6,247,340
Programme 2v3	$6,432,030

Table A20.1 Cycle demand indicators

Territory authority area	Commute share 2013 (%)	Territory authority area	Commute share 2013 (%)
Far North District	0.7%	Horowhenua District	2.2%
Whangarei District	1.5%	Kapiti Coast District	2.0%
Kaipara District	0.8%	Porirua City	1.7%
Auckland City	1.1%	Upper Hutt City	1.6%
Thames-Coromandel District	3.0%	Lower Hutt City	2.3%
Hauraki District	1.3%	Wellington City	8.0%
Waikato District	0.9%	Masterton District	3.2%
Matamata-Piako District	1.7%	Carterton District	1.6%
Hamilton City	3.6%	South Wairarapa District	1.9%
Waipa District	1.3%	Tasman District	5.1%
Otorohanga District	0.6%	Nelson City	8.0%
South Waikato District	2.2%	Marlborough District	4.3%
Waitomo District	1.0%	Buller District	3.6%
Taupo District	1.9%	Grey District	3.3%
Western Bay of Plenty District	0.8%	Westland District	3.5%
Tauranga City	2.9%	Kaikoura District	3.9%
Rotorua District	2.9%	Hurunui District	1.7%
Whakatane District	2.8%	Waimakariri District	1.6%
Kawerau District	3.1%	Christchurch City	6.6%
Opotiki District	1.4%	Selwyn District	1.9%
Gisborne District	3.3%	Ashburton District	3.1%
Wairoa District	1.7%	Timaru District	3.2%
Hastings District	3.9%	Mackenzie District	4.2%
Napier City	3.4%	Waimate District	1.6%
Central Hawke's Bay District	0.9%	Chatham Islands Territory	1.2%
New Plymouth District	2.9%	Waitaki District	2.2%
Stratford District	0.9%	Central Otago District	4.2%
South Taranaki District	2.2%	Queenstown-Lakes District	3.6%
Ruapehu District	2.0%	Dunedin City	2.6%
Wanganui District	3.6%	Clutha District	1.1%
Rangitikei District	1.4%	Southland District	1.6%
Manawatu District	1.5%	Gore District	1.8%
Palmerston North City	5.6%	Invercargill City	2.8%
Tararua District	1.4%		

Vehicle Emissions

See READ ME right of sheet.

	Do Minimum	Programme 1	Programme 2v3
Emissions 2017	$ 7,245,718	$ 7,245,718	$ 7,245,718
Emissions 2038	$ 7,708,672	$ 7,467,535	$ 7,469,472
Emissions Change			

-READ ME-
This Emissions Cost analysis follows the methodology laid out in the Waka Kotahi Monetised Benefits and Costs Manual (MBCM). The methodology is carried out separately for each project, with results summarised at the top the the sheet.

Inputs including the length of each section, the speed enviornment, travel time, AADT, and heavy traffic composition, are used to calculate the dollar value of four different vehicle emissions.

Do Minimim

Do Minimum 2017

Section	Length (m)	Travel Time (min)	Speed Environmer	AADT	% Heavy	Estimated Gradient	Emissions Class - I	Emissions Class -	Light - Rate (g/km)	Heavy - Rate (g/km)	Light - Weighted	Heavy - Weighted	Emission Component Total	Emission rate (g/day)	Cost ($)	Light - Rate	Heavy - Rat
AM Peak	4000	5.01	50	43130	0.06	0%	40703.9375	2426.0625	3	1.1	2.83125	0.061875	2.893125	499121.925	$ 2.06	0.5	4.3
Interpeak	4000	4.34	50	36554	0.06	0%	34497.8375	2056.1625	3	1.1	2.83125	0.061875	2.893125	423021.165	$ 1.75	0.5	4.3
PM Peak	4000	5.05	50	73712	0.06	0%	69565.7	4146.3	3	1.1	2.83125	0.061875	2.893125	853032.12	$ 3.52	0.5	4.3
														1.78			
														Total CO ($/Day)	$ 7.33		

Do Minimum 2038

Section	Length (m)	Travel Time (min)	Speed Environmer	AADT	% Heavy	Estimated Gradient	Emissions Class - I	Emissions Class -	Light - Rate (g/km)	Heavy - Rate (g/km)	Light - Weighted	Heavy - Weighted	Emission Component Total	Emission rate (g/day)	Cost ($)	Light - Rate	Heavy - Rat
AM Peak	4000	5.14	50	45859	0.06	0%	43279.43125	2579.56875	3	1.1	2.83125	0.061875	2.893125	530703.2775	$ 2.19	0.5	4.3
Interpeak	4000	4.38	50	38991	0.06	0%	36797.75625	2193.24375	3	1.1	2.83125	0.061875	2.893125	451223.3475	$ 1.86	0.5	4.3
PM Peak	4000	5.48	50	78347	0.06	0%	73939.98125	4407.01875	3	1.1	2.83125	0.061875	2.893125	906670.6575	$ 3.74	0.5	4.3
														1.89			
														Total CO ($/Day)	$ 7.80		

Programme 1

Programme 1 2017

Section	Length (m)	Travel Time (min)	Speed Environmer	AADT	% Heavy	Estimated Gradient	Emissions Class - I	Emissions Class -	Light - Rate (g/km)	Heavy - Rate (g/km)	Light - Weighted	Heavy - Weighted	Emission Component Total	Emission rate (g/day)	Cost ($)	Light - Rate	Heavy - Rat
AM Peak	4000	5.01	50	43130	0.06	0%	40703.9375	2426.0625	3	1.1	2.83125	0.061875	2.893125	499121.925	$ 2.06	0.5	4.3
Interpeak	4000	4.34	50	36554	0.06	0%	34497.8375	2056.1625	3	1.1	2.83125	0.061875	2.893125	423021.165	$ 1.75	0.5	4.3
PM Peak	4000	5.05	50	73712	0.06	0%	69565.7	4146.3	3	1.1	2.83125	0.061875	2.893125	853032.12	$ 3.52	0.5	4.3
														Total CO ($/Day)	$ 7.33		
														1.78			

Programme 1 2038

Section	Length (m)	Travel Time (min)	Speed Environmer	AADT	% Heavy	Estimated Gradient	Emissions Class - I	Emissions Class -	Light - Rate (g/km)	Heavy - Rate (g/km)	Light - Weighted	Heavy - Weighted	Emission Component Total	Emission rate (g/day)	Cost ($)	Light - Rate	Heavy - Rat
AM Peak	4000	5.18	50	43770	0.06	0%	41307.9375	2462.0625	3	1.1	2.83125	0.061875	2.893125	506528.325	$ 2.09	0.5	4.3
Interpeak	4000	4.56	50	38122	0.06	0%	35977.6375	2144.3625	3	1.1	2.83125	0.061875	2.893125	441166.845	$ 1.82	0.5	4.3
PM Peak	4000	5.42	50	76200	0.06	0%	71913.75	4286.25	3	1.1	2.83125	0.061875	2.893125	881824.5	$ 3.64	0.5	4.3
														Total CO ($/Day)	$ 7.56		
														1.83			

Programme 2v3

Programme 2v3 2017

Section	Length (m)	Travel Time (min)	Speed Environmer	AADT	% Heavy	Estimated Gradient	Emissions Class - I	Emissions Class -	Light - Rate (g/km)	Heavy - Rate (g/km)	Light - Weighted	Heavy - Weighted	Emission Component Total	Emission rate (g/day)	Cost ($)	Light - Rate	Heavy - Rat
AM Peak	4000	5.01	50	43130	0.06	0%	40703.9375	2426.0625	3	1.1	2.83125	0.061875	2.893125	499121.925	$ 2.06	0.5	4.3
Interpeak	4000	4.34	50	36554	0.06	0%	34497.8375	2056.1625	3	1.1	2.83125	0.061875	2.893125	423021.165	$ 1.75	0.5	4.3
PM Peak	4000	5.05	50	73712	0.06	0%	69565.7	4146.3	3	1.1	2.83125	0.061875	2.893125	853032.12	$ 3.52	0.5	4.3
														Total CO ($/Day)	$ 7.33		
														1.78			

Programme 2v3 2038

Section	Length (m)	Travel Time (min)	Speed Environmer	AADT	% Heavy	Estimated Gradient	Emissions Class - I	Emissions Class -	Light - Rate (g/km)	Heavy - Rate (g/km)	Light - Weighted	Heavy - Weighted	Emission Component Total	Emission rate (g/day)	Cost ($)	Light - Rate	Heavy - Rat
AM Peak	4000	5.32	50	43773	0.06	0%	41310.76875	2462.23125	3	1.1	2.83125	0.061875	2.893125	506563.0425	$ 2.09	0.5	4.3
Interpeak	4000	4.52	50	38141	0.06	0%	35995.56875	2145.43125	3	1.1	2.83125	0.061875	2.893125	441386.7225	$ 1.82	0.5	4.3
PM Peak	4000	6.27	50	76219	0.06	0%	71931.68125	4287.31875	3	1.1	2.83125	0.061875	2.893125	882044.3775	$ 3.64	0.5	4.3
														Total CO ($/Day)	$ 7.56		
														1.83			

Programme	Year	Emissions per day (tonnes)			
		CO	Nox	PM10	HC
Do Minimum	2017	1.775	0.438	0.023	0.145
	2038	1.889	0.466	0.025	0.154
Programme 1	2017	1.775	0.438	0.023	0.145
	2038	1.830	0.451	0.024	0.149
Programme 2v3	2017	1.775	0.438	0.023	0.145
	2038	1.830	0.451	0.024	0.149

Light - Weig	Heavy - We	Emission Cc	Emission rate (g	Cost ($)	Light - Rate	Heavy - Rati	Light - Weig	Heavy - Wei	Emission Cc	Emission rat	Cost ($)	Light - Rate	Heavy - Rate	Light - Weig	Heavy - We	Emission Co	Emission rat	Cost ($)		
0.471875	0.241875	0.71375	123,136.15	$ 2,012.91	0.03	0.17	0.0283125	0.0095625	0.037875	6534.195	$ 3,005.81	0.24	0.17	0.2265	0.0095625	0.2360625	40725.5025	$ 53.35		
0.471875	0.241875	0.71375	104,361.67	$ 1,706.00	0.03	0.17	0.0283125	0.0095625	0.037875	5537.931	$ 2,547.51	0.24	0.17	0.2265	0.0095625	0.2360625	34516.1145	$ 45.22		
0.471875	0.241875	0.71375	210,447.76	$ 3,440.19	0.03	0.17	0.0283125	0.0095625	0.037875	11167.368	$ 5,137.12	0.24	0.17	0.2265	0.0095625	0.2360625	69602.556	$ 91.18		
			0.44							0.02							0.14		**Total ($/Day)**	$ 18,047
																			Annual Cost	$ 6,587,016
			Total NOx ($/Day)	$ 7,159.10						**Total PM10 ($/Day)**	$ 10,690.45						**Total HC ($/Day)**	$ 189.75	**2020 Adjusted Cost**	$ 7,245,718

Light - Weig	Heavy - We	Emission Cc	Emission rate (g	Cost ($)	Light - Rate	Heavy - Rati	Light - Weig	Heavy - Wei	Emission Cc	Emission rat	Cost ($)	Light - Rate	Heavy - Rate	Light - Weig	Heavy - We	Emission Co	Emission rat	Cost ($)		
0.471875	0.241875	0.71375	130,927.45	$ 2,140.27	0.03	0.17	0.0283125	0.0095625	0.037875	6947.6385	$ 3,196.00	0.24	0.17	0.2265	0.0095625	0.2360625	43302.3608	$ 56.73		
0.471875	0.241875	0.71375	111,319.31	$ 1,819.74	0.03	0.17	0.0283125	0.0095625	0.037875	5907.1365	$ 2,717.35	0.24	0.17	0.2265	0.0095625	0.2360625	36817.2518	$ 48.23		
0.471875	0.241875	0.71375	223,680.69	$ 3,656.51	0.03	0.17	0.0283125	0.0095625	0.037875	11869.571	$ 5,460.14	0.24	0.17	0.2265	0.0095625	0.2360625	73979.1548	$ 96.91		
			0.47							0.02							0.15		**Total ($/Day)**	$ 19,200
																			Annual Cost	$ 7,007,883
			Total NOx ($/Day)	$ 7,616.52						**Total PM10 ($/Day)**	$ 11,373.50						**Total HC ($/Day)**	$ 201.87	**2020 Adjusted Cost**	$ 7,708,672

