Appendix D. Concept design report

bonisch consultants

DUNEDIN TUNNELS TRAIL (CYT) - CONCEPT

CONCEPT DESIGN

ROUTE OPTION 4 & 5

REVISION A

16 February 2021

QUALITY ASSURANCE STATEMENT

Contract Number	7332		
Contract Title	Dunedin Tunnels Trail (CYT) - Concept		
Project Manager	Glenn O'Connor		
Revision	A – Issued for client comment		
	Name	**Signature**	**Date**
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Approval for issue	Glenn O'Connor		17/2/2021

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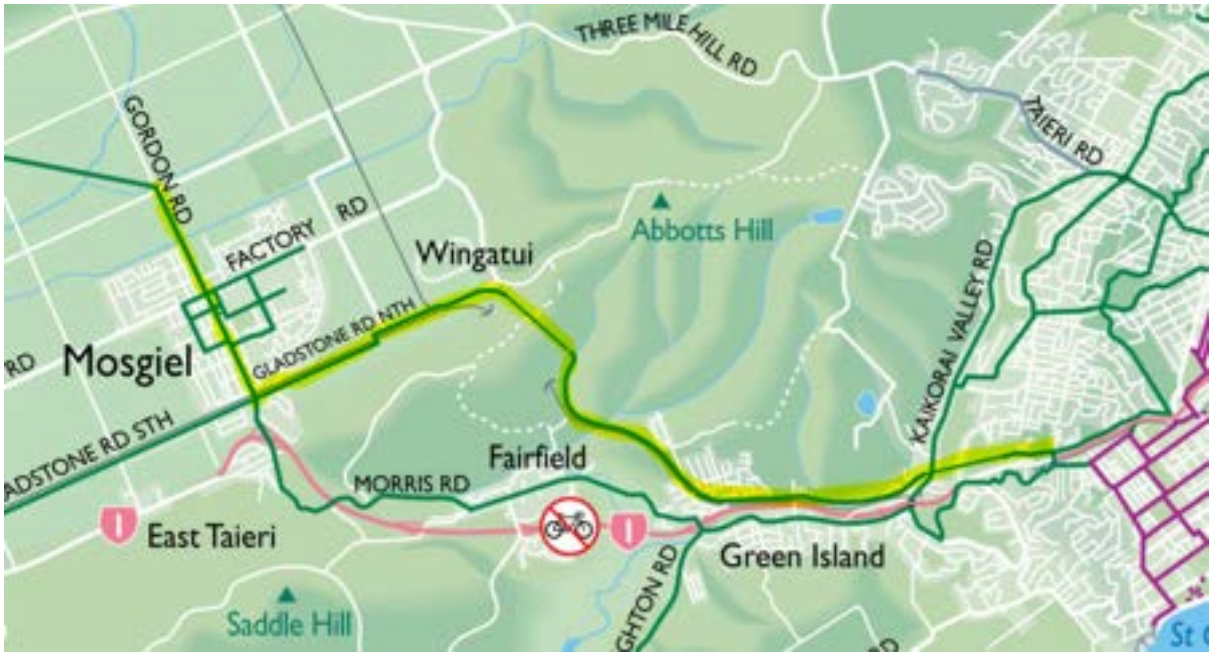
1 INTRODUCTION AND PURPOSE OF REPORT

The Tunnels Trail Project aims to connect Dunedin's urban cycle network with Mosgiel and beyond. The intention of this project is to provide a safe and user-friendly transport corridor as part of the DCC Strategic Cycle Network linking Mosgiel through to the Caversham valley, incorporating linkages to suburbs as practical in-between (Burnside, Abbotsford).

The project has been initiated based on the Strategic Cycle Network which identified a corridor that utilised Gordon Road through Mosgiel, Gladstone Road North, the Chain Hills decommissioned rail tunnel, KiwiRail Corridor through to Burnside, access through private properties through Burnside to Kaikorai Valley Road and the Caversham decommissioned rail tunnel to then link to current and future cycleways at Barnes Drive and South Road. This route is shown highlighted below (excerpt from the DCC Integrated Transport Strategy):



The Dunedin City Council (DCC) has identified this project as one of its major projects and has included it within their Major Projects Programme. Bonisch Consultants Limited (Bonisch) has been engaged by DCC to complete a Project Business Case and associated Preliminary Design for this project.

The purpose of this report is to detail the conceptual design component completed following Workshop 3 - long-listing and assessment. This conceptual design was required to be completed to provide for a maximum of two routes with cost estimation to inform discussion and selection of a preferred route through the short-listing process of the project business case. The conceptual design is to include a high-level identification of risks and challenges, cost estimation and buildability / constraints for each alignment. Preliminary Design of the preferred route will then follow once identified through the business case process.

2 PROJECT OBJECTIVES AND DESIRED OUTCOMES

Project objectives and desired outcomes were presented in the Project Brief. This is summarised below:

Dunedin is already well served with road connections for motor vehicles. The project objective is to achieve a more even balance for other types of road users and the Tunnels route will extend the cycle network from Dunedin to Mosgiel.

The key objectives for the Tunnel Project are:

- Improve road safety for cyclists traveling between Dunedin and Mosgiel.
- Improve network access for cyclists.
- Increase the level of service of cycle infrastructure between Dunedin and Mosgiel.
- Increase residents' satisfaction with cycle infrastructure in Dunedin city.
- Increase the number of cyclists travelling to work and school by bicycle.
- Work towards connecting Dunedin to cycle networks beyond the city, e.g. Gold Trail.

The key outcomes for this project are:

- Improvements in road safety by providing an alternative, dedicated route for pedestrians and cyclists between Mosgiel and Dunedin with gradients suitable to all levels.
- Increase in the number of cyclists travelling to work and school by bicycle, measured by annual counting.
- Increase in residents' satisfaction with suitability of Dunedin's provision for cycling, measured through Dunedin's annual Residents' Opinion Survey.
- Improvement in access to cycling in Dunedin, measured by lengths of completed and connected primary routes.
- Consideration will also be given to security and safety of all users on the route and this may include motion sensor lighting for example. There will also be thought to future-proofing the route by installing cable ducts where practical during construction.

3 BACKGROUND AND WORK TO DATE

This project has been in discussion and thinking within DCC and the wider community for some time. The Dunedin Tunnels Trail Trust (DTTT) has been an active supporter and advocate for this project. Due to this history, there have been a number of investigations and reports completed on this project over time. Those made available to the project team have been taken into consideration however we will not summarise these in this section. The Project Business Case methodology has provided for a stand-alone process to confirm the preferred option and complete the necessary investigations to enable conceptual preliminary design.

Below is a summary of work completed to date to inform this conceptual design:

3.1 Workshop 1 - ILM

An ILM workshop was held on 9 September 2020. The results of this workshop were summarised in the Abley memorandum dated 23 September 2020.

3.2 Workshop 2 – Tunnels Analysis and Fatal Flows (including associated investigations)

Following the ILM workshop tunnel analysis and investigation commenced to determine if repurposing the Tunnels for a cycle / pedestrian trail was fatally flawed. This was undertaken early in the business case process as, if the tunnels option was found to be fundamentally unworkable, it would provide significant limitations on the project's ability to address the identified problems and resulting benefits.

Investigations completed included:

1. CPTED and IPTED assessment;
2. Geotechnical appraisal;
3. Dilapidation survey (structural);
4. Tunnels heritage assessment;
5. Tunnel geometry and services assessment.

The results of these investigations were presented at a workshop on 15 October 2020. The workshop concluded that the repurposing of the Chain Hills and Caversham tunnels for the use of a cycle trail is not fatally flawed.

Recommendations from these investigations which impact on conceptual design are summarised within the appropriate design sections later in the report.

3.3 Workshop 3 – Longlisting and Assessment and Updated ILM

The longlisting workshop was held on 3 November 2020. The results of this workshop were summarised in the Abley memorandum dated 30 November 2020.

An early multi-criteria analysis of 5 options was completed. These options were:

1. Do minimum;
2. Upgrade existing route;
3. Upgrade existing route + Caversham Tunnel;
4. New route using Chain Hills and Caversham Tunnels and rail corridor; and
5. New route using Chain Hills and Caversham Tunnels and link track.

This identified that the options 4 and 5 were likely to be the preferred options with both scoring much higher than options involving the existing route. The overall business case will complete further analysis of the 4 options with the do minimum excluded however the conceptual design will be focused on options 4 and 5.

3.4 ILM Problem and Benefit Statements

The ILM problem and benefit statements current at the time of this report are those as amended in Workshop 3 below.

Problem Statements:

- Problem 1 - The poor cycling level of service, particularly steep gradients, discourages the use of active mode travel (30%).

- Problem 2 - Low active mode usage does not support a low carbon transport system or realise healthy lifestyles (30%).
- Problem 3 - The disconnected active mode network creates a severance between local and regional communities constraining tourism, recreational, social and employment opportunities, affecting the uptake of low carbon transport choices and healthy lifestyles (20%).
- Problem 4 - The perceived safety issues between Mosgiel and Dunedin deter active modes choice, limiting viable travel options (20%).

Benefits Sought:

- Benefit 1 - Attractive and safe active modes alternatives – 40%.
- Benefit 2 - Healthy people, connected community – 30%.
- Benefit 3 - Strong and thriving economy – 10%.
- Benefit 4 - Low carbon transport system – 20%.

4 DESIGN STANDARDS AND PHILOSOPHY

4.1 DCC Project Brief Acceptance Criteria

The Project Brief project output description requirements included acceptance criteria set out by the DCC transport team. The acceptance criterias that are relevant to the concept design are summarised below:

1. Outputs comply with:
    a. DCC standards for road and cycleway construction.
    b. NZTA Guidelines and standards for road and cycleway construction, including NZ Cycle Trail Design Guide.
    c. KiwiRail policies for public pathway safety.
2. Design is consistent (where possible) along the full length of the route.
3. Cycleway width of 3 metres (where possible) along the full length of the route.
4. Cycleways are comfortable to ride. They have a surface that is as smooth as possible and well-maintained; they follow a direct route with as few obstructions as possible.
5. Outside of the rail corridor, cycleway maintains appropriate gradient and only where necessary has drop kerbs that are built to pram crossing standard (ramps have shallow angles).

4.2 Design Philosophy

With reference to the Project Objectives / Desired Outcomes, Acceptance Criteria and ILM Problem Statements the below Design Philosophy has been developed to guide concept development of Long List Options 4 and 5.

