Lake Road Cycle Options

Andrew Macbeth

BE, MEng, CPEng, FIPENZ

Director, ViaStrada Ltd, Christchurch

Chris Jones

BSc (Construction Management)

Transport Programmes Manager, North Shore City Council

Abstract

Cycle lanes were approved by North Shore City Council for installation on Lake Road between Esmonde Road and Hauraki Road, a distance of about 600 m, late in 2008 but there was uncertainty about the optimal design. ViaStrada Ltd was engaged to develop and review options for accommodating cyclists on this 23 m wide road corridor carrying about 40,000 motor vehicles per day on a four lane cross-section.

Some 18 options were developed, each with various advantages and disadvantages. They made tradeoffs amongst the various competing uses of road space on Lake Rd. These uses included pedestrians, cycles, cars, trucks and buses. Some design options made it easier for drivers to turn right into driveways and side streets; others restricted this facility. Some would encourage higher motor vehicle speed. Some would feel more comfortable for cyclists; some options would provide for off-road cycling on cycle paths while others provided for cycling to be done on-street through cycle lanes. Some options provided more space for pedestrians. Various road surfaces and lane delineation techniques were considered.

This paper provides a comprehensive review of many potential options for balancing the needs of all road users and has lessons for cycle facility design in many situations. In addition to reviewing the theoretical options, the paper presents the final decision made by the council, weighing up the technical preferences and the realities in terms of limited road reserve, an existing designation and constrained budgets.

Summary

Cycle lanes were approved by North Shore City Council (NSCC) for installation on Lake Road between Esmonde Road and Hauraki Road, a distance of about 600 m as part of a corridor upgrade. ViaStrada Ltd was asked to develop and review options for accommodating cyclists on this 23 m wide road corridor carrying four lanes of motor vehicles and about 40,000 motor vehicles per day as a response to concerns expressed by councillors on behalf of interested citizens.

Some 18 options were developed. All options had some advantages and some disadvantages. They make tradeoffs amongst the various competing uses of road space on Lake Rd. These uses include pedestrians, cycles, cars, trucks and buses. Some design options made it easier for drivers to turn right into driveways and side streets. Some would encourage higher motor vehicle speed. Others would feel more comfortable for cyclists; some options provided for off-road cycling on cycle paths while others provided for cycling to be done on-street through cycle lanes. Some options provided more space for pedestrians. Different people would prefer different options after balancing all the variables, depending on their own perspectives and experience as pedestrians, cyclists and drivers.

The approved concept plan (described as Option 1 in this report) had 1.5 m wide cycle lanes on each side of Lake Rd. ViaStrada had some concern that this design would be unsafe for cyclists. However, North Shore officers felt that compliance with the acceptable widths specified in the design guide were sufficient, particularly in light of safety audits that did not identify problems with the proposed design.

ViaStrada recommended Option 7, which consists of a 1.7 m cycle lane downhill (northwards) and a 2.0 m uphill cycle lane to accommodate overtaking manoeuvres. This is more space-efficient than providing 2.0 m cycle lanes for both directions. This option provides a 2.8 m western footpath and 2.0 m median midblock. The median can be widened to 2.5 m at side roads to accommodate turning manoeuvres by reducing the through-traffic lanes at these intersection locations to 2.9 m.

ViaStrada's second choice was Option 3. This is similar to Option 7 but has both cycle lanes at 1.7 m wide, with slightly more width in the median and footpaths.

Both these options (and any others involving cycle lanes) can use textured lane markings (Option 4) to reinforce the presence of the cycle lane. We recommend that this should only be used at "stress points" (along with coloured surfacing) to discourage motorists from cutting into the cycle lanes.

Taking various constraints into account the final design added coloured marking to the full length of the cycle lane with a wide textured delineation line. This adjusted design addressed the concerns that had been previously expressed and satisfied the needs of the various interest groups.

The installation contract commenced in March 2009 with works to move services, upgrade the water main and realign property boundaries. The main works will commence in January 2010 and will continue until January 2011.

1 Introduction

Cycle lanes were approved for installation by North Shore City Council in late 2008 on Lake Road between Esmonde Road and Hauraki Road, a distance of about 600 m. This portion of Lake Rd is between North Shore's city centre in Takapuna and a significant ferry terminal for Auckland-bound commuter cyclists, at Devonport. ViaStrada Ltd was asked to develop and review options for accommodating cyclists in light of concern for the safety of cyclists on this road, which carries around 40,000 motor vehicles per day. The location is illustrated in Figure 1.

Figure 1: Location Map

Cycle lanes already exist further south on Lake Rd and are proposed to connect Devonport to Takapuna in the regional cycle network, a distance of about 5 km. The current layout for Lake Rd aims to provide a significant improvement in travel amenity for both motorists and for active transport modes (walking and cycling).

National targets from the NZ Transport Strategy 2008 require 30%[1] of all urban travel to be by walking and cycling by the year 2040. On Lake Rd, achieving the national cycling targets would result in cycle traffic volumes increasing from current levels of about 300 cyclists per day to 3,000 per day or more. This would equate to approximately 150 cyclists in the peak hour in each cycle lane.

Figure 2 shows a portion of the road prior to the installation of cycle lanes.

[1] Cycle traffic volumes are not expected to be 30% of motor vehicle traffic volumes, however, as cycle trips are typically shorter than motor vehicle trips. So if equal numbers of trips were done by cycle as by car, "vehicle kilometres travelled" (VKT) and consequently traffic counts, would be greater for cars than cycles.

Figure 2: Narrow lanes on Lake Rd prior to installation of cycle lanes

Surveys done on Lake Rd at Takapuna Grammar School show that two thirds of cyclists at that location were adults (as commuters) rather than school students and three quarters cycled on the road, as opposed to the footpath. These proportions would be higher on the Esmonde Rd to Hauraki Rd section of Lake Rd, as it is further from the school. The dominant demographic of cyclists for design purposes is thus adult commuters, although a good facility design will be likely to broaden the appeal of the route for other cyclist types.

Council staff had reported exhaustively over recent years on the Lake Rd corridor upgrade project. In the agenda for the 16 October 2008 meeting of the Infrastructure and Environment Committee, a staff report of over 100 pages discussed Stage 2 of the project. Amongst other things, it identified the need for "improved separation of the on-road cycle lanes from the traffic lanes" by:

- Placing a solid "mini-median" (up to 300 mm wide) between the cycle-lanes and the adjacent traffic lanes;
- Painting the white cycle lane edge line as a "rumble strip";
- Placing the gutter between the cycle lane and the traffic lane; and
- The practicality of creating the cycle lane from a different material than the road to indicate that it has a different function.