Light - Weig	Heavy - We	Emission Cc	Emission rate (g	Cost ($)	Light - Rate	Heavy - Rati	Light - Weig	Heavy - Wei	Emission Cc	Emission rat	Cost ($)	Light - Rate	Heavy - Rate	Light - Weig	Heavy - We	Emission Co	Emission rat	Cost ($)		
0.471875	0.241875	0.71375	123,136.15	$ 2,012.91	0.03	0.17	0.0283125	0.0095625	0.037875	6534.195	$ 3,005.81	0.24	0.17	0.2265	0.0095625	0.2360625	40725.5025	$ 53.35		
0.471875	0.241875	0.71375	104,361.67	$ 1,706.00	0.03	0.17	0.0283125	0.0095625	0.037875	5537.931	$ 2,547.51	0.24	0.17	0.2265	0.0095625	0.2360625	34516.1145	$ 45.22	**Total ($/Day)**	$ 18,047
0.471875	0.241875	0.71375	210,447.76	$ 3,440.19	0.03	0.17	0.0283125	0.0095625	0.037875	11167.368	$ 5,137.12	0.24	0.17	0.2265	0.0095625	0.2360625	69602.556	$ 91.18	**Annual Cost**	$ 6,587,016
			Total NOx ($/Day)	$ 7,159.10						**Total PM10 ($/Day)**	$ 10,690.45						**Total HC ($/Day)**	$ 189.75	**2020 Adjusted Cost**	$ 7,245,718
			0.44							0.02										

Light - Weig	Heavy - We	Emission Cc	Emission rate (g	Cost ($)	Light - Rate	Heavy - Rati	Light - Weig	Heavy - Wei	Emission Cc	Emission rat	Cost ($)	Light - Rate	Heavy - Rate	Light - Weig	Heavy - We	Emission Co	Emission rat	Cost ($)		
0.471875	0.241875	0.71375	124,963.35	$ 2,042.78	0.03	0.17	0.0283125	0.0095625	0.037875	6631.155	$ 3,050.41	0.24	0.17	0.2265	0.0095625	0.2360625	41329.8225	$ 54.14		
0.471875	0.241875	0.71375	108,838.31	$ 1,779.18	0.03	0.17	0.0283125	0.0095625	0.037875	5775.483	$ 2,656.79	0.24	0.17	0.2265	0.0095625	0.2360625	35996.6985	$ 47.16	**Total ($/Day)**	$ 18,599
0.471875	0.241875	0.71375	217,551.00	$ 3,556.31	0.03	0.17	0.0283125	0.0095625	0.037875	11544.3	$ 5,310.52	0.24	0.17	0.2265	0.0095625	0.2360625	71951.85	$ 94.26	**Annual Cost**	$ 6,788,668
			Total NOx ($/Day)	$ 7,378.26						**Total PM10 ($/Day)**	$ 11,017.72						**Total HC ($/Day)**	$ 195.55	**2020 Adjusted Cost**	$ 7,467,535
			0.45							0.02							0.15			

Light - Weig	Heavy - We	Emission Cc	Emission rate (g	Cost ($)	Light - Rate	Heavy - Rati	Light - Weig	Heavy - Wei	Emission Cc	Emission rat	Cost ($)	Light - Rate	Heavy - Rate	Light - Weig	Heavy - We	Emission Co	Emission rat	Cost ($)		
0.471875	0.241875	0.71375	123,136.15	$ 2,012.91	0.03	0.17	0.0283125	0.0095625	0.037875	6534.195	$ 3,005.81	0.24	0.17	0.2265	0.0095625	0.2360625	40725.5025	$ 53.35		
0.471875	0.241875	0.71375	104,361.67	$ 1,706.00	0.03	0.17	0.0283125	0.0095625	0.037875	5537.931	$ 2,547.51	0.24	0.17	0.2265	0.0095625	0.2360625	34516.1145	$ 45.22	**Total ($/Day)**	$ 18,047
0.471875	0.241875	0.71375	210,447.76	$ 3,440.19	0.03	0.17	0.0283125	0.0095625	0.037875	11167.368	$ 5,137.12	0.24	0.17	0.2265	0.0095625	0.2360625	69602.556	$ 91.18	**Annual Cost**	$ 6,587,016
			Total NOx ($/Day)	$ 7,159.10						**Total PM10 ($/Day)**	$ 10,690.45						**Total HC ($/Day)**	$ 189.75	**2020 Adjusted Cost**	$ 7,245,718
			0.44							0.02							0.14			

Light - Weig	Heavy - We	Emission Cc	Emission rate (g	Cost ($)	Light - Rate	Heavy - Rati	Light - Weig	Heavy - Wei	Emission Cc	Emission rat	Cost ($)	Light - Rate	Heavy - Rate	Light - Weig	Heavy - We	Emission Co	Emission rat	Cost ($)		
0.471875	0.241875	0.71375	124,971.92	$ 2,042.92	0.03	0.17	0.0283125	0.0095625	0.037875	6631.6095	$ 3,050.62	0.24	0.17	0.2265	0.0095625	0.2360625	41332.6553	$ 54.15		
0.471875	0.241875	0.71375	108,892.56	$ 1,780.07	0.03	0.17	0.0283125	0.0095625	0.037875	5778.3615	$ 2,658.12	0.24	0.17	0.2265	0.0095625	0.2360625	36014.6393	$ 47.18	**Total ($/Day)**	$ 18,604
0.471875	0.241875	0.71375	217,605.25	$ 3,557.19	0.03	0.17	0.0283125	0.0095625	0.037875	11547.179	$ 5,311.84	0.24	0.17	0.2265	0.0095625	0.2360625	71969.7908	$ 94.28	**Annual Cost**	$ 6,790,429
			Total NOx ($/Day)	$ 7,380.18						**Total PM10 ($/Day)**	$ 11,020.58						**Total HC ($/Day)**	$ 195.61	**2020 Adjusted Cost**	$ 7,469,472
			0.45							0.02							0.15			

Pollutant	$/tonne	Base Date
PM10	$ 460,012	2016
NOx	$ 16,347	2016
CO	$ 4.13	2016
HC	$ 1,310.00	2016

Emission Rate in Tonnes per day

		CO	NOx	PM10	HC
Do Minimur	2017	1.775	0.438	0.023	0.145
	2038	1.889	0.466	0.025	0.154
Programme	2017	1.775	0.438	0.023	0.149
	2038	1.830	0.451	0.024	0.149
Programme	2017	1.775	0.438	0.023	0.145
	2038	1.830	0.451	0.024	0.149

Appendix O Economic Assessment

Shaping Future Dunedin

Economic Report

December 2020

m.e consulting

Prepared for

Connecting Dunedin Partners

Waka Kotahi / NZ Transport Agency

Dunedin City Council,

Otago Regional Council

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1 Introduction

Shaping Future Dunedin Transport (SFDT) is a collaborative partnership between Waka Kotahi NZ Transport Agency, Dunedin City Council and Otago Regional Council to improve how people move into, out of and around central Dunedin.

Dunedin's central city transport network has functioned largely unchanged for about 50 years and presents several barriers to people coming into and moving around the central city. The current one-way state highway system bisects the central city and there can be conflict between users of the road environment and pedestrian environment.

New large-scale developments, particularly the new hospital ($1.4 billion) and planned works at University of Otago ($650 million), present an opportunity to consider whether the network is appropriate for the medium and long term. In 2018, representatives from the Ministry of Health (MOH) asked the Transport Agency and Council whether it would be possible to make changes to the road network in order to deliver better access and integration between the new hospital and the city. The hospital build will last 6-8 years which will cause significant travel disruption. This could provide a stimulus for travel behaviour change. In addition, if adjustments to the transport network are sought it would be more efficient to progress these in parallel with the hospital work.

As part of the SFDT process, Connecting Dunedin Partners are seeking to understand the economic impacts and implications of the potential programme of works (Option 1), which includes changes to the transport network and managing travel demand.

1.1 Background

As part of its SFDT programme, Connecting Dunedin Partners (CDP) have shortlisted two alternative programmes for improving the function of the transport network, Option 1 and Option 2. The Partners undertook public engagement and a range of technical assessments, which resulted in Option 1 being the potential programme of works. For the purposes of this report, Option 1 has been used for assessment.

The preferred programme of works includes the following, SH88 relocated to Frederick Street, St Andrew Street pedestrian focus, improved harbour arterial, pedestrian package, cycle package, public transport package, parking and behaviour change.

The Partners have commissioned research which will be used to form the basis of a business case and will provide an evidence base that supports the investment in the transport network. This research includes transport modelling[1], urban design[2], public engagement[3], socioeconomic benefits[4], etc. This report provides research on the economic role that SFDT programme could play in the local economy.

[1] Stantec (2020) Shaping Future Dunedin Transport Programme Business Case (Part A).
[2] Boffa Miskell (2020) Shaping Future Dunedin Transport - Dunedin City Centre Place Value.
[3] Socialpinpoint (2020) https://nzta.mysocialpinpoint.com/shaping-future-dunedin-transport#/
[4] NZIER (2020) Shaping Future Dunedin Transport - wider benefits population and community.

1.2 Project Objectives and Approach

The objective of the economic report is to provide a robust analysis and assessment of the economic benefits that may arise from SFDT programme, constructing and operating new transport network for the Dunedin CBD.

The following steps below outline the approach taken:

- Using M.E's Economic Futures Model (EFM) developed for DCC, economic projections for DCC will be generated and illustrated with the use of graphs and tables. The model projects employment, gross output and value added into the future which help to build a picture of the Dunedin economy going forward.
- Structure capital and operating costs into cashflows that are then placed into a Multi-Regional Input Output ('MRIO')model of the Dunedin economy within Otago and New Zealand
- Identify through the MRIO resulting contributions to GDP and Employment at local regional and potentially national level.
- A summary of the outcome and EIA are reported on.

The Input Output approach is well defined in economics. The fundamental steps and assumptions are presented in Appendix 1. In summary;

- An I-O framework of the local regional and national economy is combined into a Multi-Regional model such that cross border transactions are fully accounted for.
- The IO framework represents a point in time so that technologies that are present at the time the IO framework was created are assumed to exist into the future. In this instance 2016.
- The IO framework assumes that there are constant returns to scale. This means that as an industries outputs increase as a result of additional demand, its input requirements increase in direct proportion.
- The IO framework assumes that an economy is operating at full potential, that there are not unused employment or capital resources available for growth. This means that as funds are diverted between activities there are compensating downturns elsewhere. In this case, we will need to determine who is funding the programme, to what extent. Money being spent in Dunedin from Central Government sources represents 'new money' into the Dunedin economy, and is treated differently from money that is diverted from other projects within Dunedin, to fund this one.

With reference to the economic impacts, the approach is broadly consistent with a CBA, with the main differences relating to how the different elements are treated. An economic impact assessment does not differentiate between costs and benefits. It looks at all the transactions and translates these into economic transactions at a sector level. Next, these transactions are modelled to estimate the flow-on impacts. The impacts are presented in Value Added and employment terms. Value Added is similar to GDP. It is important to note that the EIA does not include aspects like deadweight losses, environmental costs and so forth.

In this assessment, we used an Input-Output model. These types of models have advantages and weaknesses when compared to other types of economic impact models. For example, IO models do not capture price changes and are not 'constrained'. But they are user friendly, transparent and less 'black box' compared to other economic impact models and allow the user to explore the impact pathway.

The purpose of this assessment is not to replicate the assessment that is currently underway to support the Business case process[5], rather it is to explore the more fundamental question, what are the economic impacts from SFDT, in terms of local, regional and national. This report does not overlap with the NZIER social assessment, which was intended to measure the non-market impacts of the SFDT.

1.3 Limitations and Caveats

This analysis is structured in a way that is consistent with the input data we have received. The economic report presents an understanding of the potential costs and benefits of constructing the SFDT programme. The assessment in this report will need to be updated if new research/information becomes available as the process unfolds.

The following list outlines the key limitations and caveats of this economic assessment.