Typologies will be considered in a sequential order based on a typology hierarchy. Where a workable option is found to be suitable typologies lower in the hierarchy will not be considered further in the concept phase unless there are obvious other practical options.

The typology hierarchy developed for this project is:

1. Shared bi-directional path / trail.
2. Separated Cycleway / Cycle Only paths bi-directional.
3. Separated Cycleway / Cycle Only paths one-way.
4. Traditional on-road Cycle Lanes.
5. Sealed shoulders.
6. Mixed traffic lanes.
7. Neighbourhood greenways.

Note that advisory shoulders have not been considered as an appropriate solution within this route. It is understood these have not been applied through Dunedin previously, therefore road users may not understand their use.

4.3 Design Standards

There are two overarching design standards which are applicable to the concept design of this route. These design standards have been utilised in the development of the concept design. They are:

4.3.1 NZTA Cycling network guidance – Planning and Design

This is an online resource developed by NZTA that provides standards, guidelines and advice to the design of cycle network facilities for a range of different applications and situations. This provides key information and links to supplementary design standards and documentation that can be applied depending on the nature of the cycleway / walkway and the wider context it sits within. Key supplementary guidelines include:

- Austroads Guide to Road Design Part 6A – Paths for Walking and Cycling (referred to as Austroads guide throughout).
- Austroads Cycling Aspects of Austroads Guides (referred to as Austroads guide throughout).
- NZTA considering historic heritage in walking and cycling projects.
- NZTA Technical note TN002 – Updated guidance for separated cycleways at side roads and driveways (referred to as NZTA TN002 throughout).
- NZTA Technical note TN004 – Buffered Cycle Lane Design 2020 (referred to as NZTA TN004 throughout).
- Queensland Government Technical Note 133 – Guidance on the widths of shared paths and separated bicycle paths. Note the link provided on the NZTA website is inactive. We understand this has been supersede by Speed Management on shared paths guidance released in August 2020. (referred to as QG TN133 throughout).
- VicRoads Cycle Notes 21 – Widths of off-road shared use paths (referred to as VicRoads CN21 throughout).
- MBIE – New Zealand Cycle Trail Design Guide (referred to as Trail Design Guide throughout).
- Christchurch City Council – Major Cycleway Best Practice Design Guide 2016 (referred to as CCC guide throughout).

4.3.2 KiwiRail Track Engineering Standard – Public Pathways on the Road Corridor and KiwiRail Design Guidance for Pedestrian & Cycle Rail Crossings (referred to as KiwiRail Standard throughout)

This document provides guidance for parties wishing to build a public pathway, including cycleways, on the operational rail corridor. It does not specify cycleway or walkway design standards; rather it identifies general objectives to guide cycleway/walkway design adjacent to operational railway corridors.

4.4 Key Design Parameter Summary – Shared Path

The above guidelines provide information for a wide variety of path typology and situations. As the options being considered for concept design will first be assessed for a shared path typology in close proximity to the rail corridor, there are a number of key design parameters which route concepts will first be assessed against before considering other concepts lower in the typology hierarchy. These key initial parameters are detailed below. Where other typologies are used, parameters will be detailed within the design summary of that section.

4.4.1 Path Width

The acceptance criteria provided by DCC provides a preference for 3m wide paths to provide consistency to other shared paths within the region e.g. Peninsula Connection, Portobello Road etc.

NZTA guidance references the Austroads guide for overall guidance and specifically VicRoads CN21 and QG TN133 in regard to width. The Trail Design Guide is also considered applicable to determining width.

These guides first consider the number of cyclists and pedestrians using the space. Austroads figure 5.4 shows there is a relatively high threshold of use before a 3m shared path becomes unsuitable. Advice provided from the Business Case team indicates the majority of the path would fall within the 2.5-3.0 shared path range of these graphs, however with potential for key access points to trend into the 2.5 cycle + 1.5 pedestrian path recommendation.

Path width guidance from the various guides is summarised in the below table:

Shared Path Width Guidance Summary				
Guidance	Description	Desirable Minimum (m)	Min - Max Typical (m)	Notes
Austroads	Local Access Path	2.5	2 - 3	Values in QG TN133 reference Austroads
Austroads	Regional Path	3	2.5 - 4	
VicRoads	Recreational and Regional Commuter Path	2.5		Allows a clearance of 0.5m between path users when passing
VicRoads	Recreational and Regional Commuter Path. Assumes passing and meetings between users is frequent, bicycle speeds exceed 25km/hr and there are a more diverse range of users	3		Allows a clearance of 1m between path users when passing. In most circumstances, new shared use paths should be 3.0m wide.
Trail Design Guide	Grade 1 Trail (easiest)	2.5	2 - 4	Minimum recommended width for tunnels if 2.0m
CCC Guide	Shared Pathway: 50/50 directional split (peak ped+cyc two-way volumes >250/hr)	3	3-4	Desirable design is 4m for 50/50 direction split, and 3m for 90/10 direction split

The next consideration is the classification of the path. As this path would form part of the Dunedin Strategic Cycle Network it is considered to be a path of Regional Standing when assessing against Austroads guidance.

4.4.1.1 Concept design parameters selected for path width:

- Desirable Width – 3m
- Minimum Width (to avoid obstructions over short distances) – 2.5m
- Where no alternatives are available in the typology hierarchy further reduced width can be considered with additional controls in place.

4.4.2 KiwiRail Clearances

KiwiRail Standard clause 8.5.1 states there must be a clear and defined boundary between the pathway and operational track area. This must ensure there is no possibility of any pathway user accidently leaving the pathway. This is typically achieved through provision of fencing ranging in height from 1.2m to 1.8m.

KiwiRail Standard clause 8.2 states setback requirements for trackside fencing of a proposed pathway.

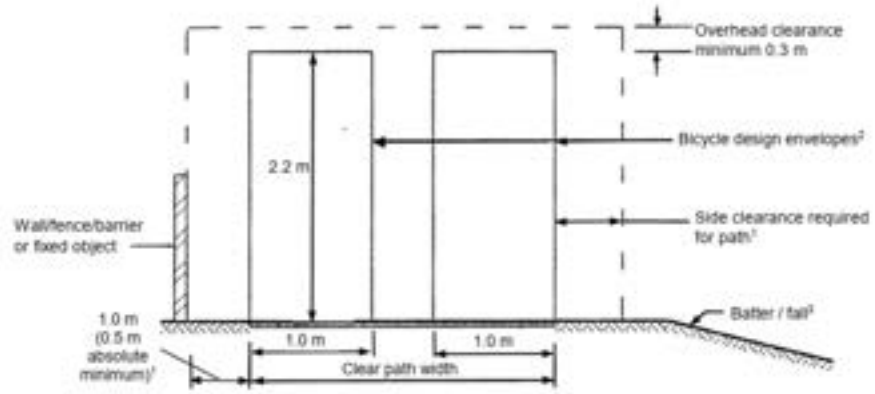
4.4.2.1 Concept design parameters selected for KiwiRail Track Clearance and Fencing:

- For concept design provision for fencing will be included wherever the path is located adjacent to Rail Tracks unless there is a substantial natural barrier between.
- Desirable setback – 6m from the track centreline.
- Minimum setback – 5m from the track centreline.
- Absolute minimum setback – 4m from the track centreline (may be permitted on a case-by-case basis, by exception).

4.4.3 Path Clearances

Austroads Guide Figure 5.7 provides a clearance envelope for cycle paths to allow for design of adequate separation between the path and surrounding features or hazards (fixed objects, vertical drops, steep batters). This is inserted below for reference:

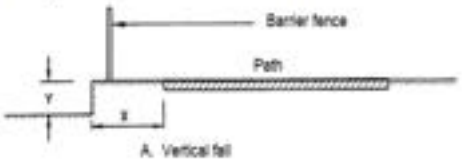
Figure 5.7: Clearances between cyclist envelope and potential path hazards



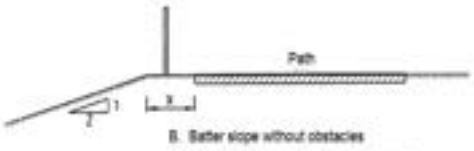
1 *This may be reduced to 0.3 m where a fence or obstacle has smooth features.*
2 *Refer to Section 3.2.2 for guidance on bicycle design envelopes.*
3 *Refer to Section 5.5.3 for guidance on batters and need for a fence.*

Austroads Figure 5.10 sets out requirements for fencing and barriers at batters and vertical drops. This provides a table that relates proximity and slope of a batter to a fencing requirement.

Figure 5.10: Requirement for fence barriers at batters and vertical drops



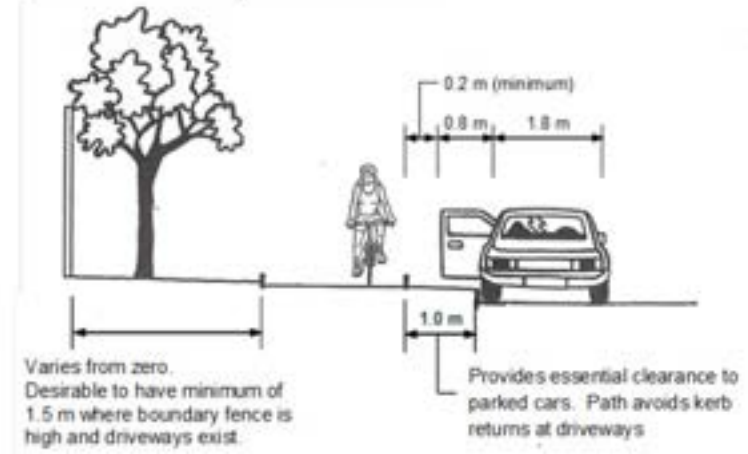
	X (m)	Y (m)
Fence not required*	<2	<0.25
Partial barrier fence required	<5	0.25 to 2
Full barrier fence required	<5	>2



	X (m)	Z (m)
Fence not required	<1 1 to 5	>8 >3
Partial barrier fence required	<5	1 to 3
Full barrier fence required	<5	<1

Austroads Figure 5.8 provides desirable clearances for shared paths within berms including from boundary's with fence lines and driveways, and from road corridors with parked cars. This is inserted below for reference:

Figure 5.8: Location of path in road reserve



For further context the CCC guide provides desirable and desirable minimum offsets for separated paths location in the road reserve in table 7-2 inserted below:

Boundary Offset	5 m from boundary	Absolute Minimum 3 m Possible exemption to rule where adjacent to park or reserve, where no street vehicle access and open view along frontage but his needs justification and mitigation measures for safety of users. Footpaths should be maintained and retained as a separate facility unless the whole area is to be shared.
Width between edge line of driving vehicle/parking and cyclist	1 metre	Absolute Minimum 0.6 m where no parking 0.85 metres adjacent to on-street parking

4.4.3.1 Concept design parameters selected for path clearances:

- **Path side barrier fence offset – desirable 0.5m, absolute min 0.3m**. This has been adopted on the basis that the fence will be constructed of smooth materials and the path width of 3m could be slightly sacrificed through detailed design if required to provide additional clearance. **This offset will also be applied to adjacent boundary fence lines where there are no vehicle accessways crossing.**
- **Requirement for fencing adjacent batters and vertical drops**. For the purpose of concept design this has been simplified to **a batter of 1 in 3 or steeper within 5m of the path will require some form of barrier or fence.**
- **For Boundary offset where there are vehicle accessways crossing** a desirable clearance of **3.0m** has been adopted as a mid-point between Austroads and CCC guidance. This is considered appropriate on the basis that shared paths will likely not be possible in areas with large amounts of vehicle crossings in the context of this site, and it provides space for a vehicle to partially exit a property and give way to path users (3.0m is approximately over half the length of a 5.0m standard vehicle). In short areas of constrained width, a reduced offset of **1.5m** may be adopted in the concept design as an absolute minimum when combined with appropriate supplementary design elements.
- **For width between traffic / parking and the path** a desirable clearance of **1.0m** has been adopted in accordance with Austroads and CCC guidance. Absolute minimums of **0.6m** where there is no parking and **0.85m** adjacent to parking from CCC guidance have also been adopted.

4.4.4 Grade

Path grade will not be assessed in detail at the concept phase however steeper grades would have an impact on path width.

Austroads Guide clause 5.4.3 state that grades should not exceed 5% unless unavoidable. They provide discussion that where gradients in excess of 5% occur approaches should be widened and clear escape routes and recovery areas included within the design. As a guide they note: a grade greater than 10% over 50m with horizontal curves or a grade greater than 12% over 50m on straight paths should be avoided.

The Trail Design Guide states in Table 2 for Grade 1 (easiest) trails that:

- 98% of the trail should have a grade between 0-2 degrees (0% to 3.5%),
- Between 2 and 3 degrees (3.5% to 5.2%) for no more than 100 metres at a time,
- And between 3 and 4 degrees (5.2% to 7%) for no more than 10 at a time.

For the purpose of this concept design areas where the grade would be likely to exceed **5%** for extended lengths will be highlighted where possible.

4.4.5 Design Speed

CCC guidance sets out design speeds for shared and separated pathways in table 7.2. These will be adopted later in design for assessment of sight distances.

Cycle path: Design Speed for Alignment	25km/h (30km/hr for sight distances)	20km/h

4.4.6 Surfacing

For cost estimation purposes the path is has been assumed to be Asphalt surface.

5 CONCEPT DEVELOPMENT INTRODUCTION

5.1 Scope and Limitations

The purpose of this concept development is to bring a higher level of understanding of the likely design treatment, risks, issues, constraints, and costs associated with the two identified new route options from the Long list Workshop. The intention of this is to inform the Business Case process selection of a preferred option to be developed to Preliminary Design.

This concept design has been completed as a largely desktop exercise to assess likely approximate 2D design arrangement for the overall route. This has been undertaken considering the below information resources to understand the existing environment and constraints:

- Site drive over supplemented by Google Streetview (where accessible);
- Aerial photography (available through LINZ data service);
- DCC GIS;
- Beforeudig cable plan request;
- DCC supplied LiDAR;
- NZ Contours Topo, 1:50k (available through LINZ data service);
- NZ land parcels (available through LINZ data service);
- KiwiRail track video (supplied by KiwiRail);
- Information gathered from Business Case development to date.

Please note the concept design is limited in scope and accuracy to achieve the objective of this stage of the project. It does not include 3D design, is not survey accurate and is not supported by detailed investigations.

Key items excluded from this phase include:

- Key design interventions such as intersection layouts, retaining walls and other structure arrangements. Where likely interventions are required these will be noted for future consideration and design development.
- Design arrangement within the tunnels. (these have been considered to concept level within the fatal flaws analysis).
- Streetlighting.
- 3D design.
- Drainage design.

5.2 Overarching Route Options and Sections

As discussed previously, the longlisting workshop held on 3 November 2020 identified two new overarching route options to be considered further, along with two options utilising the existing route. The scope of this report is to complete concept design for the two new routes described below as:

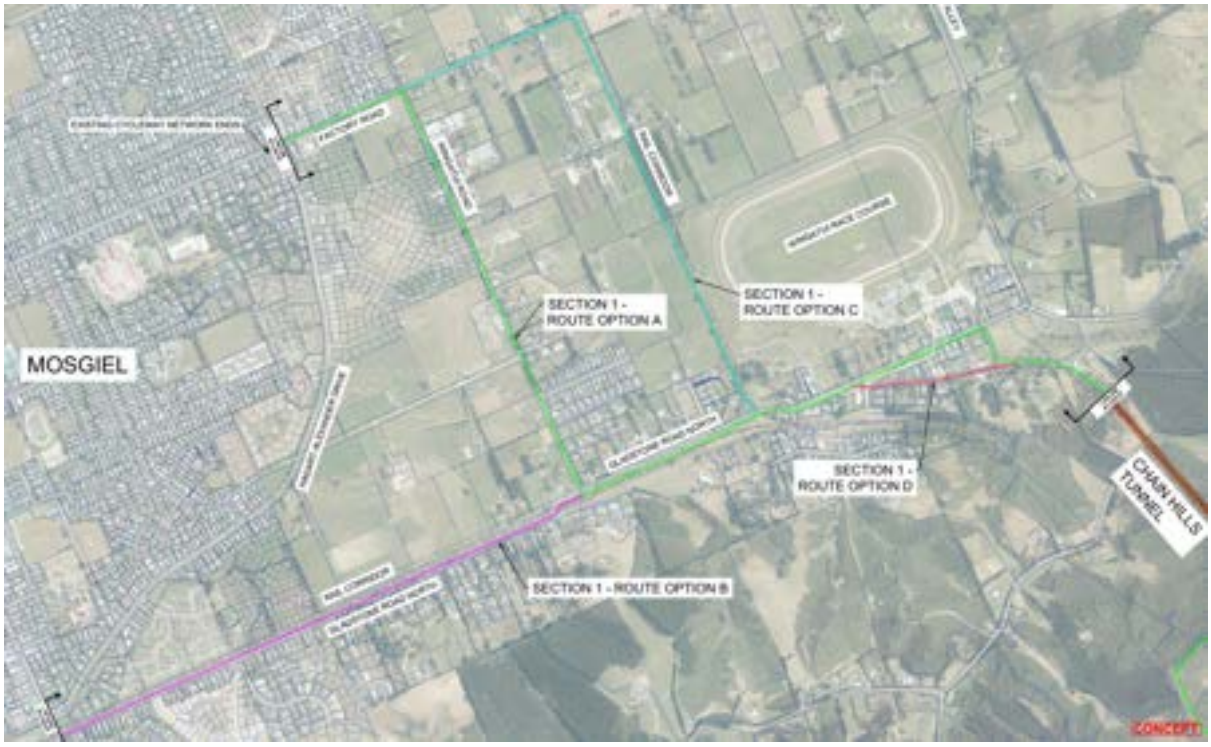
- **Option 4 - New route using Chain hills and Caversham tunnels and rail corridor;**
- **Option 5 - New route using Chain Hills and Caversham tunnels and link track.**

Both of these route options follow a similar path with the main difference being utilising the rail corridor in Option 4 and utilising the road corridor for Option 5. For the concept development these options have been split into 4 Sections as detailed below:

- **Section 1 – Mosgiel to Chain Hills tunnel**
- **Section 2 – Chain Hills tunnel to Burnside (at Carnforth Street)**
- **Section 3 – Burnside (at Carnforth Street) to Caversham tunnel**
- **Section 4 – Caversham tunnel to Barnes Drive / SH1 intersection**

Each section may include several potential options and sub-options to be assessed against the design philosophy to develop up to two workable solutions for each section. These sub-options will cover both Option 4 and Option 5 overarching routes from the longlisting workshop.

6 CONCEPT DESIGN – SECTION 1 – MOSGIEL TO CHAIN HILLS TUNNEL



6.1 Potential Connection Points

The cycle path connection point to Mosgiel has a number of potential or desirable connection points where this project could end, and the wider network can continue from.

There are:

- Factory Road / Hagart Alexander Drive

  This is the end point of an existing on-road cycle network which extends to the centre of Mosgiel. This existing on-road cycle network is part of the Strategic Cycle Network and with the facility already installed this makes for an attractive connection point.

- Gladstone Road North / SH87 intersection

  This connection point was the identified connection point within the Strategic Cycle Network. There is currently no existing cycle network on SH87 but it is identified as a route in the Strategic Cycle Network.

- Silver Stream trail

  At the north end of Wingatui Road where it transitions to Stedman Road is Silver Stream. There is an existing walking / pedestrian track that follows Silver Stream to the west past SH87. This may provide opportunity to connect to the wider trail network and bypass central Mosgiel. This option would likely have benefits for the wider trail network tourism component.

For the purposes of this concept design the connection points investigated are both Factory Road and SH87. It is considered Silver Stream could be included as an additional connection point in the future and outside the scope of this project currently.

6.2 Route Option A – Factory Road – Hagart-Alexander Drive to Wingatui Road

6.2.1 Existing Environment Context

Factory Road is a chip seal road generally of urban typology with a centreline, edge-lines, parking lanes and a combination of kerb edging and sealed and gravel shoulders. There are footpaths on both sides of the road at the western urbanised end but only a footpath on the north side at the end nearest Wingatui Road. The berm width is variable, with kerb and channel in urbanised sections, and a minor drainage swale on the south side at the eastern end. There are hedges and vegetation encroaching into the road corridor in places. There is overhead power on the south side of the road. The road is generally set at a similar level to the surrounding land. Services include trunk water and wastewater mains, stormwater and wastewater drainage mains, and a water supply main.