This project was intended to provide technical information and expert advice on the options to inform the council's decision-making process. As these issues recur from time to time in different jurisdictions, it was felt that it would be useful to publicise the findings of the project for a wider audience through a published conference paper.

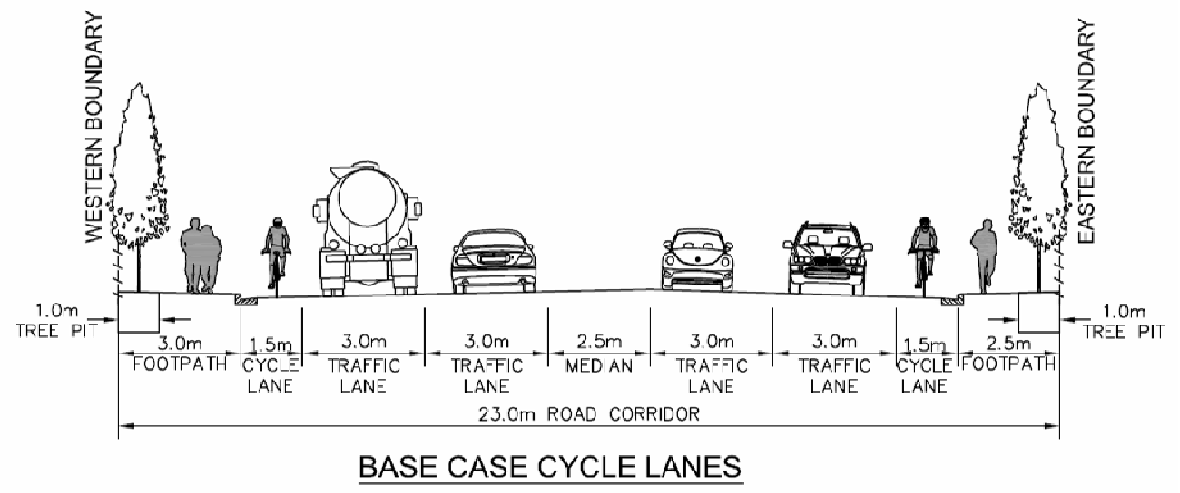
The report to NSCC discussed 18 options for Lake Rd. Space does not permit inclusion of all the discussion on these, but the full report is available on the ViaStrada website:

http://viastrada.co.nz/project/2009/lake-road-cycle-lane-options

This paper illustrates and briefly discusses all 18 options, including the "base case", and explains a number of the more interesting and useful options in more detail. The NSCC staff-recommended option and the council decision are also discussed.

2 Options

2.1 Option 1: Base Case Cycle Lanes



This cross-section provides a 1.5 m wide cycle lane on each side of the road. The New Zealand Supplement to Austroads Guide to Traffic Engineering Practice Part 14 Bicycles (the NZ Supplement) notes that 1.5 m is the "desirable minimum width" for a cycle lane next to the kerb when the speed limit is 50 km/h or less. However, when the 85th percentile speed is "significantly higher" than 50 km/h, then the 85th percentile speed should be used.

The 85th percentile speed of Lake Road averaged throughout the day is currently about 55 km/h, but is over 60 km/h during times when traffic volumes are low and drivers are not impeded by other vehicles. Operating speeds are expected to increase once the four-laning is complete. Accordingly, we recommend that an 85th percentile speed of 60 km/h is used for design purposes.

With an 85th percentile speed of 60 km/h, then by interpolation from Table 4-1 of the NZ Supplement, the "desirable minimum width" of cycle lanes should be 1.7 m. Lane widths below the "desirable minimum width" (such as the 1.5 m wide cycle lanes in the base case) "should only be used in low speed environments and when it is not possible to achieve greater widths", according to the NZ Supplement.

The NZ Supplement also notes that "minimum width cycle lanes adjacent to narrow traffic lanes should be avoided". This provides another reason for rejecting cycle lanes that are 1.5 m wide.

As a general rule, cycle lanes narrower than the "desirable minimum width" should only be used for occasional "pinch points" on existing roads where cycle lanes are being retrofitted, rather than applied as a continuous width on new cycle lanes.

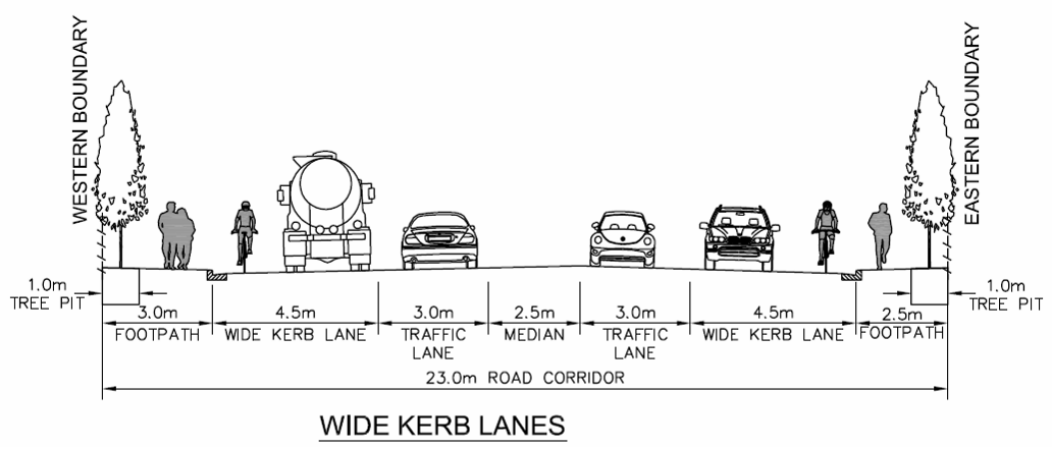
The NZ Supplement also notes that "if cycle traffic flows exceed 150 in the peak hour, then additional width to accommodate overtaking manoeuvres should be considered". The Lake Road facility is expected to carry more peak hour cycle traffic than this threshold over the design life of the project, so a width of about 2.0 m would provide for this function. Cycle lanes wider than 1.5 m are discussed in other options.