- Capital and Operating Costs: NZTA provided the capital costs, operational costs and project timings (as at December 2020), which may change as SFDT planning develops. The MRIO relies on costs of economic resources used during production drawn from the Statistics New Zealands' Supply-Use tables. Information in the most recent Supply-Use tables (and Input-Output Tables) is also used. Similarly, data from the Annual Enterprise Survey informed parts of the analysis.
- Non-market Values: this assessment did not include primary research. So, it was not possible to accurately estimate the non-market values associated with the proposed development. Examples of such values include the potential environmental or social gains from a modern well designed transport network controlling negative externalities and emissions. These benefits (and the potential costs) are not included in the analysis but have been canvased in research conducted by traffic modelling and social benefits assessment.
- Uncertainty/Future: there is always uncertainty associated with future estimates and economic assessments. This report relies on capital expenditure data that covers the development period of the SFDT programme. In total information covers 10 years of expenditure. Because this is a relatively short timeframe the levels of uncertainty are moderate about the far future. In addition, the impacts of Covid19 within the economy will change significantly over that time period, which increases the uncertainty. This means that any economic modelling that relies on a static framework – such as IO modelling, may not produce reliable estimates of impacts in the coming decade. Given the effects are discounted to current terms through the NPV process, the effect of distant outcomes plays a smaller role in the final figures.

Other: the analysis is based on several assumptions that are noted in the report. The team has used the best available data and/or applied conservative assumptions. In terms of the economic impact modelling,

[5] Another research project has been commissioned to apply the standard transport assessment methodology (EEM – now MBCM).

- Appendix 1 provides a short summary of IO modelling and summarises the key limitations.
- EIA/CBA/MCA/LSF/EEM/MBCM: this report applies commonly adopted methods for assessing the merits of the options (EIA), however it is acknowledged that Treasury has developed the living standards framework (LSF) as a new method for assessing policy. This report has not attempted to provide an analysis that matches this new LSF. Also NZTA has it's own evaluation method (EEM – now MBCM) which has been applied to SFDT programme by traffic modelling specialists (Stantec).

1.4 Report Structure

This rest of the report is structured as follows:

- Section Two – summarises employment, gross output and value added projections for the Dunedin economy extracted from the Economic Futures Model (EFM).
- Section Three – identifies and describes potential economic implications of the SFDT Option 1 to Dunedin city.
- Section Four – details and analyses the results from the EIA.
- Section Five – presents key conclusions.

2 Dunedin Economy

SFDT will serve the local economy, both the travel needs of the community and economy. Therefore, it is important to understand the nature of the existing and future economy with local area and the CBD. This section of the report provides contextual background on the economy which the Programme will serve.

The contextual information that is presented in this report is drawn from Economic Futures Model (EFM) that was commissioned by Dunedin City Council in 2018. The EFM is a macro-economic projection model created by Market Economics Limited (M.E). The EFM is a multi-regional input-output model, capable of holistically capturing the economic, environmental and social impacts associated with changes in economic activity over the next 30 years. The EFM model provides employment, gross output and value added by sector, projecting future levels of economic activity anticipated in Dunedin City.

2.1 Population Projections

Dunedin's population is expected to increase from around 126,800 (2018) to 130,700 (2048) under a medium growth scenario, and from 129,400 to 152,000 over the next 30 years under a high growth outlook (Figure 2.1).

Following guidance by Statistics NZ issued in June 2019, it was recommended DCC use the medium-high projections scenario for Dunedin until 2028, and the medium growth scenario from 2028 until 2043[6]. Subsequently DCC has recently updated their population projections, which fall largely within the medium-high population projection range, for which the EFM model is run off.

Figure 2.1: Dunedin City Population Projections

Population Projections	2018	2023	2028	2033	2038	2043	2048	2018-2028		2028-2048	
								n	%	n	%
Medium	126,820	128,430	129,740	130,560	130,870	130,670	130,725	2,920	2.3%	985	0.8%
High	129,360	133,730	137,950	141,900	145,380	148,600	151,950	8,590	6.6%	14,000	10.1%
DCC Update (2020)	130,520	135,100	138,670	141,420	142,320	142,670	142,990	8,150	6.2%	4,320	3.1%

The updated population projections anticipate Dunedin will grow by an additional 8,150 (6.2%) people from 2018-2028, and by around 4,320 (3.1%) from 2028-2048. That is equal to an annual growth rate of 0.6% in the first 10 years, which declines to 0.2% per annum for the subsequent 20 years until 2048.

2.2 Employment Projections (MECs[7])

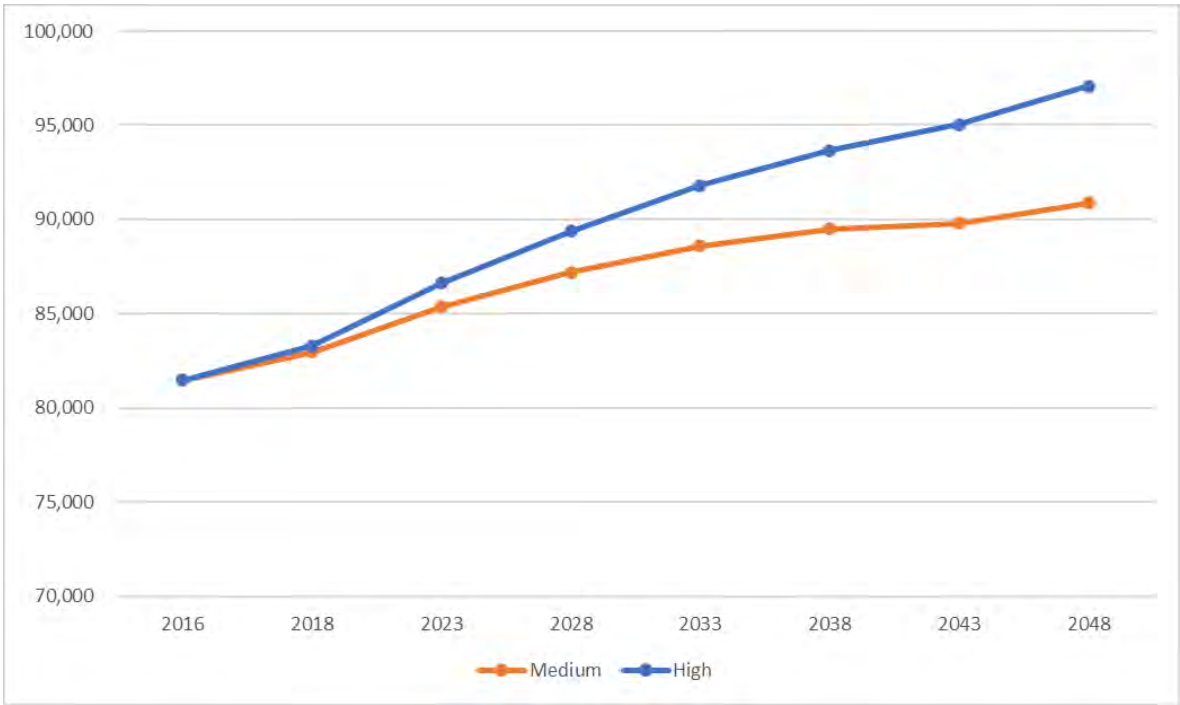
Given Dunedin's updated population projections reflect that of a medium-high scenario, employment for Dunedin City is projected to increase by somewhere between 4,200 and 6,100 workers until 2028. That is

[6] DCC, DRAFT 2020 Updated DCC Growth Projections 2018 to 2068 (June, 2020) – prepared pre COVID-19
[7] Modified Employment Counts – includes both employees and working proprietors.

a total of approximately 87,200 to 89,400 MECs (Figure 2.2). The next 20 years from 2028-2048 would see an additional 3,700 to 7,700 Modified Employment Counts (MECs), or total workers somewhere between 90,900 and 97,100.

The average annual growth rate for employment is slightly higher (0.5%) in the first 10 years to 2028 compared to the following 20 years from 2028 to 2048 where it is equal to 0.2%.

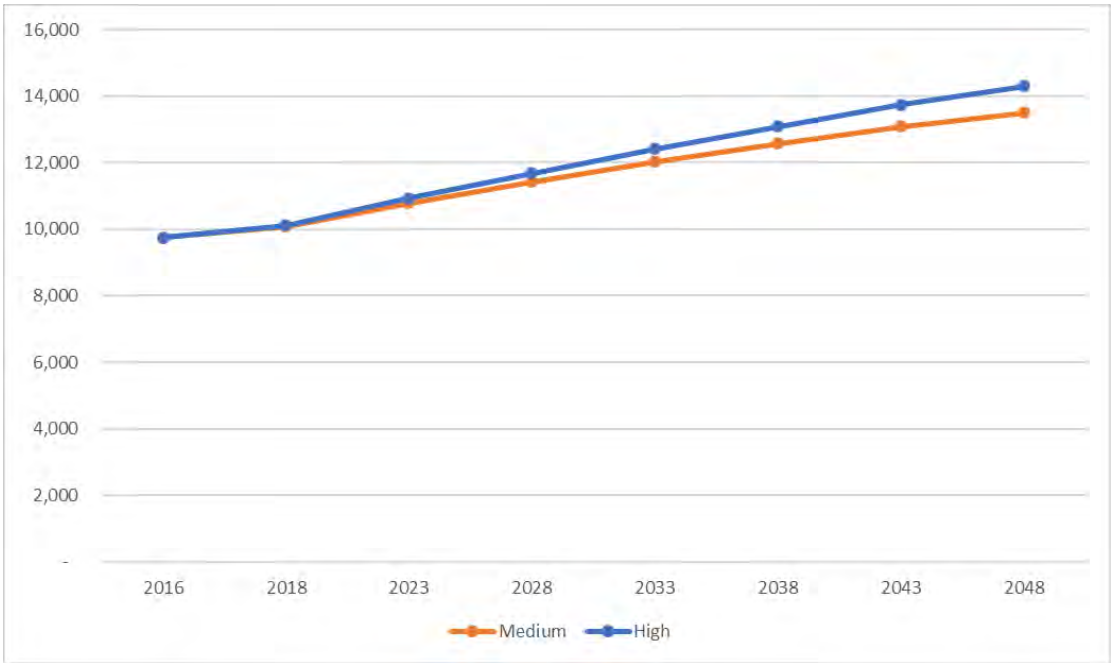
Figure 2.2: Employment Projections (MECs), 2016-2048



2.3 Gross Output

Figure 2.3 below illustrates gross output (in 2016 millions) under both the medium and high scenario for the Dunedin economy. Gross output is the total value of goods and services produced by an economic activity or industry. For each industry, gross output must also be equivalent to gross inputs. From 2018 to 2028 total gross output is anticipated to grow at around 1.3%-1.6% per annum, producing a total gross output somewhere between $11.4bn and $11.7bn in 2028.

Figure 2.3: Gross Output ($2016millions), 2016-2048



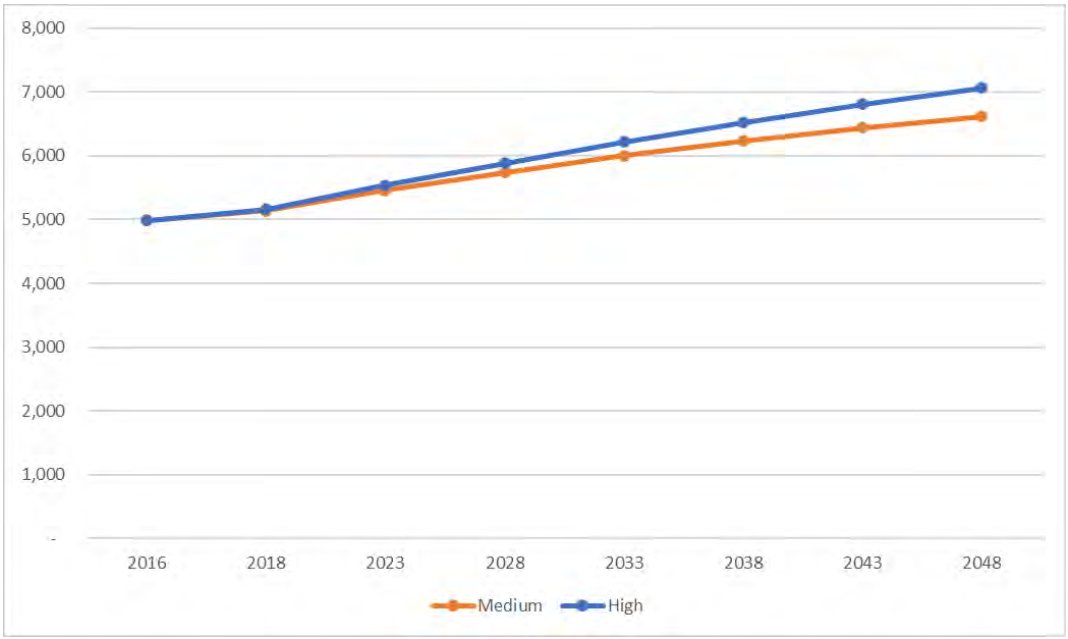
The value of total gross output is projected to decline slightly over the subsequent 20 years (2028-2048), an average annual growth rate of 0.9%-1.4%. Overall, gross output is anticipated to increase by somewhere between 34%-42%, an additional $3,400 and $4,200 in total gross output for Dunedin (2018-2048).