Context Summary:

ONRC (mobile roads)	Arterial
ADT (mobile roads)	4180
Surface (mobile roads)	Western end – Grade 3/5 – width 13.5m Eastern end – Grade 4 – width 10.4m
Berm description	Footpaths on both sides of the road at the western urbanised end but only a footpath on the north side at the end nearest Wingatui Road. The berm width is variable, with kerb and channel in urbanised sections, and a minor drainage swale on the south side at the eastern end.
Speed limit (DCC speed limits bylaw Amendment 8-2018)	50km/hr

Factory Road Photos showing existing typology looking East:

6.2.2 Shared Path Concept Design Considerations

Initial concept design investigated the option of a separated shared path or separated cycleway. This option was found to be impractical for the setting with the below issues identified:

- Existing facility on Factory Road is an on-road facility based on the existing wider road formation meaning a shared path would be out of context for this environment unless it was able to be continued to the chain hills tunnel entrance.
- Variable road typology combined with variable berm widths did not provide sufficient width to accommodate a shared path.
- Overhead power on the south side of the corridor further limits ability to provide a continuous corridor.

- Urbanised sections have many vehicle crossings which would provide increased conflict with a shared path typology.

6.2.3 Preferred Concept Design Typology – Buffered On-Road Cycle lanes

Buffered on-road cycle lanes in accordance with NZTA TN004 were selected as the preferred option for this road section. This provides for a continuation of the existing facility on Factory road with the addition of buffers between traffic lanes and cycle lanes. This can be accommodated by removal of parking on the north side of the road and widening of the south side of the road in the eastern half.

Note this differs from the existing arrangement on Factory Road to the west which has un-buffered cycle lanes and maintains parking on both sides of the road. There is an approximate 0.7m shift in the northern kerb location across the Centre Street intersection which limited the ability to continue the same arrangement. In addition, it appears the northern cycle lane is set at 1.6m wide with 2m parking and 3m lanes which are below the minimums outlines in TN004.

The proposed cross section would include a road shoulder on the north side with no parking of approx. 0.7m, 1.8m Cycle lanes, 0.3m painter buffer flush median (acceptable min) and 3m wide existing traffic lanes. Where possible parking lanes of 2m with will be provided.

NZTA TN004 design width table 1 is included below for context:

Table 1: basic parameters for cross-section elements for buffered bike lane design

Key	Element	Desirable min	Acceptable min	Practical max
	Parallel parking	2.0	2.0	2.5
	Cycle lane – next to parallel parking	1.8	1.7	2.0
	Cycle lane buffer – traffic side	1.0	0.3	1.0
	General traffic lane	3.2	2.9	4.5
	Cycle lane buffer – traffic side	1.0	0.3	1.0
	Cycle lane – kerbside	1.6	1.4	1.8
	Flush median	2.5	0.5	4.0

Key Constraints, Issues and Risks

- Road width limitations will necessitate removal of parking on the north side. Based on a 228m of available parking length divided by 6m parking length this amounts to approximately 38 car parks lost.
- Above ground electricity services restrict south side widening scope before having to adjust existing traffic lane location or incurring significant expenditure to shift to underground.

6.2.4 Intersection Treatment – Factory Road and Wingatui Road

With the proposed on-road cycle lane and existing stop priority control at this intersection, the inclusion of cycle lanes in line with standard MOTSAM layouts will be simple and cost effective to implement.

6.3 Route Option A – Wingatui Road – Factory to Gladstone Road North

6.3.1 Existing Environment Context

Wingatui Road is a chip seal road generally of rural typology with a centreline, edge-lines and sealed and gravel shoulders. There are no footpaths except for in urbanised areas near Factory Road. The

berm width is variable with minor drainage swales in some locations. There are overhanging hedges and vegetation in places. There is overhead power on the west side and isolated overhead power/chorus cables on the east side. A bridge is located mid-way along this section of road with guard railing resulting in reduced width. The road is generally set higher than surrounding land. There is a section of urban development on the western side near Factory Road. Services include trunk water and wastewater mains.

Context Summary:

ONRC (mobile roads)	Secondary Collector
ADT (mobile roads)	Range from 1750 to 2300
Surface (mobile roads)	Two coat 3/5 seal width 6.7m
Berm description	Sealed and gravel shoulders, no footpaths generally. Variable width and includes above ground power infrastructure.
Speed limit (DCC speed limits bylaw Amendment 8-2018)	50km/hr

Wingatui Road Photos showing existing typology looking North:

6.3.2 Shared Path Concept Design Considerations

Initial concept design investigated the option of a separated shared path or separated cycleway. This option was found to be impractical for the setting with the below issues identified:

- Variable typology combined with variable berm widths and established vegetation did not provide sufficient width to accommodate a shared path. In addition, the road slightly meanders within the road corridor making it impractical to provide a suitable continuous corridor for a shared path without significant expense or without a number of road crossings and changes in typology.
- The bridge mid-way along provides a barrier to any shared path. There is limited space for an additional bridge structure with electrical and trunk pipe crossings reducing options.
- Overhead power on the west-side of the corridor further limits ability to provide a continuous corridor.
- Urbanised sections have a large number of vehicle crossings which would provide increased conflict with a shared path typology.
- One-way separated paths were not considered appropriate for the typically rural typology of the road.

6.3.3 Preferred Concept Design Typology – Buffered On-Road Cycle lanes

On-road cycle lanes were selected as the preferred option for this road section. This is able to be accommodated by widening of the road on both sides in accordance with NZTA TN004. The proposed road width would be 10.2m which amounts to a seal widening of 1.75m each side from existing. The road cross section would include variable berm widths including grass, water tables and gravel shoulders, 0.2m wide sealed shoulders (to allow for edge-lines), 1.6m cycle lanes (desirable min with no parking), 0.3m painter buffer flush median (acceptable min) and 3m wide existing traffic lanes.

Key Constraints, Issues and Risks

- Encroachment on eastern side water table and drain at White Hart Lane.
- Bridge in centre of the route. May necessitate cyclist merge with traffic.
- Kerb and channel relocation on west side outside recently constructed sub-division.
- Encroachment on existing vegetation overhanging into the road corridor.
- No footpath provision limiting pedestrian linkage to the tunnels trail.

6.3.4 Intersection Treatment - Wingatui Road and Gladstone Road North

It is expected at this location the path would transition from on-road cycle lanes to a separated shared path. A give-way crossing facility can be implemented in this location to accommodate the transition between the two facility types.

6.4 Route Option A – Gladstone Road North – Wingatui to Chain Hills Tunnel Track

6.4.1 Existing Environment Context

Gladstone Road North is a chip seal road generally of semi-rural typology with a centreline, edge-lines and sealed and gravel shoulders. There is kerb and channel and a footpath on the north side between

Wingatui Road and Henderson Street. The berm width is variable with a minor drainage swale along the southern side of the carriageway. There are overhanging hedges and vegetation in places. There is overhead power on the north side. The road is set higher than properties on the north side of the road with a steep drop off to lower lying ground in some areas. The road is set below green space on the south side, which is adjacent to the Main South Rail line. The road narrows to pinch points at the Northern Rail Line crossing and again adjacent to Magazine Road. Services include a trunk water and three wastewater mains.

Context Summary:

ONRC (mobile roads)	Secondary Collector
ADT (mobile roads)	Range from 630 - 1260
Surface (mobile roads)	Two coat 3/5 seal width 6.3m & Two coat 4/6 seal width 7.3m
Berm description	Sealed and gravel shoulders, no footpaths except on north side from Wingatui to Henderson St. Variable width corridor and includes above ground power infrastructure.
Speed limit (DCC speed limits bylaw Amendment 8-2018)	70km/hr although appears to be posted as 50km/hr

Gladstone Road North photos showing existing typology looking east:

6.4.2 Shared Path Concept Design Considerations

There is generally ample space available to accommodate a shared path on the south side of Gladstone Road through this section either adjacent to the road or rail corridor. There are two key areas where space is constricted where land purchase would be required to accommodate the path specifically at 256 Gladstone Road North, and either 298,300,306, 310 Gladstone Road or 21 Magazine Road depending on the route selected. It was deemed for concept design that these land purchases would be possible therefore would not discount this route as an option when also considering the lack of alternatives.

There is limited width for on-road or one-way cycleway options therefore these were not considered further.

6.4.3 Preferred Concept Design Typology – Shared Path

A 3m wide shared path typology has been selected as the preferred option for this section. This can be accommodated as follows:

- Path traverses up the bank from Wingatui and then follows adjacent to the rail track in the elevated rail corridor greenspace at 6m offset.
- The path shifts down to being adjacent to Gladstone Road after 610m to cross the rail corridor with a new priority control level crossing.
- Land purchase and relocation of private property fencelines back to the boundary at 256 Gladstone Road and priority give way crossing at Paterson Road.
- Path then follows at 1.5m offset from existing fencelines that are located over the boundary, likely requiring an open ditch to be piped.
- Priority give way crossing at Crossan Terrace then follows existing property access road to 292 Gladstone Road. These properties would have new accessways installed out to Gladstone Road removing vehicle use on the existing parallel access road.
- Path shifts to 1m offset from Gladstone Road where property purchase would be required to accommodate the path. An existing ditch would need piped. The path would then enter the existing dual tunnel access track.
- The tunnel track would be upgraded to address grade and ride quality to the tunnel.

Key Constraints, Issues and Risks

- A new level crossing will be required to accommodate the path alignment. This will require KiwiRail approval of the level crossing. In addition, some private vegetation may need removed to provide required sight distances.
- Barrier fencing required where path is parallel and adjacent to the rail corridor.
- Adjacent batter grades ranging from 1:2 to 1:3 along the western section may necessitate the implementation of barrier fencing of the path.
- Land purchase is required to accommodate the path alignment.
- 306 Gladstone Road has a house that may be too close to the proposed boundary realignment location to be a tenable option.
- Adjustment / filling of roadside drainage ditches is likely required.
- Existing property fencelines located within the road corridor limits space in places.

6.5 Route Option B – Rail Corridor – State Highway 87 to Wingatui Road

Route Option B would provide an alternative connection point to Mosgiel from the Wingatui / Gladstone Road N intersection. This route option would connect to the Chain Hills Tunnel from this intersection via Route Option A (potentially supplemented with Route Option D).