The presence of a cycle lane that did not completely comply wit the NZ Suplement would provide some benefit to cyclists in that it would encourage motorists to position their vehicles in the centre of their lane, which would create more space for cyclists.

ViaStrada recommended that if the median and footpath widths were to be retained as shown in the base case, then consideration should be given as to whether the road should be marked with cycle lanes that do not comply with the NZ Supplement, or whether the cycle lanes should be omitted in favour of wide kerb lanes. This is discussed in the next option.

The "base case" with its 1.5 m wide cycle lanes was thus not recommended.

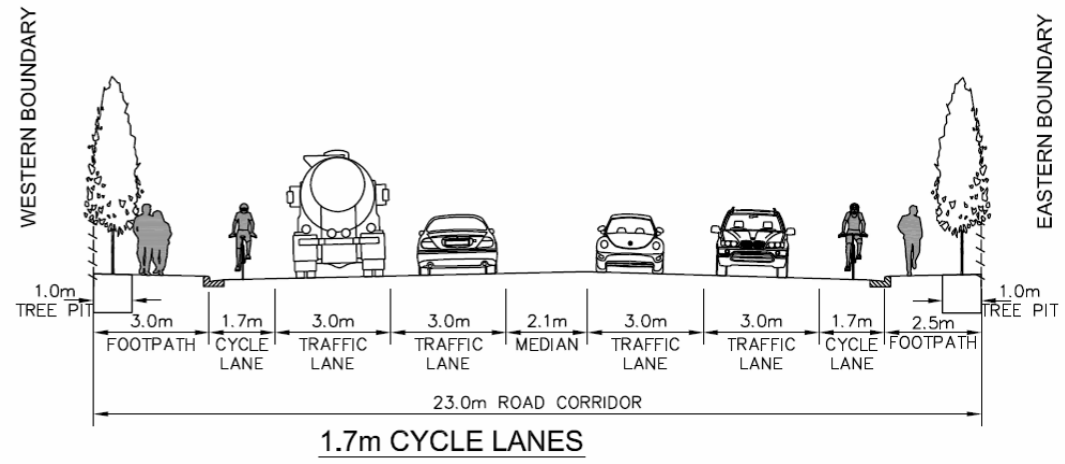
2.2 Option 2: Wide Kerb Lanes



Wide kerb lanes provide additional space next to the kerb for cyclists to share with motor vehicle traffic.

This option was not recommended – see full report for details.

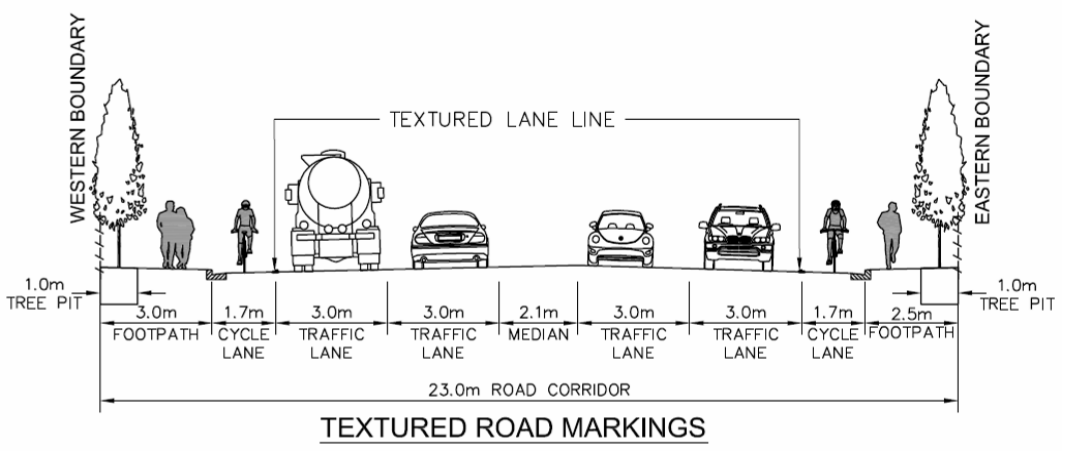
2.3 Option 3: Cycle Lanes 1.7 m Wide



This cross-section provides 1.7 m cycle lanes instead of the 1.5 m lanes of the base case (Option 1). The cycle lane widths satisfy the requirements of the NZ Supplement.

This was the consultant's second-best option – but see full report for more details.

2.4 Option 4: Textured Lane Markings

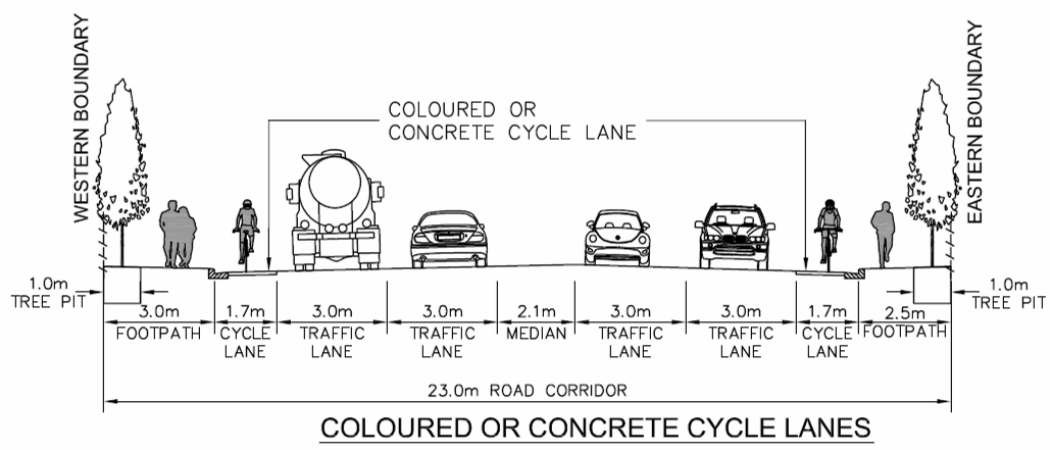


This option provides a textured lane line, such as an “audible textured edge line”, “profile line marking” or “vibraline” sometimes used on rural state highways. An urban example (Dunedin) with a low profile (4 mm) pavement marking is illustrated on the left of Figure 3. A more conventional rural installation (with a 7 mm line thickness) is shown on the right.