2.4 Value Added

Value added is the additional value added to goods and services by the contributions of capital and labour, i.e. the value of output after the cost of bought-in materials and services has been deducted. It includes the national accounts categories 'gross operating surplus', 'compensation of employees', 'other taxes on productions' and 'subsidies'. The sum of all value added is equal to gross domestic product (GDP), excluding taxes on products and import taxes net of subsidies. Thus in New Zealand, total value added is equal to approximately 88% of GDP.

Total value added for Dunedin is expected to increase to somewhere between $5.7bn and $5.9bn by 2028 and between $6.6bn and $7.1bn by 2048 (Figure 2.4). Overall, value added is projected to increase by an additional $1.5bn to $1.9bn (28%-37%), which translates to an average annual growth rate of 1.0%-1.2% over the next 30 years out to 2048.

Figure 2.4: Value Added ($2016millions), 2016-2048



2.5 Summary

The EFM provides projections for economic activity in Dunedin for the next 30 years to 2048 and are contained in Table 2.1. As the population, workforce, gross output and value added continue to grow overtime, Dunedin City will need additional infrastructure. The identified growth does not and will not occur at these rates unless Dunedin has a robust transport network in place. Aspirationally, Dunedin is seeking to reduce carbon emissions and encourage alternative transport options (PT and active modes) to promote economic growth and become one of the world's great small cities through transport, placemaking and liveability improvements. The SFDT programme aims to move Dunedin towards that goal.

However, even with significant shifts in mode usage, the city will still require investment for private car users to facilitate the output and employment growth outlined in Figure 2.5, below.

Table 2.1: Dunedin City Economic Projection, Medium and High Scenario EFM (2018-2043)

EFM Projections	2018	2023	2028	2033	2038	2043	2048	2018-2028		2018-2043	
								n	%	n	%
Employment (MECs)											
Medium	82,960	85,370	87,190	88,610	89,490	89,790	90,870	4,230	5.1%	7,910	9.5%
High	83,300	86,630	89,390	91,820	93,670	95,030	97,090	6,090	7.3%	13,790	16.6%
Gross Output ($2016m)											
Medium	10,080	10,790	11,430	12,030	12,580	13,080	13,510	1,350	13.4%	3,430	34.0%
High	10,120	10,930	11,690	12,420	13,090	13,740	14,300	1,570	15.5%	4,180	41.3%
Value Added ($2016m)											
Medium	5,140	5,460	5,740	6,000	6,230	6,440	6,620	600	11.7%	1,480	28.8%
High	5,160	5,540	5,880	6,220	6,520	6,810	7,060	720	14.0%	1,900	36.8%

3 Shaping Future Dunedin Programme

CDP have investigated a number of programmes to address the transport and placemaking issues options, both in terms of roading and non-roading. These programmes have focused on different alternatives for private vehicle, public transport, active transport, parking, urban design and encouraging behavioural change. In this section, a summary of the programmes are presented along with an alignment of the project with Central Governments Infrastructure Ready Projects assessment criteria. In the following section, the programmes are assessed in terms of their direct economic effects, both in terms of capital and operation. For the purposes of this report, Option 1 has been used for assessment.

3.1 SFDT Private Vehicle

The SFDT is proposing to maintain the existing one-way arterial pattern for State Highway 1. If the one-way system is kept as it is, other changes will need to be made to support the new hospital development. The change involves moving the main east-west route, from St Andrews Street to Frederick Street (shifting the State Highway 88 connection to State Highway 1 north). Also, improvements along the harbour arterial, Ward, Wharf and Strathallan Streets, which will allow more traffic to by bypass the hospital. These works on the roading network are expected to be completed over the coming six years, at a cost of $19.8 million for the State highways and $15.8 million for harbour arterial.

The Programme also includes a reduction in speed limits to 40 km/hr for parts of the CBD around State Highway 1 (see Figure 3.1 below). The Reduced Speed Zone includes the University of Otago in the north (up to Union Place), south past Queens Gardens (down to Jetty Street). The area is bound by George Street in the west and Grange Street in the west.

The operational costs associated with the changes proposed in the SFDT will result in minimal additional cost per annum. For this study it is assumed that operational costs are the same between the current network and the proposed network.

Figure 3.1: SFDT Programme – State Highway Network and Reduced Speed Zone

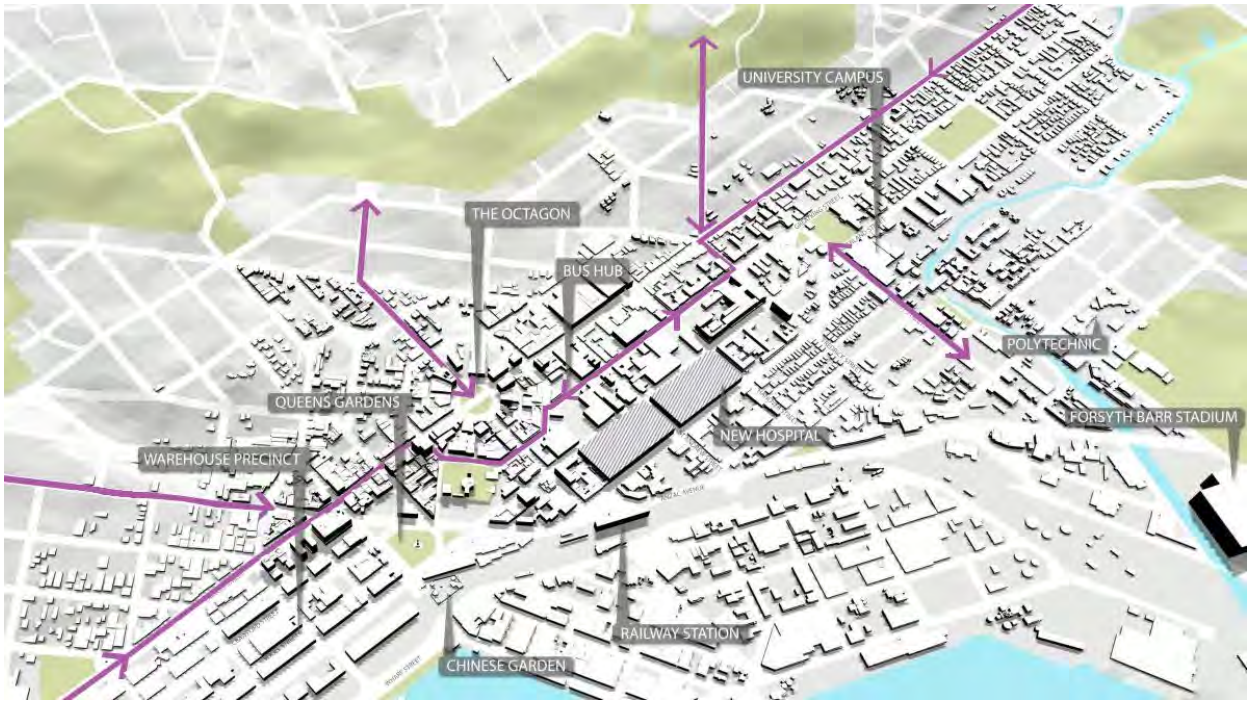


3.2 SFDT Public Transport

Another goal of the project is to improve public transport, in terms of frequency, fares, and quality. While the network of services will remain unchanged (see Figure 3.2), the frequency of services is proposed to increase in the short term and fares will be reviewed, also a free bus zone has been proposed. The quality of the service is to be improved with upgrades to bus stops. There is potential for the introduction of bus priority and the development of Park-and-Ride infrastructure, however the preferred option did not include funding to enable these potential changes.

The capital cost of the changes to public transport network is expected to be $14.4 million over the coming five years and $10.3 million for new Park-and-Ride facilities. While ongoing operating costs are expected to cost $1.6 million per annum, which covers increased frequency and reduced fares.

Figure 3.2: SFDT Programme – Public Transport Network



3.3 SFDT Active Transport

One of the goals of the Programme is to make it easier and safer for everyone to get around the central city via active modes, both on foot and cycling. The existing State Highway network acts as a barrier to east-west movement by pedestrians and cyclists. This is particularly important around the new hospital building and between popular destinations such as the Octagon and George Street, the University, the Polytechnic, the Railway Station, Toitū, the Chinese Gardens, Queens Gardens and the Warehouse Precinct. Also, the linkages between the CBD and the waterfront are constrained by the transport network.

The SFDT programme includes $10.9 million for capital works to improve the pedestrian and cycling networks. The works includes,

- Improving the quality of the footpaths on the main walking routes so they are safe for everyone to use, regardless of age and mobility.

- Adding more seating and planting to improve people's walking experience. This is particularly important around the new hospital building and between popular destinations.
- Providing more Barnes Dances at key intersections, more mid-block crossing points and moving e-scooter parking off footpaths.
- Placing a Reduced Speed Zone over much of the central city.

While there is substantial proposed investment in active transport, by and large the network will remain unchanged.

3.4 SFDT Parking and Behavioural Change

The SFDT research did consider parking options, with potential off street parking in the south and west of the CBD, which would cater for commuters from the south of Dunedin. Also, as noted above there was some assessment of potential for Park-and-Ride facilities for public transport users. The final SFDT programme also includes funding to allow management of car parking in the central city ($9.5 million). For this report it is assumed that constraints on car parking will not impact the economic growth in Dunedin CBD.

The SFDT also includes funding to encourage behavioural change, from commuting in private car to other modes. We understand that the programme will include funding for education which will target employees in major companies, which would include the new hospital, the university, and other large businesses. In total $1.2 million has been allocated to support behavioural change. SFDT will also include Urban Design and placemaking improvements.

Finally, we acknowledge that 80% of commuters use private cars to access the CBD. In the future the community and CBD economy are expected to grow, which will result in growing numbers of commuters in peak periods. If mode choice does not change then there may be parking capacity issues in the CBD, which could impact economic activity and access to other important facilities (i.e. the hospital).

3.5 Shovel Ready Infrastructure Projects

CDP are also keen to understand how SFDT development might fit with Central Governments infrastructure investment programme. By referencing Crown Infrastructure Partners Ltd ('CIP') criteria the Partners are seeking to align the economic benefits of SFDT with national and regional economic values (as set out in the CIP criteria), in particular those relating to primary and secondary job creation (both in construction and operation of the transport network) and also the flow on effect to local suppliers.

As part of the Governments response to COVID-19, they have sought information on 'shovel ready' infrastructure projects that have been impacted by COVID-19. In this instance, 'shovel ready' means projects that are ready for construction within a realistic 6 – 12 months. The task force established to gather and assess this information then is able to make decisions as to which projects are able to be deployed as part of a stimulatory package. In other words, provide a degree of funding to restart the project or to bring it forward (accelerate it). Included in the list of suitable projects are infrastructure projects that include maintenance and asset replacement projects.

While CDP are not currently intending to rely on additional central government funding for the SFDT project, by aligning the impacts of the project with national and regional economic values that are being

sought, helps ensure decisions made also align with those values. It is also possible that central government funding may be required, given the constraints on the NLTF.

The Infrastructure Industry Reference Group is supported by CIP who have been tasked with gathering the relevant project information. The group has identified 4 criteria projects must meet to be considered. They are;

- Criteria1: The extent to which the project is construction ready now or within a realistic 6-12 months – ***construction readiness***
- Criteria2: the project is of an infrastructure nature, either horizontal or vertical, and that the project is ***public or regional benefit infrastructure***.
- Criteria 3: Whether the project is of a ***size and has material employment benefits*** (i.e. $10m+), and,
- Criteria 4: The ***overall benefit and risks*** of the project.

