Christchurch Transport Operations Centre

A partnership of Christchurch City Council, New Zealand Transport Agency and Environment Canterbury

Keeping Christchurch Moving

DRAFT: Transport Efficiency and Impact Guide
April 2018

GUIDELINE DEVELOPMENT

1 This guide is currently in draft format and will be expanded to include further examples.

PURPOSE AND USE OF GUIDE

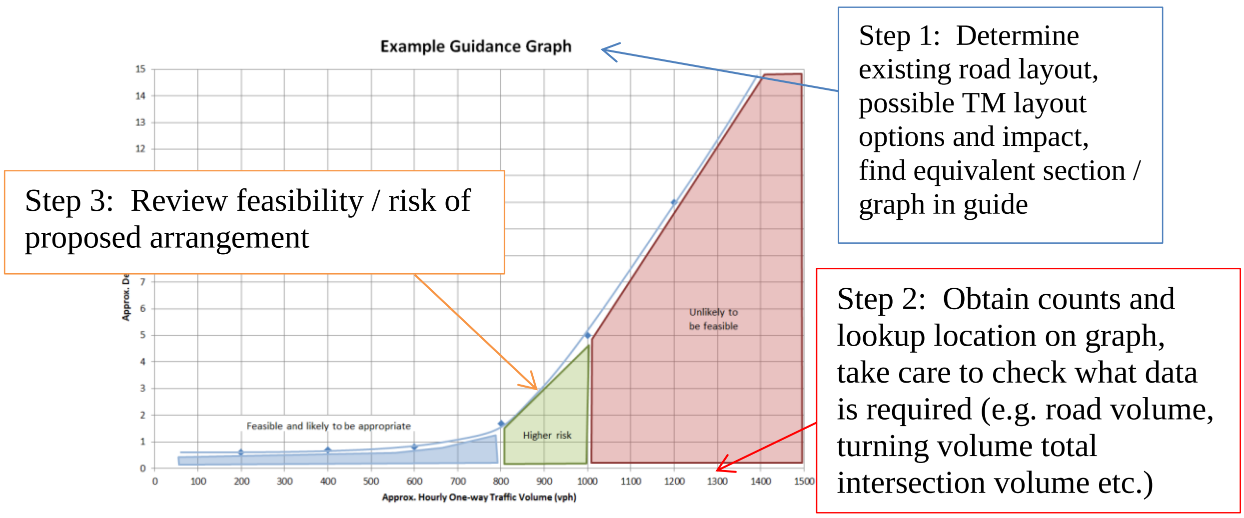
Guideline Purpose

2 The purpose of this document is to provide guidance on the potential impact, level of risk, and feasibility of certain TM arrangements under various traffic conditions (volume, layout etc.).

Using and Applying this Guide

3 This guide is a companion document to CTOC's Transport Impact Assessment (TIA) Guide. The TIA guide describes objectives and concepts of TIAs, how to obtain traffic counts for analysis, and review of alternative options for project delivery and mitigation strategies.

4 This Traffic Efficiency guide provides technical guidance on the risk and feasibility of specific TM layouts and transport impacts. Each section of the guide follows a similar structure and is relevant to a specific TM arrangement / transport impact. Step 1 is to determine the TM layout and impact on traffic (e.g. reducing 2 lanes to 1 lane) and to then select the appropriate section of the guide and appropriate graph to use to review the impact. These steps and format of the graphs are shown below.



5 **Important note**: It is assumed that all traffic volumes used in this efficiency guide are the maximum volume across the time period that the TM site will be in place. This is usually the weekday AM and/or PM peak hour volume, but may be inter-peak, night or weekend volumes if the site is assessed across these times.

GUIDE SECTIONS

6 The guide currently includes guidance on TM arrangements / traffic impacts in the following sections;

- **1: One-Lane Merge Capacity**: Reducing two-lane road to one-lane through TM merge.
- **2: Two-Way Flow through One-Lane Section**: Traffic signal (lights) or Manual Traffic Control setup to 'shuttle' two traffic through a one-lane section of a site.
- **3: Conflicting Traffic Volumes on Detour Route:** Detoured traffic volumes conflicting with opposing traffic volumes.
- **4: Combining Right Turn and Through Movements:** Closing a lane at an intersection (priority or signals) and
- **5: 4-Way Signalised Intersections: Removing Lanes:** Removing through and right turn lanes at moderately sized 4-way signalised intersections.
- **6: 3-Way Signalised Intersections: Removing Lanes:** Removing a lane from the Side Road and a through lane from the Main Road.
- **7: 2-Lane 4-Way Moderate Roundabouts: Reducing Lanes:** Removing lanes from the Side Road and Main Road and reducing the whole roundabout to 1-lane.
- **8: 3-Way and 4-Way Temporary Intersection Control:** Working in the central area of the intersection and controlling each approach with Manual Traffic Control (MTC) or temporary traffic signals.
- **[in development]**

7 This guide will be updated with additional sections as more analysis and information is developed.

1: ONE-LANE MERGE CAPACITY

8 Between intersections, reducing two-lanes to one-lane through a traffic management site and requiring traffic to merge will clearly reduce the capacity of the road. The graph below demonstrates the feasibility of a two-to-one lane merge capacity under increasing hourly directional traffic volumes.