6.5.1 Existing Environment Context

Gladstone Road North, between SH87 and Wingatui Road is a chip seal road generally of semi-rural typology with a centreline, edge-lines and sealed and gravel shoulders. Sections of the road near SH87 have kerb and channel on the south side which transitions to a sealed swale with footpath for the remainder of the road. The south side of the road is populated with residential properties, and the north side is comprised of rail corridor with the main south line. There is overhead power and a water

trunk service pipe on the north side and isolated power / telecom poles on the south. The road has been constructed on undulating terrain and is, in places, significantly higher than the rail track to the north, and in others, significantly lower with steep batters. On the northern side of the rail corridor this undulation in contour appears less pronounced. The south side of the road has inconsistent boundary lines in relation to the road shoulder and properties with fencelines built over the boundary as well as overhanding vegetation. There is a dual rail system present through much of this section, reducing available space within the corridor at the western end.

Context Summary:

ONRC (mobile roads)	Primary Collector
ADT (mobile roads)	Range from 2040-3600
Surface (mobile roads)	Asphalt width 7-7.4m & Two coat 4/6 seal width 6.5-7.5m
Berm description	Kerbs and sealed and gravel shoulders, inconsistent typology and vegetation in places on the north side with undulating contour and steep batters up and down to the rail corridor. Variable width corridor and includes above ground power infrastructure.
Speed limit (DCC speed limits bylaw Amendment 8-2018)	50km/hr

State Highway 87 and Hagart-Alexander Drive intersection looking south:

Gladstone Road North showing existing typology looking East:

6.5.2 Shared Path Concept Design Considerations

There were 3 locations considered when assessing if a shared path concept would be possible in this section. They are detailed below:

- **South side of Gladstone Road existing footpath**

  The south side of Gladstone Road was considered first as a potential location for a shared path. This area is already formed into footpath the majority of its length. The width of this zone from the road edge to the property boundary varies throughout this zone from 2.5m – 7.7m.

  A shared path within this zone would require a minimum width of 4.6m (0.6m offset from traffic, 2.5m path, 1.5m offset from property boundary) and a desirable width of 7m (1m offset from traffic, 3m path, 3m offset from property boundary).

  Based on legal boundaries (not considering areas where property fence lines do not align with the boundary) approximately 660m of the 1680m (39%) length does not provide adequate space for a shared path, with limited options to gain the required width due to established boundaries and adjacent overhead power.

  Based on this this option was considered unfeasible for further consideration.

- **North Side of Gladstone Road in berm next to rail corridor**

  As discussed earlier, Gladstone road has been constructed on undulating terrain and is, in places, significantly higher than the rail track to the north, and in others, significantly lower with steep batters. This combined with the presence of overhead power and other services means this alignment would require significant earthworks and retaining systems to provide a workable design arrangement.

  Based on the above, this option was considered unfeasible for further consideration.

- **North side of Rail Corridor within berm**

  As discussed earlier, the northern side of the rail corridor appears to have a more gradual contour than the southern side of the rail corridor adjacent to Gladstone Road. There is sufficient width to theoretically place a path within this zone with a reduced offset to the rail tracks (4m absolute minimum).

6.5.3 Other Options Considered – On-road cycle lanes

In addition to the shared path options traditional on-road cycle lanes were considered in place of the potentially impractical shared path options. There are significant barriers to this option which would

require widening on both sides of the road encroaching on the existing water table and overhead power cables to the north and reducing the footpath and parking zone on the south side in the slimmer sections of the road corridor (660m length of the total 1680m length).

A typical cross section was applied of 3m vehicle lanes, 0.3m wide cycle lane buffers and 1.6m wide cycle lanes as per TN004 to test this option. This would result in overhead power on the north side being located close to or directly on the outside edge of the cycle lane, and an offset from between the cycle lane edge and boundary of approximately 1.3m for the majority of the 660m constrained length. Reductions to the typical cross section could be made in constrained sections to provide a cross section of all acceptable minimums as per TN004 to provide an additional 0.3m of space to provide a acceptable minimum footpath width of 1.5-1.6m to make this a workable option.

If pursued further this would be a high-cost option including full kerb and channelling of both sides the road and potential associated drainage and road rebuilding / reshaping to achieve an appropriate cross section.

Based on the above, this option was not considered for preferred concept design development.

6.5.4 Preferred Concept Design Typology – Shared path located on north side of rail corridor

Note concept design plans have not been completed for this route; however, it has been assessed as below:

A 3m wide shared path typology with 0.5m clearance from the boundary and 0.5m clearance to a barrier fence line has been selected as the preferred option for this road section. This can be accommodated in the green space on the north side of the rail corridor although would require approval from KiwiRail to install the path fence line at a 4m absolute minimum offset from the track centre.

This path would provide good connection to the Wingatui intersection by following the existing property access, a mid-point access location at an existing level crossing and connection to the signalised intersection of SH87 / Hagart-Alexander Drive through reserve land.

Key Constraints, Issues and Risks

- A crossing treatment / signals upgrade would be required at the intersection of Hagart-Alexander Drive to ensure a safe transition between the path and central Mosgiel.
- Earthworks requirement to address existing batters and contour undulation. Scope is not clear until a topo survey is completed.
- Isolated working space would likely mean closure of the rail siding for construction. Single direction access for trucks will likely reduce productivity.
- Existing property boundary fencing may be inadequate for the path and additional fencing or screening may be required to maintain privacy and security or reduce hazard to path users.
- Existing services and signal equipment may be encountered / clash with design.
- Reduced offset from track centreline may not be approved by KiwiRail.

6.5.5 Intersection of State Highway 87 and Hagart-Alexander Drive

To allow safe passage for shared path users to transition here, the path will connect to the existing crossing point at the signalised intersection, with the addition of a cycle signal phase.

6.6 Route Option C – Factory and Rail Corridor – Factory / Wingatui Intersection to Gladstone Road North

Concept design and assessment of this route option was not completed as it was out of the scope of this report, however, the below observations have been noted.

Key Constraints, Issues and Risks

- The available road corridor width of Factory Road east of Wingatui reduces by approximately 2m. This provides limited scope for road widening to accommodate on-road cycle lanes without land purchase and relocation of overhead services.
- There is potential to provide for a shared path on the north side of Factory Road in this section with a width of approximately 6m and limited vehicle accessways.
- It is unclear on what scope of earthworks would be required within the rail corridor.
- There appears to be adequate space within the rail corridor to accommodate the path. A culvert or bridge arrangement would be required to cross a drainage channel.

6.7 Route Option D – Magazine Road – Gladstone Road North to Chain Hills Tunnel Track

6.7.1 Existing Environment Context

Magazine Road consists of a sealed carriageway with no centre or edge line markings. There are no footpaths or kerb and channel. The berm has minor drainage swales along each side of the carriageway, with a culvert at each vehicle crossing. There is overhanging hedges and vegetation in places. There is overhead power on the north side. The road is set higher than properties on the north side of the road, and lower than those on the south side. The properties are serviced for both water and wastewater, with a pumped wastewater trunk main transitioning through this route to Chain Hills tunnel. Magazine Road ends in a No Exit and the eastern half of this route transitions through private property.

Context Summary:

ONRC (mobile roads)	Access
ADT (mobile roads)	50
Surface (mobile roads)	Two coat 4/6 seal width 5.7m
Berm description	Grass and gravel shoulders, no footpaths. Above ground power infrastructure on the north side.
Speed limit (DCC speed limits bylaw Amendment 8-2018)	50km/hr

Gladstone Road North photos showing existing typology looking East:

6.7.2 Shared Path Design Considerations

There is sufficient space within the north side berm to accommodate a shared path. The site topography naturally has a south to north slope ranging from approximately 4% to 10%.

Magazine Road is a No Exit road servicing a limited number of properties therefore the addition of a shared path beside the existing road carriageway was considered excessive for the purposes of concept design and a greenway concept considered in its place.

6.7.3 Magazine Road Preferred Concept Design Typology – Neighbourhood Greenway / Shared Space

This road has an ADT value of 50, it would be suitable to designate the road corridor a Neighbourhood Greenway or Shared Space. Section 9.4 of the CCC Guide provides best practice guidance for

Neighbourhood Greenways, however the majority of the recommendations are applicable to much busier roads.

The main consideration would likely be the posted speed limit as generally shared spaces are required to have a reduced speed limit. This could be avoided by ending the facility and re-starting the facility at either end of the road. On-road sharrows could be provided to direct cyclists and highlight their presence to vehicles.

If this approach was not acceptable to NZTA / DCC a separated shared path design can be accommodated.

Key Constraints, Issues and Risks

- Cross fall slope of nature typography
- Legality / acceptability of a greenway / shared space approach

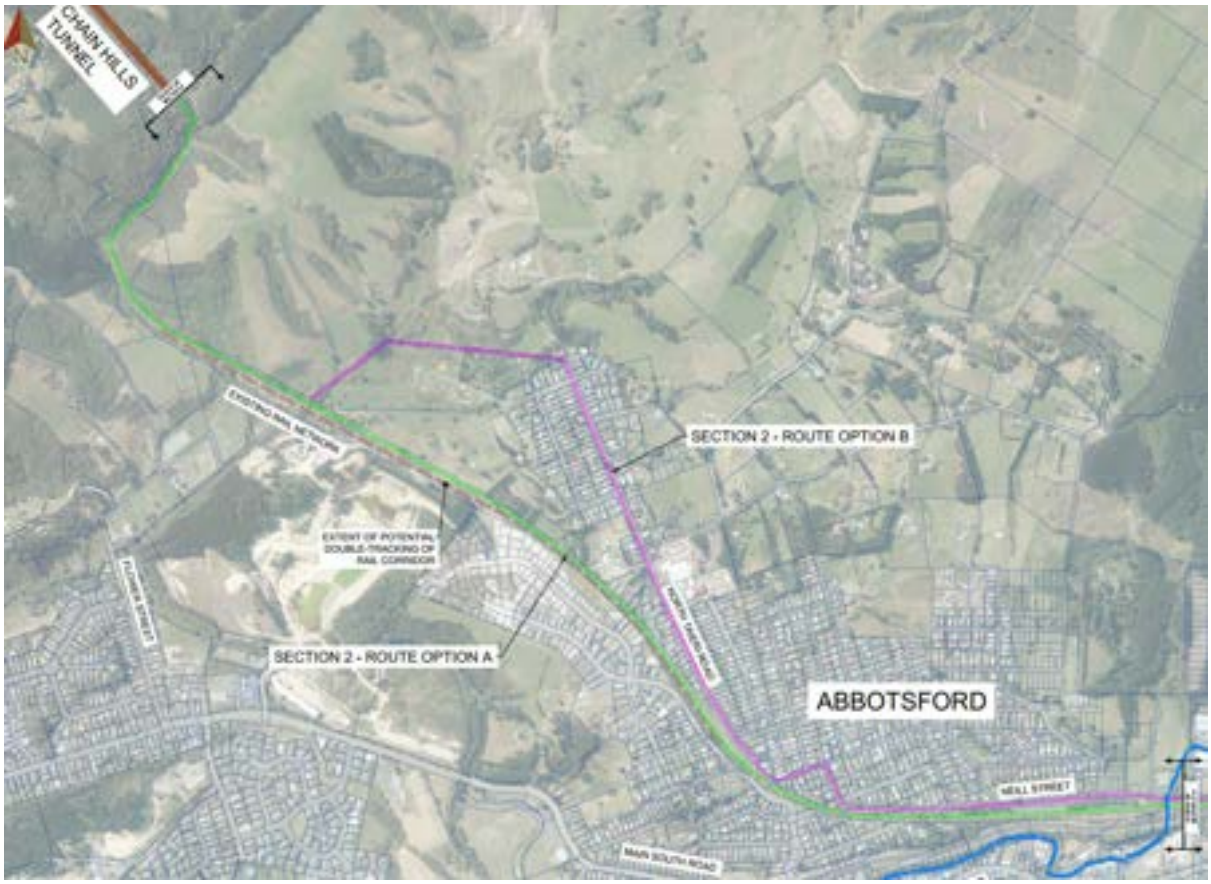
6.7.4 Eastern Portion Private Property Preferred Concept Design Typology – Shared Path