The following discussion applies the four criteria to SFDT project.

Criteria 1: Construction Readiness

The CIP classification divides shovel readiness into 3 categories;

Category A – projects that are currently under construction and have been halted due to COVID-19 (or progressing slowly)

Category B – Projects which have a high expectation of commencing construction within 6 months (by 31 October 2021),

Category C – Projects which could be expected to commence construction within 12 months (but may not or may be delayed by COVID -19).

Based on my understanding of the data provided, the construction phase of the SFDT development is likely to begin within 12 months but not within 6 months. This means that regardless of the impact of COVID-19 on timetables, the project will fall into **Category C.**

Criteria 2: Public or Regional Benefit

CIP will categorise projects based on whether they have a public or regional benefit. The categories are;

- Transport, Three waters, Buildings and Structures, and other infrastructure

Infrastructure will be classified as;

- Critical infrastructure
- New infrastructure
- Replacement/refurbished infrastructure
- Repurposed infrastructure

SFDT fits into the "**Transport**" category as "**Replacement/Refurbished infrastructure**" as it mostly refurbishes the transport network which has reached capacity and is on longer fit for purpose. The construction of the new hospital has been a catalyst, it presents an opportunity to upgrade the network to meet the medium and long term needs of Dunedin. Also the works are critical to ensure the continued access to the city during construction period. This access will be disruptive through harbour arterial

upgrade and public transport improvements. Also the changes to SH88 will address urgent safety issues on Princes Street.

Criteria 3: Size and Material Benefit

CIP have identified that projects of greater than $10m are considered as having the size and material benefit to be considered. Given that the capital cost to develop SFDT is expected to be over $100 million over the coming decade, means that the SFDT project meets this criteria.

Criteria 4: Overall Benefits national and regional

Under this Criteria, CIP are seeking projects that will benefit the wider public or a particular region. Examples included that meet the criteria include transport projects, community facilities, potable water supply, stormwater, schools hospitals and nationally significant infrastructure such as ports and airports. In addition, they highlight infrastructure that supports key industries and tourism.

Against that backdrop, SFDT matches more than one example therefore is likely to meet the threshold. SFDT is designed to improve the connectivity to and within the CBD. This area contains a large share of the employment in the district and many large institutions. As such it forms a vital component of Dunedin's economy and will be critically important to the goal of promoting economic growth in the district and region. Also, the programme aims to improve the transport network to account for the location of new hospital, in terms of connectivity to the community and other major institutes (i.e. Otago University and Otago Polytechnic). The project also has been developed to minimise the disruptions that may result during the construction phases.

Risks and Impacts of COVID-19

Having established the role the project will potentially play in the region or community, CIP will assess risks of the project not commencing within the advised timescale, or being completed on time (or at the specifications or on budget), and of the project not delivering the benefits outlined in the benefit section above. They will also seek to understand what impact COVID-19 has had on the project;

- Whether the project will commence when COVID-19 conditions allow,
- What the financial implication of COVID-19 have been or will be on the project, and,
- Whether the project will benefit from or already has benefited from any already implemented Government financial support package (e.g. the wage subsidy or business finance guarantee scheme).

Those questions are beyond the scope of this report, but will be able to be addressed by the project management team and CDP once a design and construction plan of works has been agreed if the Partners pursues additional central government funding. However, the economic impacts and the benefits that flow to local ratepayers are improved if Central Government contributes more as part of any COVID-19 stimulus package.

4 Potential Economic Implications

The SFDT programme is designed to improve connectivity, both within the CBD and to suburban areas of Dunedin. The economic performance of a CBD is inexplicitly linked to the ability of the transport network to move people (workers, students, residents, tourists, etc.) and goods into and around the area. It is well established that the benefits and costs of a transport network go beyond the direct transport costs required to move goods and people. The economic implications of transport investments will flow indirectly to the wider community and economy. Many of these benefits and costs are measured in the SFDT Business Case, which covers both direct impacts (travel time, travel costs, etc) and some of the wider economic impacts (agglomeration of businesses and socioeconomic).

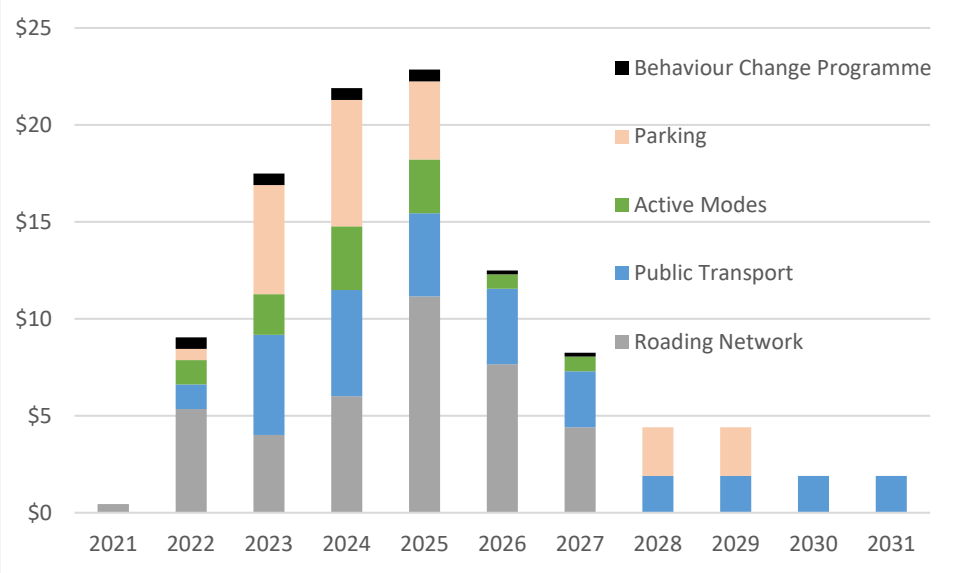
This report does not replicate the assessment undertaken for the Business Case, rather it provides a separate measurement the economic implications of the capital and operating expenditure which will flow through the economy. The potential economic implications of the proposal are estimated in this section and expressed in terms of the net additional impacts in the Dunedin City, Rest of Otago Region and Rest of New Zealand economies.

4.1 Shaping Future Dunedin Direct Activity

The direct economic activity that will occur as a result of the capital and operating expenditure is mostly going to occur over the coming four years. In total the SFDT programme is proposing $88.9 million of capital works and $16.2 million of operational expenditure.

While a large share of the allocated expenditure is focused on upgrades to the roading network (37%), a considerable amount has been allocated to public transport (29%) and active modes (10%). Figure 4.1 shows the timing and nature of the capital and operating spend between 2021 and 2031. The programme works are expected to peak in 2025 reaching $22.8 million and then reducing to $4.4 million by 2028 as the construction works are completed, then plateauing at $1.9 million at 2030 and onwards.

Figure 4.1: SFDT Programme – Capital and Operating expenditure 2021 – 2031



While the capital costs are 'lumpy', in that they vary through time, for modelling purposes they are (mostly) not assumed to be loan funded. According to the current plans approximately $66 million will be funded by NZTA, which is mostly related to the works on the roading upgrades for the State highways. The remaining funding will come from Otago Regional Council ($12 million) and Dunedin City Council ($26 million), which mostly relates to works on the local roads, public transport, carparking and active modes, along with the ongoing operational costs associated with the increase in the public transport services. Ministry of Health is expected to cover a small share of the costs of the project, approximately $1 million.

4.2 Modelling Assumptions

Key assumptions modelled include;

- Capital and operating costs are based on the Stantec works assessment for SFDT.
- Analysis in NPV terms occurs over 10 years.
- Discount rate of 4% is applied, which is consistent with the standard rate recommended by NZTA.
- Most capital expenses are funded by way of central government and council funding sources, so no loans are required.
- The expenditure by Dunedin City Council is assumed to be loan funded over the life of the project (40 years), which has the same rate of interest as the latest LGFA bonds.[8] Repayment of loans reduces spending elsewhere in the economy.

4.3 Economic Impact Model – IO Framework

Earlier work prepared in advance of this research focused on a project evaluation using standard NZTA methodologies. The standard evaluation method treats expenditure on the project as a cost and does not consider the implications of this activity for employment or economic activity within the local economy. This is because the EEM (and MBCM) is designed to assess the costs and benefits from a national perspective, at this level the project capital and operating expenditure has an opportunity cost, as these funds would be spent elsewhere on a different project which would also have similar economic activity associated with it.

Therefore, the Business Case and associated research does not consider the local economic effects associated with the capital works and operating activity. This report does not repeat the national level project assessment as it does not provide local level understanding of the activity that could be generated in Dunedin economy. Instead, this report presents the local economic impacts of the proposal to develop SFDT programme.

The project evaluation of the investments tells the national level story, but do not convey the actual economic effects the investment is likely to have on Dunedin. For this, it is necessary to analyse to alternatives using an Input Output model framework.

Input-Output models are transactional frameworks of the local regional and national economies, that capture the financial interactions between sectors, households and the government. They reflect the technology of an economy at a point in time and while this changes, they can be used to provide an

[8] New Zealand Local Government Funding Agency (2020) Tender 75 – October 2020.

understanding of how different levels and distributions of investment flow through an economy generating;

- Additional Gross Output.
- Additional Value Added (broadly GDP)
- Additional Employment measured in full time equivalent jobs.

An IO Model allows estimation of net additional impacts if the inputs are net of spending that would otherwise have occurred. In addition, the IO framework used in this project allows changes in household spending to offset the additional spending required to develop the SFDT. In this case the additional capital spending required by Dunedin City Council is funded by a 30 year loan. Council then applies the funds to the development and begins the process of repaying the principal and interest over 40 years. This happens the following year as they borrow more funds for year 2 capital requirements and so on.

We have spread the repayments out over 40 years starting at the year the capital is required. In the absence of other information, we assume that the repayments are rates funded, with a corresponding rates increase. If Council were to readjust other expenditure, we assume that the reductions elsewhere equate to the value lost by households if they had to fund SFDT.

In each year, the economy is impacted in two main ways during the development of SFDT. First, money is spent in the Construction sector to develop the transport programmes. The Construction sector purchases raw materials, pays wages and salaries, hires other specialist contractors, makes profits and pays taxes. All of these activities increase employment and GDP in Dunedin. Second, the additional rates that are required to fund the development mean that Dunedin households have less money in their pockets. This results in less spending in Dunedin and a slight reduction in employment and GDP. We have assumed that the reduction is distributed across all spend categories in proportion to the manner in which households currently spend.

The net result of both these changes (in direct spending terms) is then run through the IO Model to provide estimates of additional Gross Output, Value Add and employment, for each year for SFDT programme. Additional information is contained in Appendix 1 to this report.

In the sections that follow, the SFDT programme is assessed through the IO Model framework and the results are aggregated in nominal and NPV terms.

4.4 ME Multi-Regional Input Output Model

ME's Multi-Regional Input Output model (MRIO) divides the economy into 48 distinct sectors and three geographies – Dunedin City, Rest of Otago Region and Rest of New Zealand. A MRIO has advantages over a single economy model as it captures the full range of effects across local authority boundaries. It is often the case that a development within the boundaries of Dunedin City will also stimulate activity across the rest of Otago Region. In addition, it is likely to be the case that reductions in Dunedin Household expenditure will reduce their spend across the rest of New Zealand.

Appended to this report is a description of the economic sector structure used in the model.

While a financial analysis captures the direct effects of investment, an IO framework allows estimates of the flow on effects of additional expenditure. As CDP spends money in the construction sector they spend money with their suppliers, who then use that to pay wages, salaries, make profits and purchase from their

suppliers or raw materials. Each of these businesses then pay wages, taxes, make profits and purchase raw materials and so on.

At each step, value is added and people are employed. An IO model allows estimates of those changes to be generated. A MRIO allows estimates of those changes to be made across the wider region and the rest of New Zealand. This is important as the majority of material suppliers are unlikely to be located within Dunedin City – or even the Otago region. Many construction materials will come from the rest of New Zealand or be imported. These transactions are recorded in the model framework and incorporated into the model outputs.