Figure 3 : Textured road marking in Dunedin; 4 mm urban (left) and 7 mm rural (right)

The low-profile marking was recommended for testing on the Lake Rd / Esmonde Rd curve.

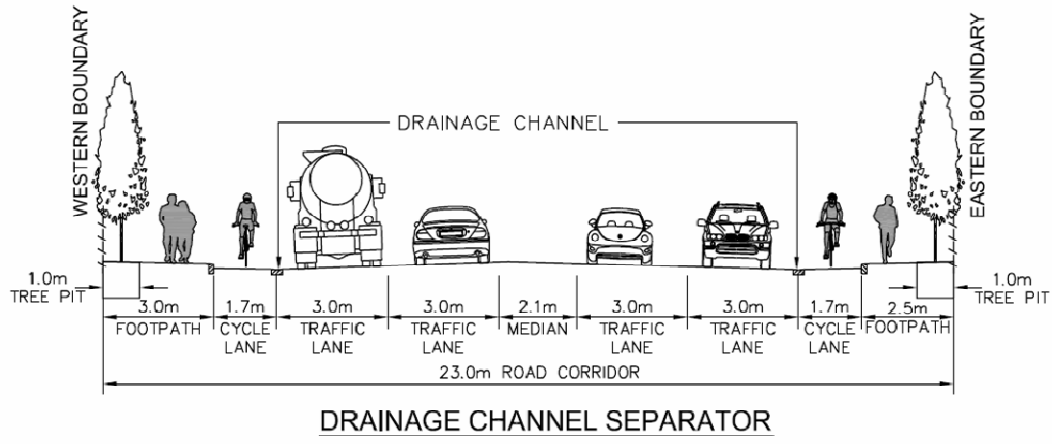
2.5 Option 5: Coloured or Concrete Cycle Lanes



Option 5 provides for the cycle lane to be surfaced with concrete (rather than asphalt) or to be coloured green to distinguish the cycle lane from the adjacent general traffic lane.

This option was not recommended – see full report for details.

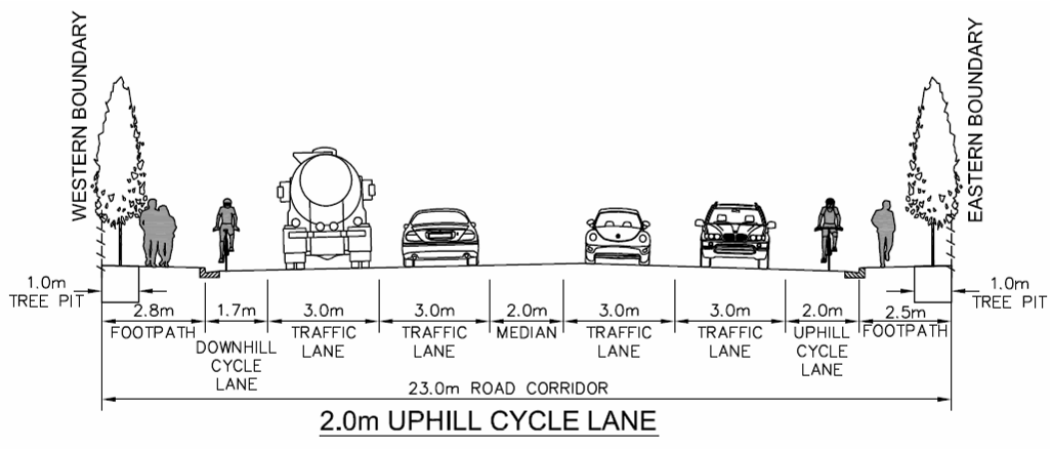
2.6 Option 6: Drainage Channel Separators



This option has a flat-profile or shallow V-channel (between 400 mm and 600 mm wide) separating cyclists and passing motor vehicles.

This option was not recommended – see full report for details.

2.7 Option 7: 2.0 m Uphill Cycle Lane



This option establishes a cycle lane wider than the "desirable minimum width" of 1.7 m, but just in the uphill direction (east side) where the speed differential amongst cyclists is likely to be higher than in the downhill direction. Space is at a premium on Lake Road and creating both cycle lanes 2.0 m wide, while ideal from a cycling perspective, may not be justified in terms of competing demands for road and footpath space.

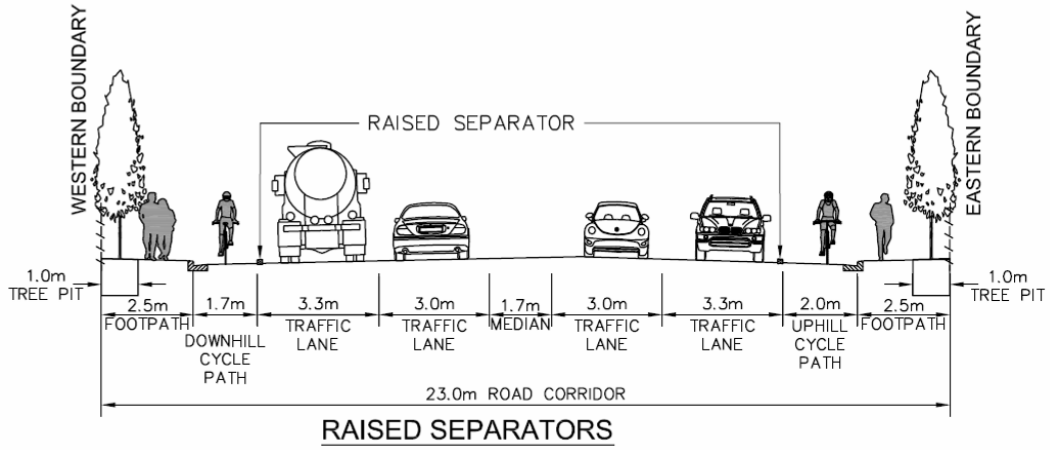
A 2.0 m uphill cycle lane would provide the opportunity for faster cyclists to overtake slower cyclists without leaving the lane, a feature that is likely to be increasingly valued in future as cycle traffic volumes increase. It also would increase the separation between motor vehicles and cyclists, improving the comfort and safety of both drivers and cyclists.