9 The graphs in the following sections provide the impacts of reducing lanes at intersections.

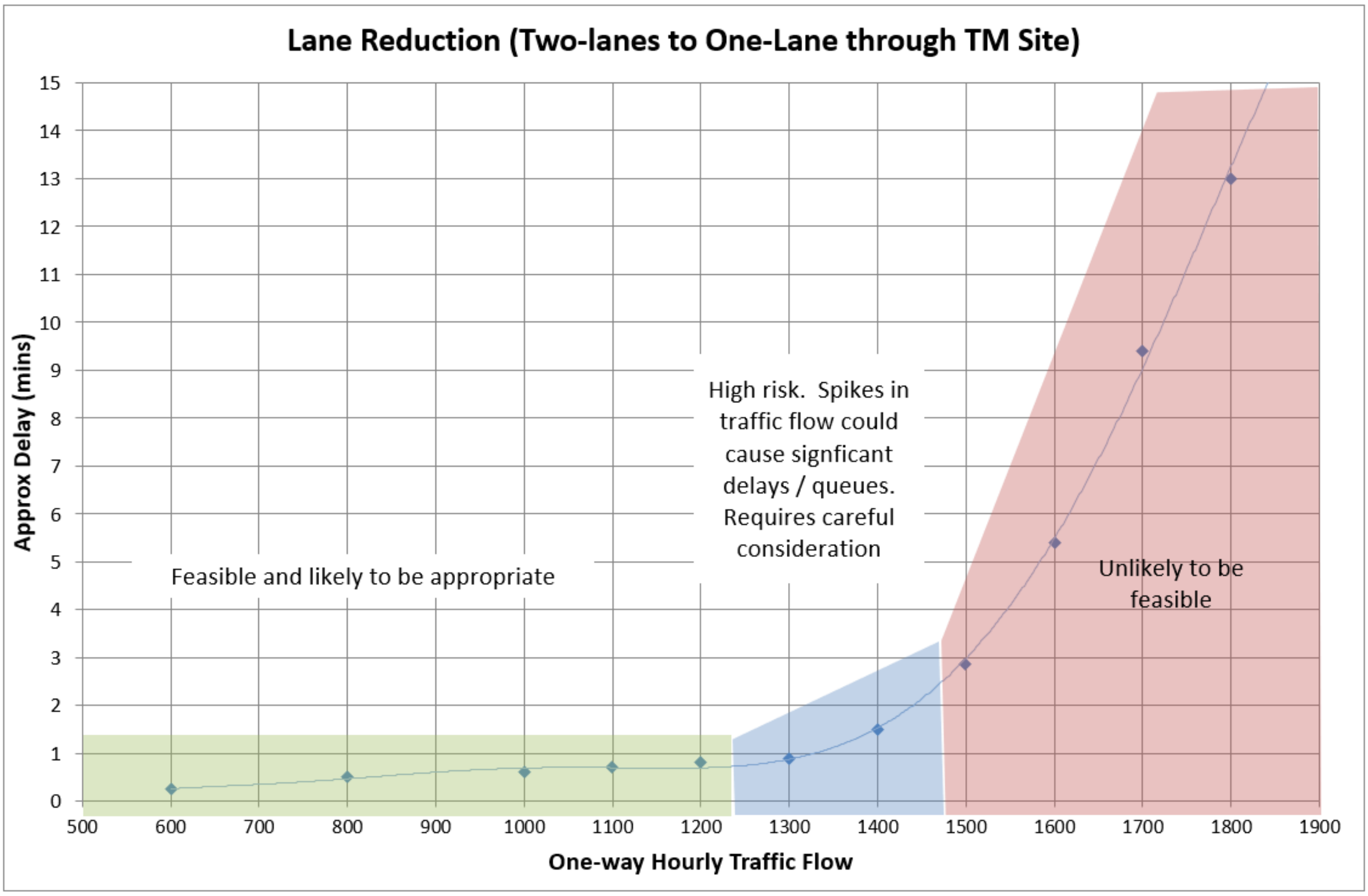


Figure 1: Capacity of Two-Lane to One-Lane Reduction through Traffic Management Area

2: TWO-WAY FLOW THROUGH ONE-LANE SECTION

10 Two-way traffic flow may be maintained through a single lane section via a priority give-way site (low volume roads, short distance), stop-go MTC, or traffic lights. The graph below indicates the feasibility of this arrangement under increasing peak hour two-way traffic flow (grey -> orange lines on the graph) and increasing length of the site (horizontal graph axis).