4.5 Shaping Future Dunedin: IO Assessment

The development of SFDT programme results in a net additional direct expenditure over the 40 years of $109.1 million in nominal terms in Dunedin. Once this flows through the economy it translates into Total Gross Output of $203.1 million in nominal terms or $160.1 million in $NPV_{4\%}$ terms. Gross Output (GO) is the broadest or widest measure of economic activity. It is simply the summation of all the transactions that have to occur within an economy to achieve a certain outcome. Because it is the sum of the total value of these transactions it makes no distinction between a transaction that might consist of mostly goods purchased overseas but might be required for the development, and transactions that involve locally generated content such as services delivered by local residents or goods made within Dunedin. It is therefore an unreliable measure of additional economic value or the benefits it brings.

Because transactions that occur within Dunedin may result in activity being stimulated outside the district, the development of SFDT programme leads to a further $24.6 million of GO in NPV terms in the rest of Otago Region and $52.3 million across the Rest of New Zealand.

Table 4.1: SFDT Programme Total Gross Output by Economy

Location ($m)	Discounted Total	Nominal Total
Dunedin City	$ 160.1	$ 203.1
Rest of Otago	$ 24.6	$ 30.3
Rest of New Zealand	$ 52.3	$ 63.1

Note NPV 4% and 40 years

This level of output generates a $76.3 million in net additional Value Add in the Dunedin economy over 40 years in nominal terms. However, once these flows are discounted at 4%, the total value added is $59.9 million. Note that Total Value Added includes the direct, indirect and induced effects of the development. A full definition of these terms is contained in Appendix A. Value Add is the component of each transaction that 'adds value' to the local economy. It is a truer measure of the effect of the development on people's wellbeing, within this economy. In summary, it contains the effects of firms directly and indirectly impacted by the development of SFDT programme, along with the wages and salaries they pay their employees, who then spend money in the local economy (Table 4.2).

Table 4.2: SFDT Programme Total Value Added by Economy ($)

Location	Discounted Total	Nominal Total
Dunedin City	$ 59.9	$ 76.3
Rest of Otago	$ 9.9	$ 12.2
Rest of New Zealand	$ 23.6	$ 28.4

Note NPV 4% and 40 years

In employment terms, the activity generated by the development and operation SFDT programme once it flows through the economy is equivalent to over 1,901 full time job equivalents across the 40 years of operation (within Dunedin City). Over the initial 10 years, developing SFDT programme will stimulate the equivalent of 1,154 full time jobs for 1 year (115 on average annually). This is made up from high levels of employment through the construction phase (peaking at 93 full time equivalents directly and flow on employment) during the first few years of operation. Employment is also stimulated across the rest of the region in the first 10 years (126 full time equivalent jobs) and the rest of New Zealand. In both cases the key stimulus is through the construction phase, as these both show a smaller number over the full 40 year duration.

Table 4.3: : SFDT Programme Total Employment sustained (MEC)

Location (MEC)	Additional Employment	Additional Emp. (10 yrs)
Dunedin City	1,901	1,154
Rest of Otago	156	126
Rest of New Zealand	247	238

In Table 4.4 below, Construction sector direct employment effects have been isolated from the total, based on the capital expenditures to establish SFDT programme. These employment estimates for the Construction sector are direct values and have not been offset by any potential reduction in activity in the Construction sector from reductions in Council spending elsewhere.

Table 4.4: Construction Sector Direct Employment Effects – SFDT Programme (MECs)

	Planning (2021)	Construction (2022-26)
Construction Sector	2	349

4.6 Sensitivity

The results presented above are sensitive to changes in assumptions made about scale timing, levels of investment and share of funding. For example, the funding share between government and councils has been decided based on standard allocations, i.e. NZTA funds all of the works relating to the State highways and approximately half of works on local network. The remainder of the funding is allocated to the councils.

In most cases, councils will collect funds from major developers to pay for network upgrades to meet growth demands (Development Contribution), this is especially the case when there are major developers that are driving the need for the network upgrades. SFDT programme is driven by the development of a new hospital and upgrades of the University, both developments are driven by central government. However, the councils are unlikely to be able to collect a contribution from these organisations except where works are directly related to the projects – such as St Andrews St. Therefore, the funding will need to be collected from rate payers.

This issue may be addressed by reallocating the funding contributions, so that NZTA or the Crown pays for a larger proportion to reflect the fact that central government is a major reason for the new development. This change in proportion would mean that more of the capital costs do not have to be sourced from the local economy, they reduce the amount Dunedin residents have to 'pay back'. This reduces reductions in spend elsewhere in the economy raising the local impacts at the detriment of elsewhere.

In Table 4.5, NZTA contribution to the project is increased by 50%. This means less money has to be funded from rates and the total contribution to Value Added within Dunedin then increases to $63.9 million in NPV terms over the project life (from the $59.9 million outlined in Table 4.2).

Table 4.5: SENSITIVITY TEST: SFDT Programme increase NZTA Fund Share by 50%, Total Value Added ($m)

Location	Discounted Total	Nominal Total
Dunedin City	$ 63.9	$ 82.3
Rest of Otago	$ 11.0	$ 13.9
Rest of New Zealand	$ 26.7	$ 32.9

Note NPV 4% and 40 years

5 Conclusions

Dunedin's central city transport network has functioned largely unchanged for about 50 years and presents several barriers to people coming into and moving around the central city. The process of identifying how the Dunedin transport network operate to meet the needs of the community and economy has resulted in the SFDT programme. For the purposes of this report, Option 1 has been used for assessment. No decision has been made as to the final funding of the SFDT programme.

New large-scale developments, particularly the new hospital ($1.4 billion) and planned works at University of Otago ($650 million), presents an opportunity to consider whether the network is appropriate for the medium and long term.

The economic analysis presented in Section 4, above concludes that consenting, constructing and operating SFDT programme will facilitate employment and GDP effects over 40 years.

In total, the development of SFDT programme is expected to generate a net additional contribution to GDP of $59.9 million in NPV over its usable lifetime. Sensitivity analysis indicates this has the potential to increase to $63.9 million if NZTA funds more of the works.

The analysis showed that SFDT programme would sustain an additional 1,901 employment job years of which 1,154 occur within the first 10 years. This is dominated by employment in construction sector in the first 5 years – peaking at 93 job year equivalents.

Appendix 1: IO Modelling

One of the assets of Input-Output modelling is that the results it provides are easy to identify and digest, and relatively easy to use once Input-Output tables are available for a particular region. However, IO analysis is not without limitations, despite being widely applied in New Zealand and around the world. The most common limitations relate to the historical nature of IO Tables. We use IO tables derived from the latest Supply and Use Tables, derive the IO tables and update these to 2016 using available information.

With reference IO modelling in general, a key assumption is that input structures of all industries (i.e. technical relationships) are fixed. In the real world, however, technical relationships will change over time. These changes are driven by new technologies, relative price shifts, product substitutions and the emergence of new industries. For this reason, IO analysis is generally regarded as suitable for short-run analysis, where economic systems are unlikely to change greatly from the initial snapshot of data used to generate the base IO tables. In addition to the 'fixed structure' assumption, other important assumptions (and limitations) of IO models are:

- Constant return to scale: This means that the same quantity of inputs is needed per unit of output, regardless of the level of production. In other words, if output increases by 10 per cent, input requirements will also increase by 10 per cent.
- No supply constraints: IO assumes there are no restrictions to inputs requirements and assumes there is enough to produce an unlimited product.
- The model is static: No price changes are built in meaning that dynamic feedbacks between price and quantity (e.g. substitution between labour and capital) are not captured.

The following indicators are used to measure economic impact:

- Value added measures all payments to factors of production (land, labour and capital), and excludes all purchases of intermediate inputs. It broadly equates with gross domestic product (GDP) as a measure of economic activity on the national level, and gross regional product on the regional level. Components of value added include compensation of employees (salary and wages), operating surplus (company profits), consumption of fixed capital (depreciation), and subsidies.
- Employment is measured in Modified Employee Count years (MECs). This is the number of full-time and part-time employees as well as working proprietors on an annual basis. This provides a measure of the labour demand associated with the estimate level of economic activity. Note that additional MEC-years do not necessarily require that additional persons be actually employed. It may mean existing employees or proprietors work longer hours to complete the additional work.

Appendix 2: 48 Sector Economy

IO_48_Code	IO_48_Name
1	Horticulture and fruit growing
2	Sheep, beef cattle and grain farming
3	Dairy cattle farming
4	Poultry, deer and other livestock farming
5	Forestry and logging
6	Fishing and aquaculture
7	Agriculture, forestry and fishing support services
8	Mining, quarrying, exploration and other mining support services
9	Oil and gas extraction
10	Meat and meat product manufacturing
11	Dairy product manufacturing
12	Other food manufacturing
13	Beverage and tobacco product manufacturing
14	Textile, leather, clothing and footwear manufacturing
15	Wood product manufacturing
16	Pulp, paper and converted paper product manufacturing
17	Printing
18	Petroleum and coal product manufacturing
19	Chemical, polymer and rubber product manufacturing
20	Non-metallic mineral product manufacturing
21	Primary metal and metal product manufacturing
22	Fabricated metal product manufacturing
23	Transport equipment manufacturing
24	Machinery and equipment manufacturing
25	Furniture and other manufacturing
26	Electricity generation and supply
27	Gas supply
28	Water, sewerage, drainage and waste services
29	Construction
30	Wholesale trade
31	Retail Trade
32	Accommodation and food services
33	Road transport
34	Other transport, postal, courier, transport support and warehousing services.
35	Air and space transport
36	Information media and telecommunications
37	Finance
38	Insurance and superannuation funds
39	Auxiliary finance and insurance services
40	Rental, hiring and real estate services
41	Ownership of owner-occupied dwellings
42	Professional, scientific, technical, administrative and support services
43	Central government administration, defence and public safety
44	Local government administration
45	Education and training
46	Health care and social assistance
47	Arts and recreation services
48	Personal and other services

Appendix P DCC's Projects - Scope Details

Central Cycle and Pedestrian Safety

Single Stage Business Case	$350,000	**Year**	2021/2022
Implementation	$7,400,000		2021/2022 - 2025/2026

1. Problem/Opportunity

- Dunedin is an area of high concern for pedestrian and urban intersection crashes.
- The improvements introduce a slow speed zone in the core area and provide Barnes Dance crossings at signalised intersections to reduce risk to pedestrians.
- The improvements also target specific streets in the central city which have high pedestrian volumes and at the same time poor levels of service for pedestrians, resulting in poor accessibility and safety for these road users. There have been 19 crashes that have resulted in a death or serious injury in the last five years (2015-2019) on the streets proposed for improvements. George/Bank Street has a medium-high collective risk, St Andrew Street has a high collective risk and Albany Street has a low-medium collective risk (according to KiwiRAP NZ Road Assessment Programme).
- There are level of service gaps in the cycle network that result in a disconnected network that is does not achieve desired benefits. The Harbour Walk/Cycleway is not connected to the city centre or Tertiary area.

2. Scope

The SSBC will identify the preferred design option for safety improvements and provision for pedestrians and cyclists in the slow speed zone, and on two central city streets:

- *St Andrew Street from Anzac Avenue to Great King street*
- *Albany Street North/South Extensions:*
  a. *George Street to Cumberland Street*
  b. *Anzac Avenue to the Harbour Circuit via Minerva Street*

The budget is for implementation of the preferred option for the above streets, the slow speed zone improvements, as well as for implementation of safety improvements on George/Bank Street from Frederick Street to North Road. Designs for this section have been completed as part of the Safer Streets SSBC.

a. Slow Speed Zone

The extent of the slow speed zone is to be confirmed, along with any interventions required to achieve the slower speeds. Initial indications are that it will be from Albany Street to Queens Gardens, joining the slow speed zone on George Street and extending east as far as SH1 southbound. Within the slow speed zone, Barnes Dances will be installed at traffic signals where appropriate. Waka Kotahi NZ Transport Agency (Waka Kotahi) are planning to lower the speed on SH1 northbound and southbound, and these routes are excluded, however there will be collaboration with Waka Kotahi to ensure designs align and are not confusing for users.

b. Albany Street North/South Extensions

The Tertiary Precinct SSBC will identify a preferred design for Albany Street between Cumberland Street and Anzac Avenue to improve safety and provides better facilities for pedestrians and cyclists. However, the rest of Albany Street to George Street in the north and to the Harbour Circuit in the south and represents a gap. Providing a complete route will unlock the benefits of investment by ensuring it is connected to existing walk/cycleways.