A 3m wide shared path typology has been selected as the preferred option for eastern portion of this section. This can be accommodated in the green space at the northern edge of these properties. Note this is south to north sloping terrain at approximately 1:3 batters. Earthworks and potential retaining walls would be required to safely transition path users through this area.

Key Constraints, Issues and Risks

- Land purchase of a portion of two properties would be required.
- Steep grades will necessitate the implementation of barrier fencing and a retaining wall on the south side of the shared path.

7 CONCEPT DESIGN – SECTION 2 – CHAIN HILLS TUNNEL TO BURNSIDE



7.1 Route Option A – Rail Corridor – Chain Hills Tunnel to Burnside (at Carnforth Street)

7.1.1 Existing Environment Context

This portion of the rail corridor sits within generally rural typology transitioning to urban then industrial over its length as it reaches closer to central Dunedin. There is a single track running along the corridor, with plans to install a double-track passing bay west of Abbotsford between KiwiRail Main South Line Chainage (MSL) 387 and 389. The rail corridor has both grass and gravel shoulders. The berm width is variable, retaining walls are utilised throughout and there is overhanging vegetation in places. The rail corridor transitions from being above the surrounding properties and roads at the western end, to moving below and back to being above again near the eastern end. The rail corridor has multiple pinch points as it transitions over and under roads, and where property development has expanded across legal boundaries. Services include local drainage which has recently been upgraded as well as cabling / ducting and potentially other signalling and KiwiRail services.

Context Summary:

Railway	Main South Line
Location	Between Chain Hills and Caversham Tunnels MSL CH389.300 to 385.600
Typology	Single Rail Track with maintenance access road

	(with proposed double tracking from MSL 389.00-387.000
Corridor description	Grass and gravel shoulders, variable width and typography within corridor, rail infrastructure and chambers both above and below ground

7.1.2 Shared Path Concept Design Considerations

This section has variable berm widths and grades, and the rail is generally on the southern side or central within the rail corridor. While there are pinch points and areas that will require additional engineering, the extended sections of green space adjacent to the rail allows for a shared path typology that can be adapted where necessary to suit the surrounding environment.

7.1.3 Preferred Concept Design Typology – Shared Path

A 3m wide shared path typology has been selected as the preferred option for this section. Concept investigations indicate the path can be accommodated on the north side of the rail corridor without encroaching on the absolute minimum setback of 4m from the track centreline, except when passing under existing bridges. The path width may also need to be reduced for short sections to pass under bridges or navigate constrained sections.

Key Constraints, Issues and Risks

Key constraints, issues and risks for this route have been noted on the plans. In addition, further commentary and contextual photos from Rail Corridor video supplied by KiwiRail are detailed below. These have been related to the MSL chainage:

Note the photos are generally looking west (direction of the MSL chainage) however the assessment is ordered based on traveling from Mosgiel to Central Dunedin. Also Note the images between locations MSL 386.075 and MSL 386.698 show the track relocated to the northern side of the corridor to accommodate drainage works. The track has since been relocated to the southern side of the corridor (indicative centreline shown in red).

- MSL 389.295 – Tunnel Approach – KiwiRail have requested that separation from tunnel is maximised to deter path users entering tunnel. May need to consider higher fence in this area.

- MSL 389.214 – Constrained corridor. Likely retaining required at base of hill.

- MSL 389.00 – KiwiRail's proposed end chainage location for double track rail passing lane, reducing space available for path.

- MSL 388.740-388.650 – Steep raising bank. Retaining wall likely required in this location potentially combined with reduced track offset.

- MSL 388.525 – Path will require new Bridge or widening of the existing structure including substantial earthworks and retaining due to presence of steep banks.

- MSL 388.500 - 387.950 – Batter directly adjacent to the rail line (approx. 1:1.5) will likely force the path further away from the rail tracks, likely at offset 1m from and running parallel with the rail corridor boundary. There may be scope to deviate the path alignment within the flatter zone to reduce earthworks and avoid the need for boundary retraining. Scope of cut/fill in this section in the range of +/- 2m.

- MSL 387.900 - Mounded rise which may require a large cut of approx. 4m depth to maintain appropriate longitudinal grades.

- MSL 387.725 – Local connection point at underpass to Green Island and Fairfield via Grandvista Drive and the existing pathway through Abbotsford School to North Taieri Road. Path will need to deviate around the underpass entrance and will require easement over school land.

- MSL 387.700-387.160 – Corridor berm banks up in this location. Path is located at the top of the bank. Likely that minor to medium retaining reinforcement will be required. Track offset reduces to 4m. Will require Kiwirail exemption to allow this design arrangement. If double tracking was not completed, this area would be less constrained.

- MSL 387 – KiwiRail's proposed start chainage location for double track rail passing lane, reducing space available for path.

- MSL 386.870 - Path passes beneath bridge. Existing bridge has two bays. Path may encroach closer than the 4m absolute minimum and may need managed through higher spec fencing. This will apply to all bridges in this area. KiwiRail approval of the design approach will be required.

- MSL 386.900-386.600 – Existing bank retaining and control through this zone. Path width reduced to 2.5m and located at absolute minimum 4m offset from rail track centre. Likely a high-cost zone with modification to existing retaining systems.

- MSL 386.850 – 386.260 – 3 existing bridge structures in this area constrains available width. Path maintained at 4m offset from track centre and 2.5m path width. Encroachment on existing bank will likely require retaining and control in this zone.

- MSL 385.800-385.250 – Path transitions to road corridor as difference in height between road and rail increases making track side path impractical due to steep bank at approx. 1:1.5.

- MSL 385.670 – New or widened bridge on Neil Street required

- MSL 385.600 – Intersection treatment required at Carnforth Street and Boomer Street for shared path, with path users to Give Way to road users. Indicative path alignment shown with red line.

7.2 Route Option B – Abbotsford – Chain Hills Tunnel to Carnforth Street (via North Taieri Road)

7.2.1 Existing Environment Context

This route follows a number of difference areas and typologies as set out below:

This route option utilises a previously unestablished legal road that extends westward from the north end of North Taieri Road and creates a connection to the historic Chain Hills rail tunnel. This route sits generally within rural typology potentially with steep grades and crosses multiple natural stormwater flow paths.

The route then transitions to an urban environment and follows North Taieri Road to Paterson Street. North Taieri Road is a chip seal road of urban typology. ONRC classification ranges from Primary Collector to Access over the route length. The road has variable widths throughout with footpaths on both sides of the road and on-road parking along most its length. There are residential properties with accessways on both sides for most of its length. The berm is variable in both width and elevation with areas sitting higher or lower than the road in places. There is overhead power generally on the eastern side of the road. Services include trunk water and wastewater mains, stormwater and wastewater drainage mains, and water supply and rider mains. A commuter bus services this area.

From here the route shifts to Paterson Street and a section of Runciman Street which is a constrained width access road with footpaths on both sides. Paterson Street has no berm width and Runciman Street has berm on the western side with established trees until the road meets and follows parallel to the rail corridor.

The route then follows parallel to the rail corridor via Runciman Street and Neill Street to Carnforth Street. Residential properties are to the north and rail corridor to the south with the berm including steep batters and established trees in some locations, as well as connection points to various pedestrian and road bridges.

Context Summary:

Section 2 - Route Option B Existing Summary							
Road	**From**	**To**	**Surface**	**ADT**	**ONRC**	**Width (Mobile Road)**	**Measured Width (cad aerials)**
North Taieri Road	Hyslop St	McKinlay Rd	Chipseal G4/6	375	Access	10	10.9
North Taieri Road	McKinlay Rd	Abbotts Hill Rd	Chipseal G5/6	920	Access	10.5	11
North Taieri Road	Abbotts Hill Rd	Exmouth St	Chipseal G4/6	2590	Secondary Collector	8.1	Range from 8.8 - 9.9. Generally 9m
North Taieri Road	Exmouth St	Paterson St	Chipseal G3/5	3450	Primary Collector	9.8	9.5
Paterson Street	North Taieri Road	Runciman St	Chipseal G4/6	690	Access	5.6	6.1
Runciman St	Paterson St	Binnie St	Chipseal G4/6	360	Access	8.5	9
Runciman St	Binnie St	Neill St	Chipseal G4/6	480	Access	8.5	9
Neill St	Runciman St	Christie St	Chipseal G4/6	1560	Secondary Collector	8.2	Range from 7 - 8.5
Neill St	Christie St	Carnforth St	Chipseal G4/6	2160	Secondary Collector	8.2	Range from 10.5 - 6.7

North Taieri Road – Hyslop to McKinlay – looking south

North Taieri Road – Abbotts Hill to Exmouth – looking south

North Taieri Road – Exmouth to Paterson – Looking south

Paterson Street Looking North

Runciman Street Looking South

Runciman Street Looking East

Neill St looking east

7.2.2 Shared Path Concept Design Considerations

Initial concept design investigated the option of a separated shared path or separated cycleway. This option was found to be impractical for North Taieri Road and Paterson Street with the below issues identified:

- Urban context of this section of the route with vehicle crossings from both sides provides a larger number of potential conflict points.
- Variable road, corridor and berm width and slope provides challenges in achieving a path within the corridor as well as mitigating impacts on property access longitudinal grades.
- Overhead power on both sides of the corridor further limits ability to provide a continuous corridor.