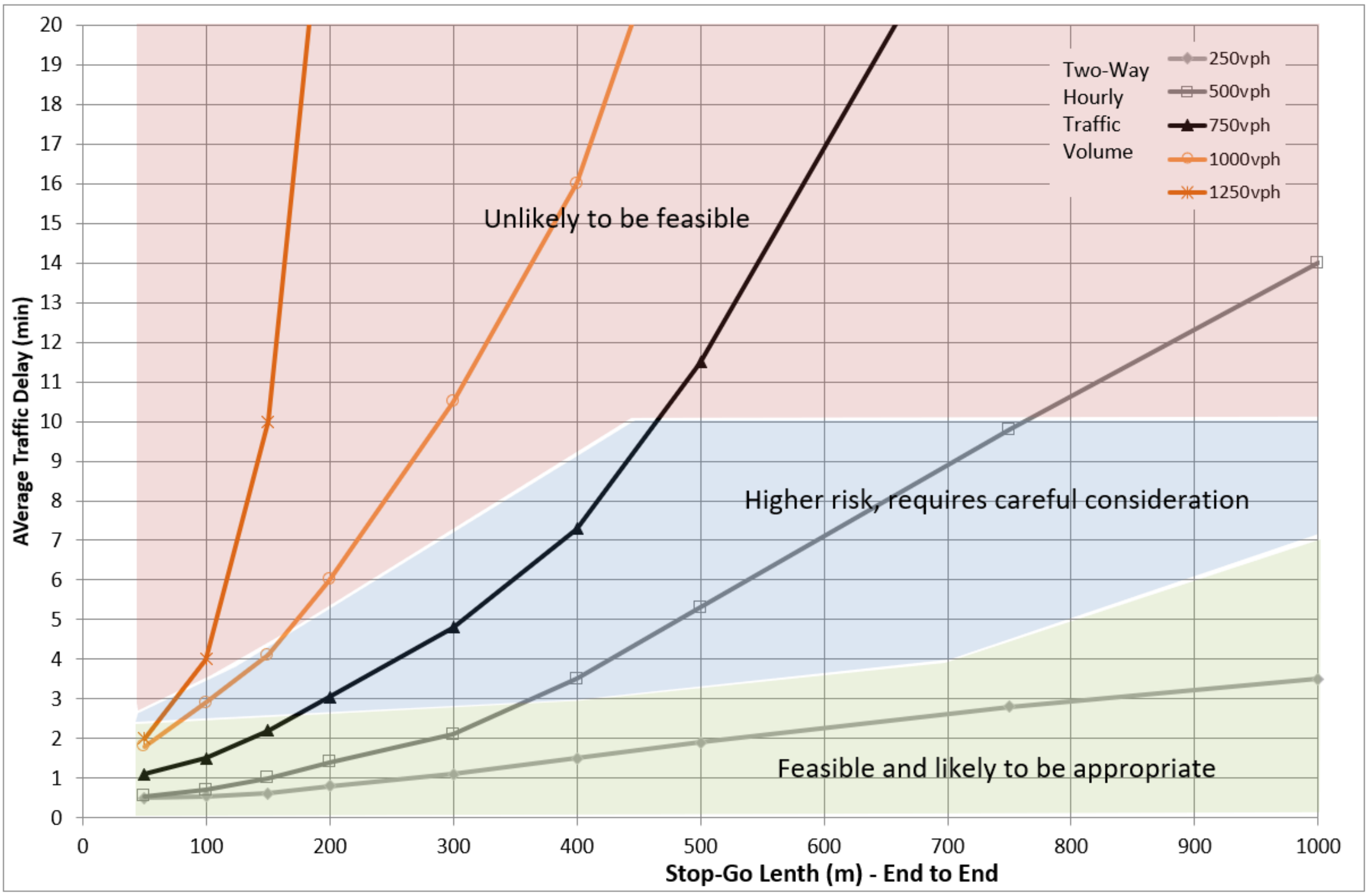
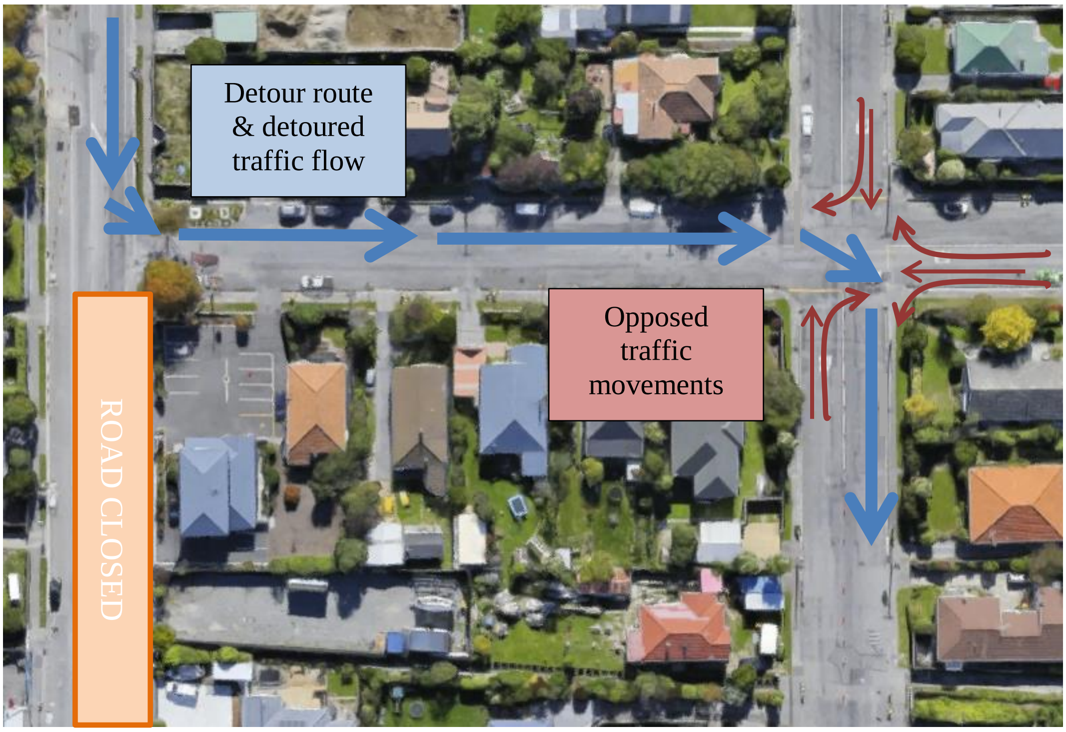