Designs for the two additional sections will need to be consistent with and provide a seamless connection to the design for the central section that is currently being developed through the Tertiary Precinct SSBC. It is anticipated that the preferred option for the central part will contain either a

buffered cycle lane or a separated cycleway, multiple pedestrians crossing points, speed management measures, intersection improvements/reconfiguration and a bus super stop.

c. St Andrew Street

This project seeks to create a safe, pedestrian focus on St Andrew Street. It will be a jointly developed project between the Council, Waka Kotahi and the Ministry of Health. It is assumed costs will be split equally between the three partners, as each has an interest in the road as follows:

Ministry of Health (MoH): The road passes between the two new hospital sites, and therefore the design of the road is central to the success and safety of the new hospital development. The MoH already have some design criteria for the section between Cumberland and Crawford Streets, and anticipate this area having a slow speed with a pedestrian focus for people crossing the road and accessing both sites, whilst also being used as a drop off area and needing to accommodate the vertical structures for two proposed pedestrian airbridges between the hospital buildings, which are part of the design.

Waka Kotahi: Currently St Andrew Street (from Anzac Avenue to Crawford Street) is owned and managed by Waka Kotahi, and forms part of SH88. The SH88 function will be moved to Frederick Street as part of the hospital redevelopment, as the function and required form is in conflict with the new land use. It is anticipated that St Andrew Street will become a local road once the works are complete, to be managed by the Council rather than Waka Kotahi. A revocation process is required to change the status of the road.

Dunedin City Council: The Council's interest is:

a. Ensuring the asset is in a suitable condition when it becomes a local road – that it has been adequately maintained and facilities are as would be expected for a central city local road.
b. Ensuring the designs for the hospital block are suitable and safe, and meet Council's standards for a pedestrian focussed area.
c. Ensuring a safe route is provided for cyclists from the Anzac Avenue and Thomas Burns shared path to the hospital and the central city. It is anticipated that with slower speeds and traffic volumes, cyclists will be able to share the road with vehicles. However, signs and markings such as sharrows and advanced stop boxes at intersections will be required.
d. The George Street Project will consider safety, walking and cycling on St Andrew Street between George Street and Great King Street, and the designs for the rest of St Andrew Street will need to be consistent with that project.

The SSBC will focus on an integrated solution which meets the needs of the three partners and provides a good outcome for the city.

d. George Street/Bank Street

This route forms part of the Safer Streets project which seeks to improve road safety and walking and cycling access on Dunedin's arterial streets. The route forms an important walking and cycling connection between the North East Valley, North Dunedin and central city destinations as well as to George Street Normal School and local businesses. A preferred option has been developed which improves road safety, pedestrian and cycling accessibility. The main features are cycle lanes, new crossing points, intersection improvements/reconfigurations, speed management measures, bus stop reallocations and a school zone.

As a design has already been developed, this street will not be included in the SSBC but can proceed directly to pre-implementation.

3. Cost Estimates

Initial cost estimates have been prepared to support the inclusion of the project in the RLTP and DCC's LTP, as shown in the following table.

Notes:

Albany Street North/South Extensions: the budget below is only for the north/south extensions of the original Albany Street project. The budget for the original Albany Street project is in the Tertiary Precinct Project.

St Andrew Street: Only the Council's contribution to St Andrew Street improvements is included below. It is assumed this will cover a third of the costs, with a third covered by MoH and a third by Waka Kotahi.

George Street/Bank Street: Only the Council's contribution to George Street/Bank Street is included below. The budget is currently within the Safer Streets project.

Item	Assumptions	Cost Estimate
SSBC	Develop business case for St Andrew Street and Albany Street north/south extensions, evaluate options, modelling, develop designs, consultation. St Andrew Street work to be developed in collaboration with Waka Kotahi and MoH.	$350k
TOTAL SSBC		$0.35m
Slow speed zone	Measures to reduce speed and improve pedestrian crossings through Barnes Dances and raised platforms, signs and markings (local roads only).	$0.9m
Albany Street North/South Extensions	Cumberland Street to George Street to include an off-road shared path for walking and cycling. Anzac Avenue and Minerva Street to include a shared path and quiet street solution.	$2.9m
St Andrew Street [Council share]	Create a slow speed shared space with pedestrian priority between the new Hospital buildings as well as a safe cycle route from the Harbour Circuit to the central city.	$1m
George Street/Bank Street [implementation money from Safer Streets Arterials]	Albany Street to Bank Street to include raised platforms for pedestrian crossing, an intersection upgrade at the George/Park/Regent/St David Street intersection, midblock crossing points and painted buffers for the existing cycle lanes.	$2.6m
TOTAL CONSTRUCTION	(Contingency included in each line item)	**$7.4**
GRAND TOTAL		**$7.75m**

4. Timing

Phasing has been indicated for the RLTP and DCC's LTP as follows:

Project	21/22	22/23	23/24	24/25	25/26	26/27	27/28	27/28	TOTAL
Central Cycle and Pedestrian Safety	$1.25m	$1.44m	$1.26m	$1.9m	$1.9m				**$7.75m**

Bike Hubs

Single Stage Business Case	$200,000	**Year**	2022/2023
Implementation (LCLR)	$2,250,000		2024/2025 – 2026/2027

1. Problem/Opportunity

- Public bicycle parking in Dunedin is distributed across the central city where there is space at the side of the footpath. Stands are grouped together, and cyclists use a chain to secure their bicycles. There are currently 110 public bike stands in the central city to service the 1000 people who cycle daily in Dunedin.
- Where no bike parking is provided, cyclists chain their bikes to the street furniture e.g. lighting poles, parking sign poles and fences. This can obstruct the footpath and create a hazard for pedestrians.
- The current bike stands have limited security and stability. Bikes can fall over whilst chained resulting in footpath obstruction and/or damage.
- There are only two areas where bike parking is under cover (Vogel Street, Moray Place).
- Most workplaces and public destinations have no bike parking facilities available for their visitors or employees.
- The creation of Bike Hubs in the central city will raise the profile of cycling.
- The Bike Hubs create an opportunity to partner with businesses and landowners to implement bike hubs on private land for the community to enjoy.
- The Bike Hubs provide an opportunity to promote active and sustainable travel to more people, delivering on the city's carbon zero and mode share goals.

2. Scope

The SSBC will provide a holistic plan for the central city, determining the number, best locations and extent of bike hub facilities necessary to cater for current demand and ensure the city is future proofed for growing demand as well as emerging micro-mobility and active EV modes. The scope includes ensuring safe access to the hubs from the cycle network.

The study area includes the central business district and the Tertiary Precinct, as illustrated in the image below.



Dunedin has so far completed 54km of cycle facilities across the city, which equates to 30% of the 178km Strategic Cycle Network. The location of the hubs would tie into the existing cycle network to enable some of the 1000 people who ride around our city daily to utilise them.

It is expected that there will be three bike hubs provided initially – located near to the Octagon, the Exchange and The Tertiary Precinct (in partnership with the Tertiary Partners).

The bike hubs may include:

a. Wayfinding signage to direct cyclists to the bike hubs.
b. Sheltered secure cycle storage.
c. Facilities such as repair/maintenance services, toilets/showers, café, lockers.
d. Cycle hire.
e. Information e.g. cycle maps, route planning, active travel and road safety promotion, bike maintenance education.

Some examples of Bike Hubs developed elsewhere in New Zealand and internationally include:






YOUR BIKE






Wellington Bike hub


CROYDON CYCLE HUB


BIKE
Nelson Bike hub


Unitech bike hub





3. Cost Estimates

Initial cost estimates have been prepared to support the inclusion of the project in the Regional Land Transport Plan and Dunedin City Council 10 Year Plan, as shown in the following table.

Item	Assumptions	Cost Estimate
SSBC	Develop business case, evaluate options, develop designs, consultation	
Legal	Investigation of property arrangements	
TOTAL SSBC/Legal		$0.2m
Construction	Assumes three hubs are provided, requiring no land purchase, working in partnership with landowners. Includes minor improvements to enable access, if required.	$1.27m
Urban design	Sum to help highlight the hubs, provide for outdoor utilisation of the area and aid access/egress in the general vicinity	$0.3m
Construction Contingency	30%	$0.68m
TOTAL CONSTRUCTION		**$2.25m**
GRAND TOTAL		**$2.45m**

4. Timing

Phasing has been indicated for the RLTP and DCC's LTP as follows:

Project	21/22	22/23	23/24	24/25	25/26	26/27	27/28	27/28	TOTAL
Central City Cycle Hubs		$0.2m		$0.75m	$0.75m	$0.75m			**$2.45m**

Harbour Arterial Efficiency Improvements

Single Stage Business Case	$800,000	**Year**	**2021/2022**
Implementation	$15,000,000		**2021/2022 - 2026/2027**

1. Problem/Opportunity

- Dunedin's Harbour Arterial is a busy route, carrying around 16,600 vehicles per day.
- Currently the route does not operate efficiently to provide an attractive route to/from the port and as a central city bypass for general traffic. The off-peak travel time is 6 minutes, whilst the peak travel time at 5pm is around 12 minutes. The improvements are expected to improve the peak travel time by 30%.
- The existing route crosses the railway line at grade. On average, there are five trains per day (Monday – Saturday) which cause the route to be closed for an average of five minutes each time. The diversion, which only available to some drivers, adds approximately five minutes to the journey. Upgrading the harbour arterial will remove this disruption for all drivers as the route utilises the Ward Street overbridge.
- There are issues with intersection layouts and a number of long-standing safety issues, with six deaths/serious injury crashes in five years (2015-2019).
- Upgrading this alternative route is important given the expected travel disruption that will be experienced during the construction of the New Dunedin Hospital, which will require use of part of both SH1 carriageways at various times, until hospital completion in 2030.

2. Scope

The SSBC will provide a design solution for the Harbour Arterial corridor, focussed on improving safety and efficiency for all modes, particularly general traffic and freight accessing the Port. The route will provide a preferred alternative to the existing at grade rail crossing.

The Harbour Arterial route will utilise the following roads (south to north): Caversham Motorway (SH1)/Andersons Bay Road intersection – Andersons Bay Road – Strathallan Street – Wharf Street - Thomas Burns Street - Ward Street – Ward Street overbridge - Frederick Street/Anzac Avenue intersection.

The scope will include:

a. Direction signage and real time information regarding congestion/delays on SH1 and the Harbour Arterial
b. Major and minor intersection upgrades to address known safety and efficiency issues
c. Corridor improvements
d. Upgrade to the Ward Street overbridge
e. Minor improvements for pedestrians and cyclists, landscaping

3. Cost Estimates

Initial cost estimates have been prepared to support the inclusion of the project in the RLTP and DCC's LTP, as shown in the following table.

Item	Assumptions	Cost Estimate
SSBC	Develop business case, evaluate options, modelling, develop designs, consultation	$800k
Signage	Real Time Information Signs displaying travel times (x4), directional signs	$500k
Intersection changes	Andersons Bay Road/Strathallan Street/Kensington Road	$3.2m
	Strathallan Street/Portsmouth Drive	
	Kitchener Street/Wharf Street – new traffic signals	
	Roberts Street/Wharf Street (turn restrictions)	
	Birch Street/Wharf Street (turn restrictions)	
	Fryatt Street/Wharf Street (turn restrictions)	
	Willis Street/Thomas Burns Street (turn restrictions)	
	Creswell Street/Thomas Burns Street (turn restrictions)	
	Bombay Street/Thomas Burns Street (turn restrictions)	
Harbourside Industrial area improvements	Network improvements within the harbourside industrial area to improve access	$1.4m
Pedestrians	Remove pedestrian signals and extend footbridge	$1m
Intersection Upgrade	Thomas Burns Street/Ward Street/Mason Street upgrade	$1.6m
Corridor improvements	Ward Street safety improvements, widening and right turn bays	$1.3m
Bridge improvements	Ward Street bridge deck widening and ramp changes	$1m
Intersection upgrade	Ward Street/Frederick Street/Anzac Avenue	$1m
Construction		$10.5m
Construction Contingency	30%	$4.5m
TOTAL CONSTRUCTION		**$15m**
TOTAL SSBC		**$0.8m**
GRAND TOTAL		**$15.8m**

4. Timing

Phasing has been indicated for the RLTP and DCC's LTP as follows:

Project	21/22	22/23	23/24	24/25	25/26	26/27	27/28	27/28	TOTAL
Harbour Arterial Efficiency Improvements	$2.16m	$2.73m	$2.73m	$2.73m	$2.73m	$2.73m			**$15.8m**

Park and Ride – Mosgiel and Burnside

Single Stage Business Case	$250,000	**Year**	2022/2023
Implementation	$10,000,000		2022/2023 – 2027/2028

1. Problem/Opportunity

- There are limited travel choices for the people who live to the south/west of the city, around Green Island, Mosgiel, Brighton and the Taieri. Car trips from the southern areas make up 65% of the trips entering the central city area.
- Park and Ride facilities will provide an attractive alternative to driving to the city and reduce parking demand and traffic in the central city, particularly relieving pressure during and after hospital construction.
- For some people, taking a bus for the full journey is not feasible as they live too far from a bus stop. This may be because they live in a more rural area, or because they are not physically able to walk to the bus stop. For these people, Park and Ride can provide a convenient alternative to driving the full journey. Using a bus from a Park and Ride site can also facilitate people making a change to using a public bus for other, non-Park and Ride trips.