This cross-section requires the narrowing of the west footpath to 2.8 m and median to 2.0 m. The uphill cycle lane could be narrowed to 1.9 m and the four through lanes could be narrowed to 2.9 m at each right turn pocket at the side streets, to allow for a 2.5 m turn lane. The uphill lane should also be reduced to 1.7 m at the Hauraki Rd signalised intersection to discourage car drivers from using the cycle lane as a "queue jump" lane.

This option provides a better level of service for cycling than Option 3 (1.7 m cycle lanes in both directions) and would accommodate the subsequent use of textured lane markings if they prove satisfactory in trials recommended in Option 4.

Accordingly, Option 7 was ViaStrada's preferred option, retaining as much functionality and safety for all road users as possible in this constrained corridor.

2.8 Option 8: Raised Separators

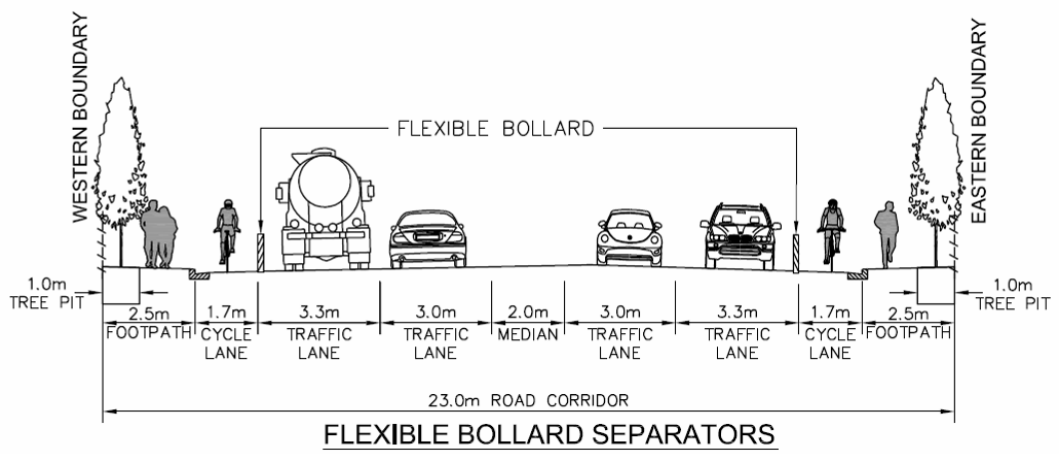


A raised separator (illustrated in Figure 4) could consist of a low kerb (say 100 mm high and a similar width), a low-profile rubber judder bar mounted longitudinally in the road, or raised reflective pavement markers (RRPMs).

Figure 4: Raised separators (Melbourne)

This option was not recommended – see full report for details.

2.9 Option 9: Flexible Bollard Separators

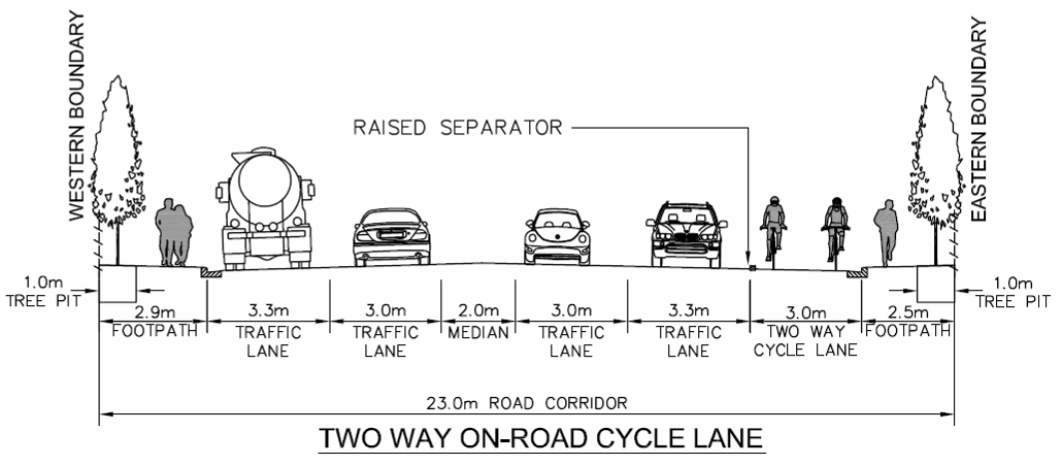


This option provides separation between cyclists and motor vehicles by use of flexible bollards. Flexible bollards (in Silverdale) are illustrated in Figure 5.

Figure 5: Flexible bollards (Silverdale)

This option was not recommended – see full report for details.

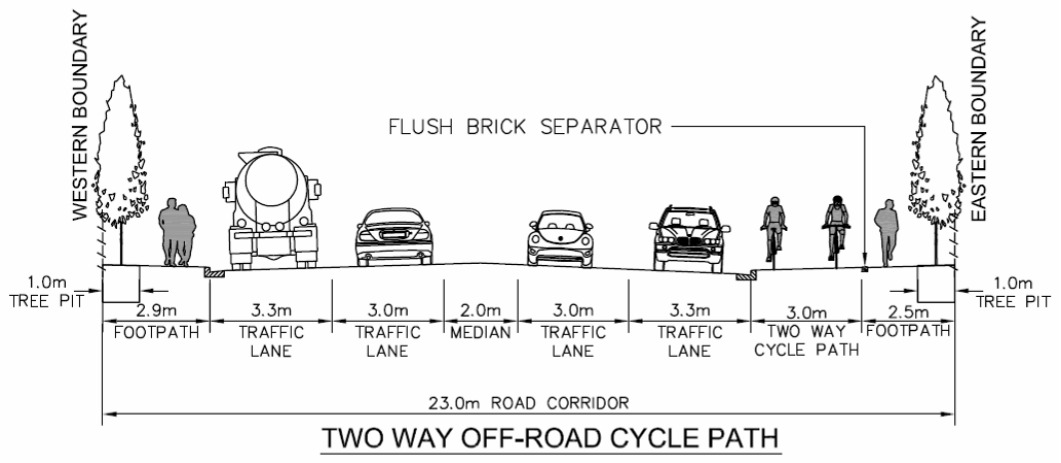
2.10 Option 10: Two-way On-road Cycle Lane



This option provides a two-way cycle lane on one side of the road.

This option was not recommended – see full report for details.