7.2.3 Preferred Concept Design Typology – on-road buffered cycle lanes on North Taieri Road – Neighbourhood Greenway on Paterson Street – shared path on Runciman / Neill / Boomer Streets

A mixed typology for this route has been selected as the preferred option dealing with the changing nature of the existing road corridors. This includes a shared path connecting the rail corridor to the north end of North Taieri Road, on-road buffered cycle lanes on North Taieri Road, a neighbourhood greenway on Paterson Street and a shared path on Runciman / Neill and Boomer Streets.

Key constraints, issues and risks for each section of this route option are detailed below:

Shared path connecting the rail corridor to North Taieri Road - Key Constraints, Issues and Risks

- There is a limited corridor for the path to follow without land purchase (on the assumption that there is a paper road in this location). A more optimal alignment may be available if land purchase or easement is obtained through this section.
- There are a number of existing stormwater flow paths or gully's in this section based on the aerial photography. The path will likely cross these therefore culvert arrangements may be required.
- It is understood from discussion with KiwiRail the geotechnical nature of the land through here is poor for construction.

On-Road Buffered Cycle Lanes on North Taieri Road - Key Constraints, Issues and Risks

On-road buffered cycle lanes have been selected as the preferred option in this section. A typical cross section in accordance with NZTA TN004 has been applied consisting of 3m wide traffic lanes, 0.3m painter buffer flush median (acceptable min) and 1.6m (desirable min with no parking) cycle lanes. This provides for a minimum cross section width of 9.8m.

- The existing road width varies from 8.8m to 11m. To accommodate on-road cycle lanes road widening over the majority of the route length would be required involving kerb and channel and footpath replacement.
- Full removal of parking would be required, with there being potential to provide constructed parking bays outside of the road width. Parking provided with parking bays will be limited in comparison to the existing numbers.
- It is notable that areas with steep berms complicate road widening where property accesses are also present. The strategy used for concept design is to locate the widening on a single side of the road the opposite side of the road to steeper batters wherever possible.
- Due to overhead power and varying berm steepness and width the typology applied for concept design was to locate potential parking bays in the berm adjacent to the cycle lane rather than accommodate parking on-road with additional widening.
- Footpath renewal and relocation would be required wherever road widening is completed, or parking bays installed.

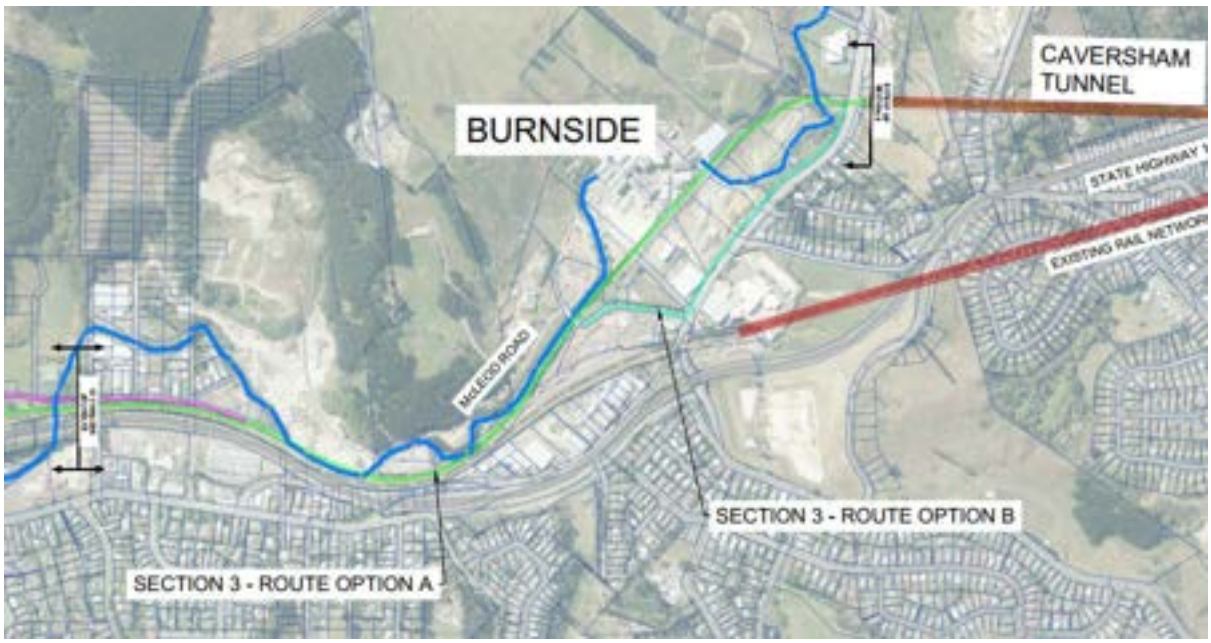
Neighbourhood Greenway on Paterson Street - Key Constraints, Issues and Risks

- Speed limit of 30km/hr would be required to meet CCC guidance.
- Limited space does not allow for any alternative treatments within his section. Wayfinding and clear messaging would need to be a focus of design.
- Change in typology for the route impacts consistency and legibility of the overall route.
- Transitions from greenway to other typologies at each end of the route would be located on sweeping bends in the road. Careful design will be required to ensure safe transitions and appropriate sight distances.

Shared Path on Runciman / Neill / Boomer Streets

- Path would encroach over existing batter sloping down to the rail corridor requiring retaining walls with barrier fencing and established tree removal. Potential high-cost area.
- Path would encroach into existing batters sloping up to the rail corridor requiring cutting into the face of the batter and retaining and established tree removal. Potential high-cost area.
- Path would encroach on existing pedestrian bridge at Dall Street requiring the bridge approach to be modified likely with retaining walls.
- The path would converge with Route Option A at Armstrong Lane therefore still require a new bridge over the Kaikorai Valley Stream.

8 CONCEPT DESIGN – SECTION 3 – BURNSIDE TO CAVERSHAM TUNNEL



8.1 Route Option A – Burnside (at Carnforth Street) to Caversham Tunnel via rail corridor, private property and road corridor

8.1.1 Existing Environment Context

This route follows a number of different areas and typologies as set out below. There is a heavy industrial presence through this section of the route that provides a low level of attractiveness and amenity to the potential route:

Boomer St is an industrial access street of width 7.3m from Carnforth Street to Kane Street. From Kane Street it appears to extend as a private access to two industrial businesses, but also appears to be formed as a road. The ADT is 480 from mobile roads. Boomer Street runs parallel to the rail corridor and is situated lower than the rail corridor. There is a steep bank up to the rail corridor with established trees.

At the eastern end of Boomer Street's private section, the Kaikorai Valley Stream meets and runs parallel to the rail corridor from MSL chainage 385.200 to 385.000. Adjacent to the stream is an industrial business understood to be Nash & Ross landfill. This appears to have a constructed edge wall on the stream that has allowed hardstand to be constructed to the edge of the stream. From KiwiRail video it appears there may be a portion of cantilevered structure over the stream as well in this location. There is overhead power located in the bank on the Rail side of the stream. There are existing bridge structures over the stream at each end of the Nash & Ross facility.

The route re-enters the Rail Corridor at MSL chainage 385.000. The berm adjacent to the rail tracks through this area is generally flat with a dirt / gravel service vehicle track. The Kaikorai Valley Stream meanders generally parallel to the rail corridor. McLeod Road (private) runs parallel on the northern side of the stream.

At MSL chainage 384.660 the route deviates from the rail tracks through a section of private land that occupies Valley Lumber within 714 Kaikorai Valley Road. The route continues to follow the alignment of the Kaikorai Stream. It is understood from KiwiRail that there are existing stockpiles of contaminated material within the zone as well from previous construction works within the rail corridor.

The Route continues across McLeod Road (Council owned portion) on the south east side of a bridge over the Kaikorai Stream and follows the historical rail corridor to Eclipse Road. In this section to the south-east there appears to be a tradewaste treatment plant. Within this section there is overhead cables on the north western side.

The route then crosses Eclipse Road at its end point where a number of industrial business vehicle crossings join and continues north-east through an industrial accessway to various autoparts and autowrecker businesses. At the north-eastern end of this driveway the route then crosses the Kaikorai Stream where there appears to be some existing access bridges.

The route then traverses undeveloped greenspace that is generally overgrown and low lying to cross the Kaikorai Stream again at an existing bridge structure where it meets Kaikorai Valley Road.

To access the Chain Hills Tunnel located on the eastern side of Kaikorai Valley Road the route needs to cross Kaikorai Valley Road. Kaikorai Valley Road is an arterial road with an ADT of 9000. It has an asphalt surface and width of approximately 13.8m. The existing road typology includes two traffic lanes (one in each direction), a flush median in the centre, cycle lanes on each side and a parking lane on the eastern side. Directly beneath the path route at the Kaikorai Valley Road crossing point are a number of services namely 3 water mains (350mm, 300mm and 375mm diameters) running parallel

to the route and 3 water mains perpendicular to the route (750mm, 300mm, and 225mm diameters) as well as 2 wastewater mains. It is understood from the 3 waters team that the services laid parallel to the route crossing the road are within a service box culvert beneath the road.

The Chain hills tunnel access is located much lower than Kaikorai Valley Road. It is currently security fenced with steps providing controlled access to the entrance zone. There is a water structure shed that houses a number of water supply components including pressure reducing valves that obscures access to the tunnel. Directly south there are electricity transformers. It is understood DCC have purchased the property to the north to assist with potential access to the tunnel.

Boomer Street – Looking east

Boomer Street – Private Section – Looking east

Rail Corridor - MSL 385.195 looking west at Boomer Street private section

Rail Corridor - MSL 385.145 looking west showing existing bridge at end of Boomer Street private

Rail Corridor - MSL 385.016 looking west showing Nash & Ross facility interface with Kaikorai Stream

Rail Corridor – MSL 384.669 looking west

Rail Corridor – MSL 384.521 looking west. Route departs rail corridor prior to this location. Contaminated land stockpiles can be seen in this photo.

McLeods Road Private looking south-west showing entrance to Nash & Ross facility and existing bridge structures over the Kaikorai Stream at the eastern side of the facility.