2. Scope

The SSBC will identify a preferred location for each Park and Ride site, and determine the required number of parking spaces, frequency of bus services and user charges. Legal advice will be required to ascertain the arrangements for land. It is likely that intersection improvements will be required to ensure that the Park and Ride buses are not delayed and can offer a desirable and competitive service.

a. Mosgiel

A Park and Ride site in Mosgiel will be able to serve the rural hinterland around Mosgiel, including Outram. It may be possible to utilise land adjacent to Mosgiel Station on Gladstone Road South for a Park and Ride site, and this would add flexibility, should a rail service become feasible in future.

b. Burnside

A Park and Ride site near SH1 in the vicinity of Burnside would serve all city-bound traffic from further south. This is a very large catchment and the site has the potential to be very popular, particularly if parking is constrained in the central city. A site has not been identified for Burnside however it would be desirable for it to be as close as possible to the Southern motorway (SH1) so there is minimal diversion for drivers.

3. Cost Estimates

Initial cost estimates have been prepared to support the inclusion of the project in the RLTP and DCC's LTP, as shown in the following table.

Item	Assumptions	Cost Estimate
SSBC	Develop business case, evaluate options, modelling, develop designs, consultation.	
Legal	Investigate availability, tenure and cost of land	
TOTAL SSBC/Legal		**$0.25m**
Mosgiel	Site development – 180 space carparks with landscaping, lighting, CCTV, fencing, drainage, surfacing and markings, a small bus interchange with shelters and driver facilities, and 1 signalised intersection to the arterial road network.	$3.5m
Burnside	Site development – 180 space carparks with landscaping, lighting, CCTV, fencing, drainage, surfacing and markings, a small bus interchange with shelters and driver facilities, and 1 signalised intersection to the arterial road network.	$3.5m
Construction		$7m
Construction Contingency	30%	$3m
TOTAL CONSTRUCTION		**$10.0m**
GRAND TOTAL		**$10.25m**

4. Timing

Phasing has been indicated for the RLTP and DCC's LTP as follows:

Project	21/22	22/23	23/24	24/25	25/26	26/27	27/28	27/28	TOTAL
Princes Street Bus Priority and Corridor Safety Plan		$2.75m	$2.5m				$2.5m	$2.5m	**$10.25m**

Parking Management

Implementation	$9.5m	Year	2021/2022 – 2026/2027

1. Problem/Opportunity

- It is essential to maintain affordable and efficient access to the city centre in a way that meets community needs. Provision of parking is the key determinant in how people choose to travel.
- Consultation has shown that people are concerned about parking provision in the city centre and around the new Dunedin hospital.
- A plan will be developed that considers the price, location, availability and guidance to parking to ensure that the parking managed by the Council provides benefits to businesses, residents and visitors to the city.

2. Scope

A Parking Management Policy will be developed which will guide the supply and management of parking to ensure it meets community needs, aligns with the city's strategic objectives including net carbon zero, and supports businesses and visitors to the city. The budget will fund the implementation of the plan.

Changes that are anticipated are:

- Introduce a demand responsive pricing approach for the management of on and off-street parking assets. This involves regular adjustment of parking prices to achieve an optimum level of availability. This will reduce congestion caused by circulating traffic and make it easier for customers to find parking. Prioritise centrally located parking for shoppers/hospital, and parking further out for commuters/long stay.
- Introduce a Parking Wayfinding System to direct drivers to selected off street parking locations. The system will include static directional signage as well as live availability information. Availability information will require car counting technologies to be introduced in car parks. Wayfinding signage will be located on the edge of the city centre on major access points, then at points along the access route to each off-street parking site. The Council will aim to work with Meridian Mall and Wilsons Parking to include their main sites.
- Replace parking meters with more efficient parking technologies for payment and enforcement, such as licence plate recognition with camera enforcement. These technologies will create operational efficiencies.
- Install sensors for data collection and easy analysis of information.
- Longer term – consolidate existing off street carparking and explore potential new parking areas e.g. adjacent to arterial routes and near to Hospital.

The study area includes the central city bounded by Town Belt, Harbour, Botanic Gardens and Oval.

3. Cost Estimates

Initial cost estimates have been prepared to support the inclusion of the project in the RLTP and DCC's LTP, as shown in the following table.

Item	Assumptions	Cost Estimate
Parking Wayfinding System	Parking directional signage to inform drivers of the most direct route into off-street parking sites. Signage can include "live parking availability" information for greater customer convenience and decongestion benefits. Car counting technology installed and "spaces available" signs outside the main car parking buildings.	$4m
Parking System for Payment and Enforcement	Parking meter upgrades to pay by plate, and additional meters for expansion of paid parking area. Licence plate recognition mobile enforcement kit (including camera and electric vehicles).	$2m
City Centre Parking Plan and Monitoring	Review on-street parking restrictions, area, time limits and prices. Implement plan. Parking sensors for data collection and parking dashboard for improved management.	$0.7m
Off Street Parking Supply	Consolidate off-street parking sites, upgrade, improve pedestrian access routes, contribute to potential new parking areas.	$1.6m
Implementation		$8.3m
Contingency	15%	$1.2m
GRAND TOTAL		**$9.5m**

4. Timing

Phasing has been indicated for the RLTP and DCC's LTP as follows:

Project	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	TOTAL
Central City Parking Management	$0.7m		$1.8m	$2m	$2m	$3m			**$9.5m**

Princes Street Bus Priority and Corridor Safety Plan

Single Stage Business Case	$450,000	**Year**	2021/2022
Implementation	$6,168,000		2022/2023 – 2023/2024

1. Problem/Opportunity

- Princes Street has a high collective risk and Dunedin is an area of high concern for all death and serious injury crashes (DSI), urban intersections and pedestrians. These safety issues are also suppressing walking and cycling. Improving safety will benefit all users. There have been 9 deaths or serious injury crashes on the corridor in the last five years (2015-2019).
- Key intersections along Princes Street are inefficient and lead to delays at peak times, which affects bus services.
- Part of the solution will be to provide a bus priority corridor which will encourage mode shift for the 65% of journeys which originate from the south. There are currently 7500 bus passengers per day on this part of the network, and the travel time is 12 minutes. A bus priority route will aim to improve the travel time by 20% and attract an additional 500 users per day.

2. Scope

The SSBC will provide an integrated corridor plan for the study area, focussed on improving safety for all modes, which will ensure good access to facilities and support regeneration of the area, and bus priority measures to ensure efficient, attractive bus services.

The study area includes Andersons Bay Road (Caversham Motorway to Princes Street) and Princes Street (The Kensington to Moray Place).

a. Safety Improvements

The overall aim is to improve safety for all modes in the study area. There are a number of co-existing safety issues which include: inadequate pedestrian crossing facilities, parking and crossing demands for the Oval sports activities, confusing layout at South Road/Princes Street intersection, poor provision for right turning traffic at Andersons Bay Road/Princes Street intersection as well as at minor intersections such as Carroll Street and Hope Street, no cycling facilities, wide carriageway on Princes Street and side streets, and higher than desirable traffic speeds.

b. Bus Priority Measures

There are 11 bus services which use Princes Street. The aim of the bus priority measures will be to provide more efficient bus trips for those travelling to and from the south of the city, which is where 65% of journeys originate. The options considered will build on the work completed for the Shaping Future Dunedin Programme Business Case, which identified a high-level concept for bus priority measures for high frequency routes from Caversham Motorway along Andersons Bay Road to the intersection with Princes Street, and along Princes Street to the intersection with Moray Place, as illustrated. It is expected that express buses will use SH1, and the Princes Street route will provide a priority route for existing services.

c. Land Use

The Creative Quarter extends along Princes Street as far as Market Reserve, and the 2GP recognises the area as the 'South Princes Heritage Precinct'. Princes Street is one of the southern entrances to the city and yet the built environment is tired and worn. Some new businesses have moved into the area in recent years, but regeneration is slow. There may be opportunities within the project to enhance the environment through transport improvements. For example, slower speeds and improved pedestrian connectivity would help to contribute to a more pleasant 'feel' for the street and make it a more attractive destination.

The preferred option which will improve safety for all modes, provide a bus priority route, and ensure good walking and cycling access along and across Princes Street to bus stops and other destinations. Interventions to be considered will include:

- Major and minor intersection upgrades to improve safety and network operation for all modes
- Slower speeds to create a more pleasant, welcoming environment
- Provision of bus priority route - bus lanes and/or clearway, bus GPS to trigger signals
- Shared bus and cycle lanes
- Changes to bus stop locations and improved pedestrian connections to bus stops
- Additional pedestrian refuges/formal crossing points on Princes Street itself and at side roads
- Barnes Dance phasing at traffic signals
- Provision for micromobility devices e.g. mobility scooters, e-scooters
- Cycle facilities that provide for connection to South Road (Southern Cycleway/Tunnels Trail), wider South Dunedin area, existing cycleways and Central City
- Bicycle parking.

3. Cost Estimates

Initial cost estimates have been prepared to support the inclusion of the project in the RLTP and DCC's LTP, as shown in the following table.

Item	Assumptions	Cost Estimate
SSBC	Develop business case, evaluate options, modelling, develop designs, consultation	$0.45m
Bus Priority Route (excluding signals/ intersections)	$1m minor works to provide bus lane/clearway, including paint and signage. Does not allow for major kerb works.	$1.00m
Significant intersection improvements	South Road/Princes Street	$1.00m
	Andersons Bay Road/Princes Street	$1.00m
	Princes Street/Jetty Street/Stafford Street/Manse Street	$0.25m
Minor Intersection improvements – for pedestrians, safety and bus priority.	Signalised intersections: Princes Street intersections with Moray Place, Dowling Street, Rattray Street, Jetty Street – to provide bus priority, signal changes, signs and markings for bus route, cycling improvements.	$0.25m
	Minor changes at other intersections: Princes Street intersections with Carroll/Police, Hope, Manor Place, Jervois, Melville, Jones, Lees, Water, Liverpool Streets, to provide turning restrictions/closure, build outs and pedestrian refuges.	$0.45m
Pedestrian crossing improvements	Build outs, refuges or solid median – on Princes Street (estimate assumes 7 refuges with build outs – 1 per block to Jetty, more at Oval)	$0.50m
Cycle improvements	Bicycle parking, signs and markings	$0.05m
Bus shelter changes	Consolidation/relocation of stops (assume 2 are relocated).	$0.10m
Urban design	% sum to aid regeneration of the area and enhance city entrance.	$0.02m
Parking	Changes to on-street parking to provide for Oval parking, and bus priority route.	$0.10m

Speed limit changes	Speed limit review process including consultation and implementation.	$0.25m
TOTAL SSBC		**$0.45m**
Construction		$4.75m
Construction Contingency	30%	$1.42m
TOTAL CONSTRUCTION		**$6.17m**
GRAND TOTAL		**$6.62m**

4. Timing

Phasing has been indicated for the RLTP and DCC's LTP as follows:

Project	21/22	22/23	23/24	24/25	25/26	26/27	27/28	27/28	TOTAL
Princes Street Bus Priority and Corridor Safety Plan	$0.45m	$3.08m	$3.08m						**$6.62m**

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