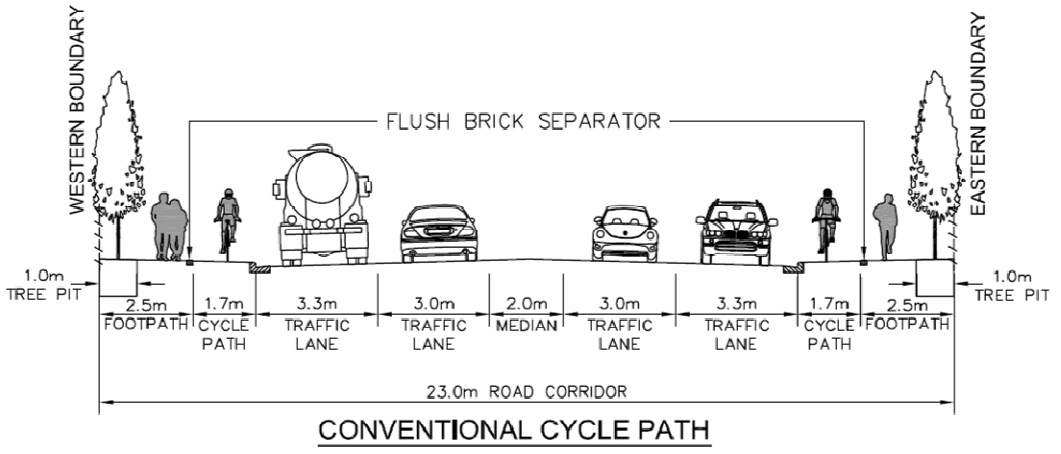
2.11 Option 11: Two-way Off-road Cycle Path



This option provides a two-way cycle path on one side of the road.

This option was not recommended – see full report for details.

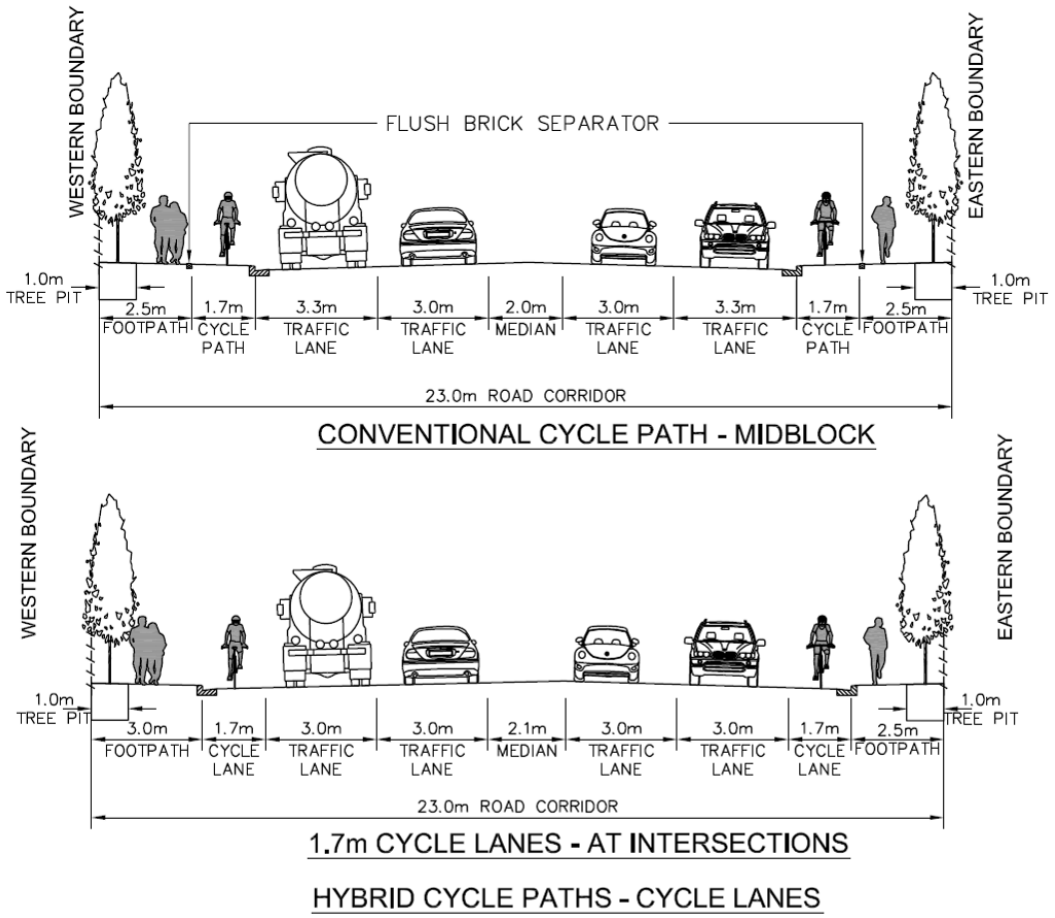
2.12 Option 12: Conventional Cycle Paths



This option provides conventional cycle paths on each footpath, next to the kerb.

This option was not recommended – see full report for details.

2.13 Option 13: Hybrid Cycle Paths – Cycle Lanes

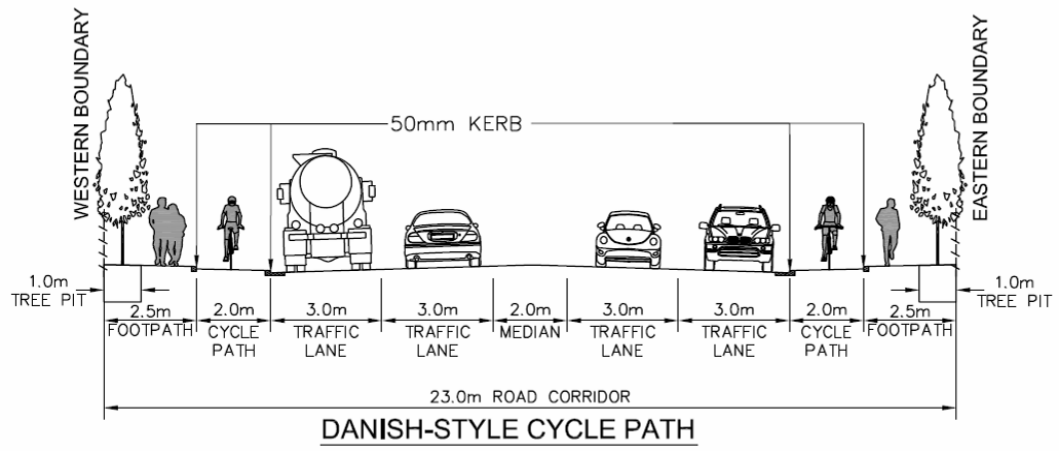


This option is a hybrid of midblock cycle paths (Option 12) and cycle lanes through the intersections (Option 3) to provide the increased separation of cycle paths mid-block with the priority of cycle lanes through intersections. A similar solution exists in Christchurch's Tennyson Street, constructed in 2001 (although the dimensions are different). This facility is illustrated in Figure 6.