McLeod Road at Kaikorai Valley Stream looking north-east along the historical rail corridor

Eclipse Road end looking north-east along private accessways

Kaikorai Valley Road looking North West to the existing undeveloped greenspace

Kaikorai Valley Road looking into Caversham tunnel entrance showing pipework shed and change in elevation

8.1.2 Shared Path Concept Design Considerations

As this route option does not follow the road corridor, a shared path is the only feasible typology. While there are pinch points and key challenge areas there appears to be sufficient space for a shared path typology that can be adapted where necessary to suit the surrounding environment, subject to land purchase.

8.1.3 Preferred Concept Design Typology – Shared Path

A 3m wide shared path typology has been selected as the preferred option for this section. Concept design indicates there likely only one feasible route from Abbotsford to Burnside and that land purchase to allocate an appropriate corridor will be critical to this route especially past the Nash & Ross landfill.

Key Constraints, Issues and Risks

- Land purchase and easements required throughout this section. Impacts on reduced space for businesses and impacts on their operations may result in additional works to re-organise internal operations.
- Boomer Street - Path encroaches within zone of influence of rail track. Tree and vegetation removal required along with potentially significant retaining to provide for path.
- Boomer Street at Kane Street appears to transition from a Council road to a private road. Land purchase / easement likely required.

- Path route through Nash and Ross landfill to use existing access bridge. This access point to the landfill would need to be closed and alternative access potentially provided via a new bridge on either Crimp, Kane or Harrison Streets.
- The condition of the existing bridges and structures close to Kaikorai Stream is not known. Structural Assessment is required.
- Capacity of existing stream has not been considered. Overflow frequency / flood modelling may be required to understand risks to the path through this section.
- New bridge structures required where path crosses Kaikorai Stream.
- Contaminated land and material stockpiles located throughout this section.
- Likely difficulty in providing amenity and comfort to path users through a heavy industrial area.
- Underpass would be a high-cost intervention with multiple service relocations and adjustments. Potential issues with adjustment and relocation of services. Limited alternative options to address difference in elevation between tunnel and road at Kaikorai Valley Road.

8.2 Route Option B – McLeods Road to Caversham Tunnel via Kaikorai Valley Road

8.2.1 Existing Environment Context

This route follows McLeods Road out to Kaikorai Valley Road, then Kaikorai Valley Road to the Caversham tunnel entrance.

McLeods Road is a secondary collector road with an ADT of 780. This road exclusively services industrial activities mainly the Nash & Ross land fill. It is a chip seal road with a rural typology with no kerb and channel and grass berms.

Kaikorai Valley Road is an arterial road with an ADT of 9000. It has an asphalt surface and width of approximately 13.8m. The existing road typology includes two traffic lanes (one in each direction), a flush median in the centre, cycle lanes on each side and a parking land on the eastern side.

McLeods Road looking northeast

McLeods Road looking east out to Kaikorai Valley Road

Kaikorai Valley Road looking north showing the intersection with McLeods and Eclipse Roads

Kaikorai Valley Road looking north

Kaikorai Valley Road looking north

8.2.2 Shared Path Concept Design Considerations

Both McLeods Road and Kaikorai Valley Road have either no or minimal property access points on the north-western side. With some land purchase and road layout adjustment an appropriate corridor can

be provided to accommodate a shared path typology. This is considered a preferable arrangement for this section given the industrial nature of traffic on McLeods road and the ADT numbers on Kaikorai Valley Road.

8.2.3 Preferred Concept Design Typology – Shared Path

A 3m wide shared path typology has been selected as the preferred option for this section.

McLeod Road - Key Constraints, Issues and Risks

- To provide a shared path on McLeod Road it is anticipated that kerb and channel will be required to define the edge of the road and the shared path installed against this. This would require filling of the existing road-side swale and potential installation of stormwater infrastructure to direct flows to the Kaikorai Stream.

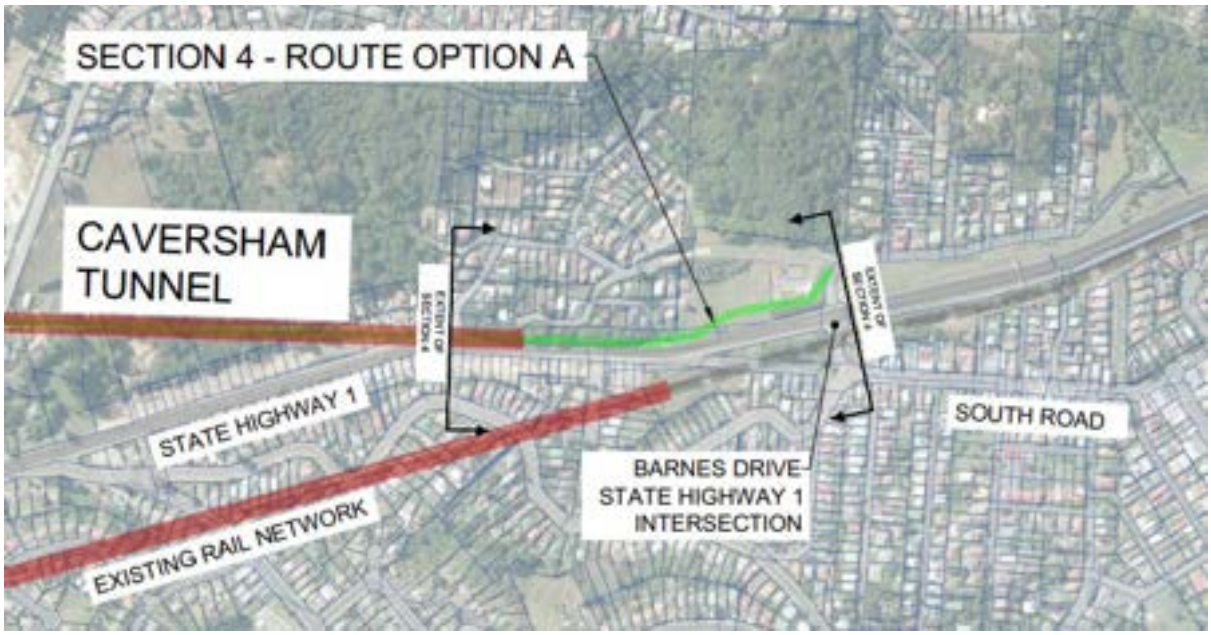
McLeod Road / Kaikorai Valley Road Intersection - Key Constraints, Issues and Risks

- The existing intersection arrangement is very open with a number of loosely defined vehicle swept paths. This is caused by both McLeod Rd and Eclipse Road intersecting with Kaikorai Valley Road in close proximity directly adjacent to each other. This provides for a challenging environment to navigate for both vehicles and pedestrians. Addressing this layout in conjunction with the shared path is a key design constraint.
- A number of options are available to address the intersection including:
    - leaving as is and crossing the shared path across Eclipse Road prior to the intersection (may require land purchase or easement)
    - Signalising the overall intersection providing for cyclist phasing
    - Realigning McLeods Road to T intersect with Eclipse Road (may require land purchase or easement)

Kaikorai Valley Road - Key Constraints, Issues and Risks

- There is currently insufficient width available to accommodate the shared path behind the existing kerb and channel. To provide width kerb realignment would be required combined with either road lane arrangement adjustment on Kaikorai Valley Road or land purchase or easement.
- The existing undeveloped greenspace falls away from Kaikorai Valley Road. This will potentially require retaining combined with barrier fencing if widening the existing footpath to accommodate the path.
- There are existing cycle facilities on Kaikorai Valley Road that terminate at or just south of the Mcleod Road intersection with no feasible space to extend. There is opportunity to remove this on-road facility in combination with installation of the section of shared path with appropriate crossing treatments. This will provide flexibility in the design of this section of the path to modify the existing road layout.
- There are existing overhead electricity poles which the path may clash with.

9 CONCEPT DESIGN – SECTION 4 – CAVERSHAM TUNNEL TO BARNES DRIVE/SH1 INTERSECTION



9.1 Route Option A – Caversham Tunnel – Kaikorai Valley Road to Barnes Drive

9.1.1 Existing Environment Context

This route extends from the Caversham Tunnel access alley. This alley is bordered by vertical rock walls, includes service sheds housing service equipment and pressure reducing valves. Services include pressurised gas and wastewater and water mains that utilise the tunnel to service Kaikorai Valley. To an existing 2.5m width shared path adjacent to SH1. The existing shared path traverses through Sidey Park and terminates at Barnes Drive. From here the South Dunedin Strategic Cycle Network splits to follow Barnes Drive south to South Road and also continues east along Barnes Drive.

Caversham Tunnel entrance looking west

Caversham Tunnel entrance looking west – showing existing services shed

Caversham Tunnel entrance track looking west from SH1 north side shared path

SH1 north side shared footpath looking west – Caversham Tunnel entrance is on the right of the streetlight pole

SH1 north side shared footpath looking west

Sidey Park shared footpath looking west to SH1

9.1.2 Shared Path Concept Design Considerations

As this route option does not follow the road corridor a shared path is the only feasible typology. There is an existing shared path connecting to the tunnel entrance however this is of limited width at 2.5m.

9.1.3 Preferred Concept Design Typology – Shared Path

A 3m wide shared path typology has been selected as the preferred option for this section. Concept investigations indicate the path can be accommodated within the existing tunnel approach, with modification of the existing water service shed.

The existing shared path approach to the tunnel will need to be widened in areas to meet the 3m wide criteria of this design. This can be accommodated on the northern side of the existing path with the removal of vegetation and potential retaining walls. There are two streetlight poles within 2.7m of the roadside kerb which will need to be repositioned to widen the shared path.

Key Constraints, Issues and Risks

- A crossing treatment will be required at the intersection of Barnes Drive and State Highway 1 to ensure a safe transition to the South Dunedin Strategic Cycle Network.
- The proximity of State Highway 1 may necessitate the implementation of barrier fencing on the south side of the shared path.
- The service shed situated near the tunnel access will need to be resituated.
- The poorly draining, low lying nature of the tunnel access will require drainage design considerations through preliminary design. This includes the lack of overland flow path from this area.
- As the existing gas and wastewater pipelines are to remain, these will need to be factored in preliminary design considerations.
- CPTED considerations include removal of the existing 2.0m timber fence at SH1 road level to increase passive surveillance. Consideration of acoustic impacts the removal of this fence would have on Neighbouring properties is required.
- CPTED considerations include reinstatement of closed pedestrian bridge from Lindsay Road. Structural assessment is required.
- Vegetation maintenance and clearance required on and above the rock face.
- Bank retaining in order to widen the existing shared path.