Figure 6: Hybrid cycle path / cycle lane (Christchurch)

This option was not recommended – see full report for details.

2.14 Option 14: Danish-style Cycle Paths

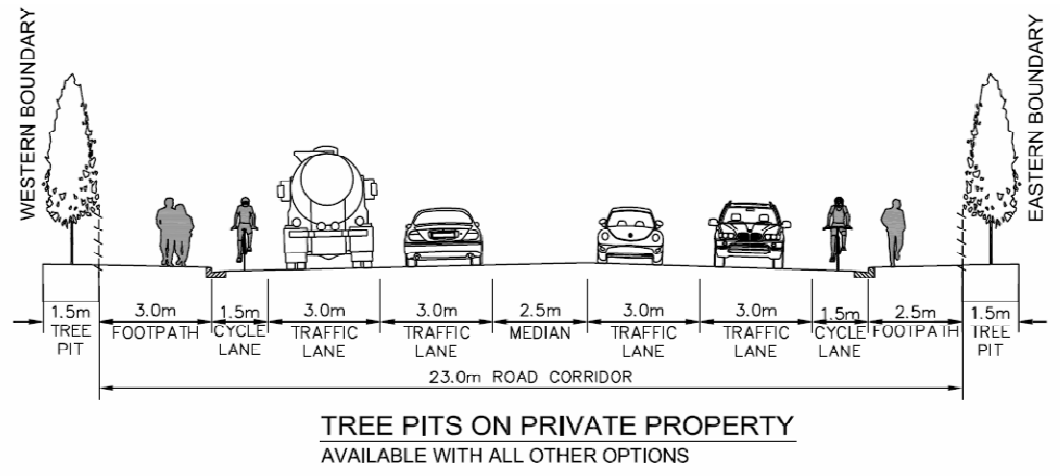


Copenhagen is known for its cycle paths located, and built at an intermediate level, between the footpath and the road. The levels are separated by low kerbs. A Danish style cycle path is illustrated in Figure 7.

Figure 7: Danish cycle path

This option was not recommended – see full report for details.

2.15 Option 15: Tree Pits on Private Property



This option provided more footpath space by relocation of new street trees into private property, by negotiation with landowners.

2.16 Option 16: Solid Medians

This option would help the viability of other options by providing solid medians, which can be narrower than flush medians, thus allowing more width for other functions.

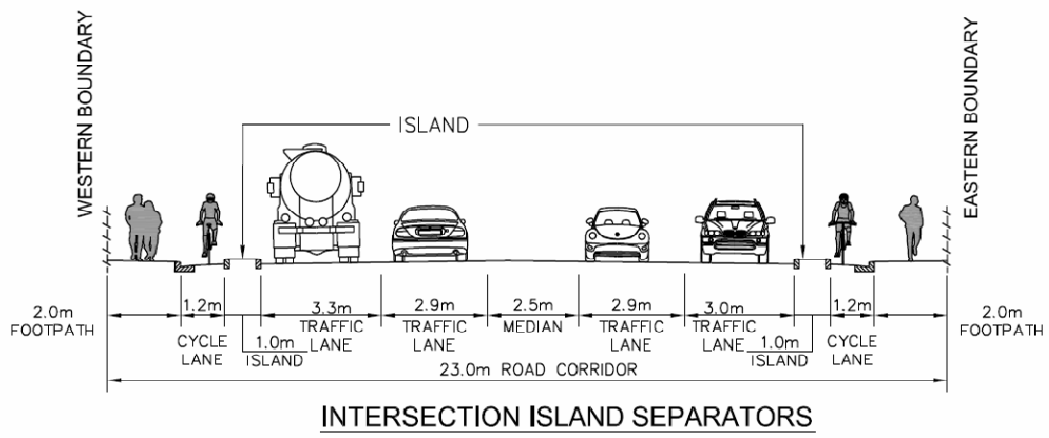
This option was not recommended – see full report for details.

2.17 Option 17: Reversible Three-lane Cross-section

Three-lane (or five-lane) reversible roads provide one central lane which can operate in one direction in the morning peak and in the opposite direction in the afternoon peak. This can work well if there is a strong "tidal" flow on a road.

This option was not recommended – see full report for details.

2.18 Option 18: Intersection Island Separators



The objective of this detail is to place a physical island between cyclists and motor vehicles at the side road intersections to reinforce their "ownership" of the cycle lane. An island at each intersection would provide regular physical separation between motor vehicles and cycles. This may be considered as a "one (or two) bollard per block" option.

As detailed (Figure 8), the right-of-way of on-road cyclists is unambiguous for drivers on the side road.

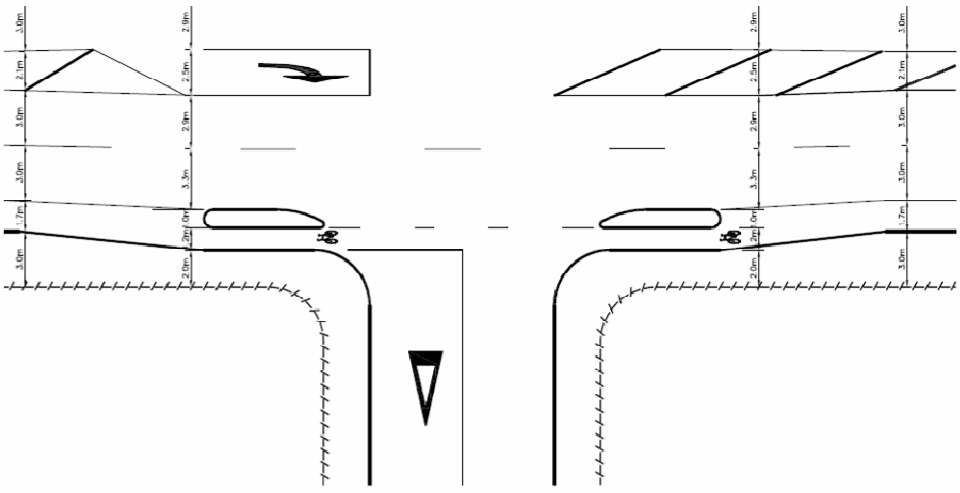


Figure 8: Plan of Intersection Island Separators

This option was not recommended – see full report for details.

3 NSCC Review Process

Consideration of the design of Lake Road by the Infrastructure and Environment Committee, at North Shore City Council, coincided with significant public interest in the impact of new cycle lanes on available road space and thus their potential negative impact on traffic flow. Furthermore, the council's commitment to improving safety on the network raised questions about the safety of the proposed lanes. This was seen to be particularly relevant in terms of the number of school children that would use the route alongside commuter and recreational cyclists.

There was a view that reports on the proposed design had been biased in favour of cycling, that insufficient work had been done to check current use, and that forecasts of future use and by what category of cyclist could be overoptimistic.

These questions and concerns were raised with officers, by councillors, through the committee process. The easy answer was that these were perceived issues, and that development of the design had already taken these factors into account. However, these were real issues for people, even if they were perceived, and are the reasons given for choosing not to cycle, to be against the provision of cycle facilities, or supportive of off-road rather than on-road facilities.

Officers reflected that councillors were simply representing the views of citizens, the people being served, and that they were not considering the matter in a technical way, but on the basis of common sense. Therefore, it was incumbent upon council officers to review designs objectively and provide recommendations based on that review.

The matter was played out in the media, as those who were pro-cycling and those against carried out a public debate. However, overzealous supporters and opponents of cycle lanes can be unhelpful in resolving such issues, as the real solutions are generally found by discussion, compromise and consensus. This was particularly the case on Lake Road where there were significant constraints due to various factors such as availability of land, budgets and sometimes conflicting land uses along the route. This is generally the case were upgrades are taking place.

In the case of Lake Road, the designation had been approved in 2002, and land purchases had proceeded since then. At the time of the review, land acquisition had been completed and negotiations with landowners in terms of mitigation works, landscaping and the cross-section of the road had been completed. This meant that there could be no significant changes to the proposed cross-section. There were several pinch points. Finally, there was a budget constraint: the proposed solution should be economical.

It should also be kept in mind that this project was not only about providing cycle lanes; it included:

- Improving safety through the provision of a flush median;
- Upgrading lane widths to comply with standards;
- Providing improved pedestrian facilities through better footpaths and pedestrian crossings;
- Providing recessed bus bays to remove buses from the live lane;
- Extensive rehabilitation of the road structure;
- Improved amenity through undergrounding of power and telecom cables;
- Improved storm water management;
- Upgrading a main water supply for the City;
- Extensive replanting as part of the landscape mitigation plan; and
- Providing cycle lanes.

The primary concern expressed by councillors was that they wished to see improved separation of all road users, but particularly cyclists and motor vehicles. Officers were asked to also look for ways in which off-road paths could be provided. This had to be balanced with wishing to keep the footpaths as wide as possible, retaining the median to help to reduce the crash record and not to do anything that would make congestion worse. A further consideration was the number of driveway crossings on the route.

It was at this point that the assistance of ViaStrada was requested to provide their expertise and to ensure an objective review by bringing in a new perspective. In considering the options that were presented in the report, North Shore Officers categorised them into five solution-types:

- Changes in the cross-section to provide wider cycle lane widths (3; 7; 10; 15; 16);
- Special marking of the cycle lanes (4; 5; 6; 8; 9; 18);
- Off-road cycle paths (11; 12;);
- Separation through different levels (13; 14);
- Other (2; 17).

ViaStrada's preferred option (Option 7) and second choice (Option 3) both suggested widened cycle lanes which would be achieved by sacrificing space on the median and footpath. This was made difficult because of three offset intersections and some pinch points. It was suggested that coloured lane marking should be used at intersections.

Interestingly, ViaStrada's report was based on a key conclusion that the cycle lane should be widened to 1.7 m from 1.5 m because this complied with the "desirable" range for the conditions as set out in table 4.1 in the New Zealand Supplement. North Shore officers, on the other hand, felt that the "acceptable" range could be applied. Weighing up the various factors, officers finally recommended the following combination solution to the committee:

- Incorporate intersection island separators as per Option 18; and
- Provide a green textured surface as per Option 5; and
- Provide a textured wider lane marking as per Option 4.

The committee felt that the intersection island separators would cause a hazard to cyclists and drivers alike and therefore chose to approve a green textured marking for the full length with a textured wide line marking.

This was seen to be a solution that balanced the various road user needs and the safety concerns that had been expressed, and it was supported by the various users. It is interesting that the additional cost and work required for construction is relatively small, but this small additional effort and expenditure is able to address concerns that could have led to the project being delayed for over a year. Instead, the project is on time and budget and will incorporate an innovative approach to cycle lane provision.

The contract commenced in March 2009 with works to move services, upgrade the water main and realign property boundaries. The main works will commence in January 2010 and will continue until January 2011. Important lessons have been learnt from this review and are being used on other projects:

- Pay attention to what the people you are trying to serve are really saying; many times "non-technical" people can identify very real and serious problems.
- Perception is real and needs to be addressed seriously and diligently; it is often much more difficult to deal with and is often the real obstacle to progress.
- Challenge is good; you can find innovative solutions under pressure.
- Consensus works. Claiming the moral high ground does not help; you need to get down and work together to find the best way forward.
- Understand the constraints and realise from the outset that you have to balance different needs.
- Collaborate and make sure you test all points of view.
- Be objective; anyone can see through bias but it clouds judgement.

Application of these lessons allows us to challenge conventional thinking in search of innovative and balanced solutions.

Conclusions

Lake Road is a constrained but busy arterial road corridor. Accommodating the needs of competing modes (walking, cycling, public transport, trucks and cars), plus the concerns of residents and adjacent land users, has meant that outcomes were needed that balanced sound technical advice with local knowledge and the political realities of urban life. Lake Road will be better for cycling than it was previously, and all parties have learnt more about how to manage these trade-offs in future cases. The technical work undertaken for this project and reported in this paper will be of benefit to others trying to improve conditions for cycling on a range of urban arterials and collectors throughout New Zealand, especially where space is constrained.