Figure 2: Capacity of Two-Way Traffic Flow through One-Lane Section

3: CONFLICTING TRAFFIC VOLUMES ON DETOUR ROUTE

11 Detouring traffic may involve crossing traffic streams across opposing movements which do not typically come into conflict. In the example below a detour route (blue) is shown around a one-way closure (orange). With no other restrictions or TM controls, the detoured traffic volume would conflict with a number of opposing traffic movements (red) – these conflicts with this volume of traffic would not usually occur.

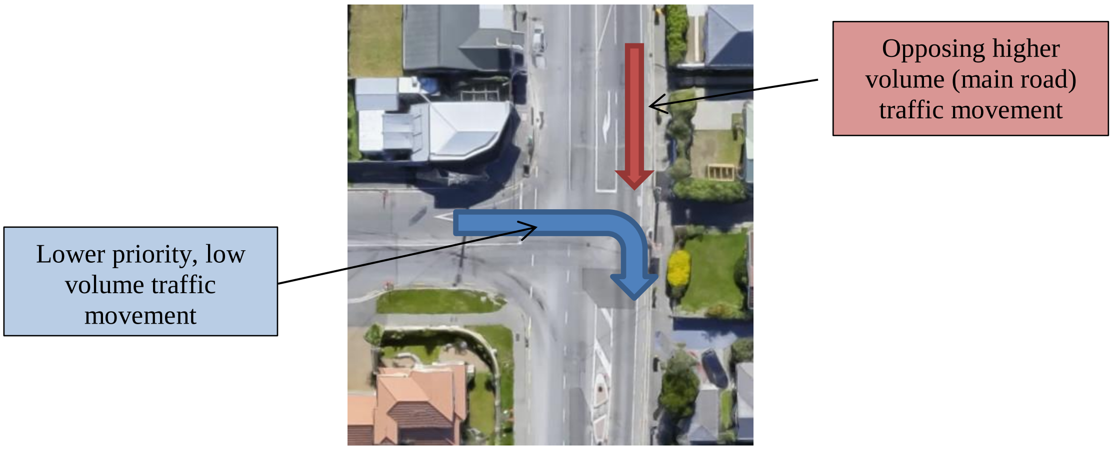


12 The guidelines below present the risk profile and potential feasibility of low priority movements crossing a higher volume of opposing traffic;

12.1 The low priority movement is typically a lower volume than the opposing traffic, this is shown in the graphs with increasing grey->orange lines.

12.2 The higher opposing volume (typically the main road) is on the horizontal x axis.

12.3 On the top right of the graphs the key indicates these movements; the blue arrow indicates the low volume low priority movement and the red arrows indicate the high volume opposing main road traffic. For example;



Volume of Traffic Crossing Path (e.g. turning right) of Opposing Major Flow

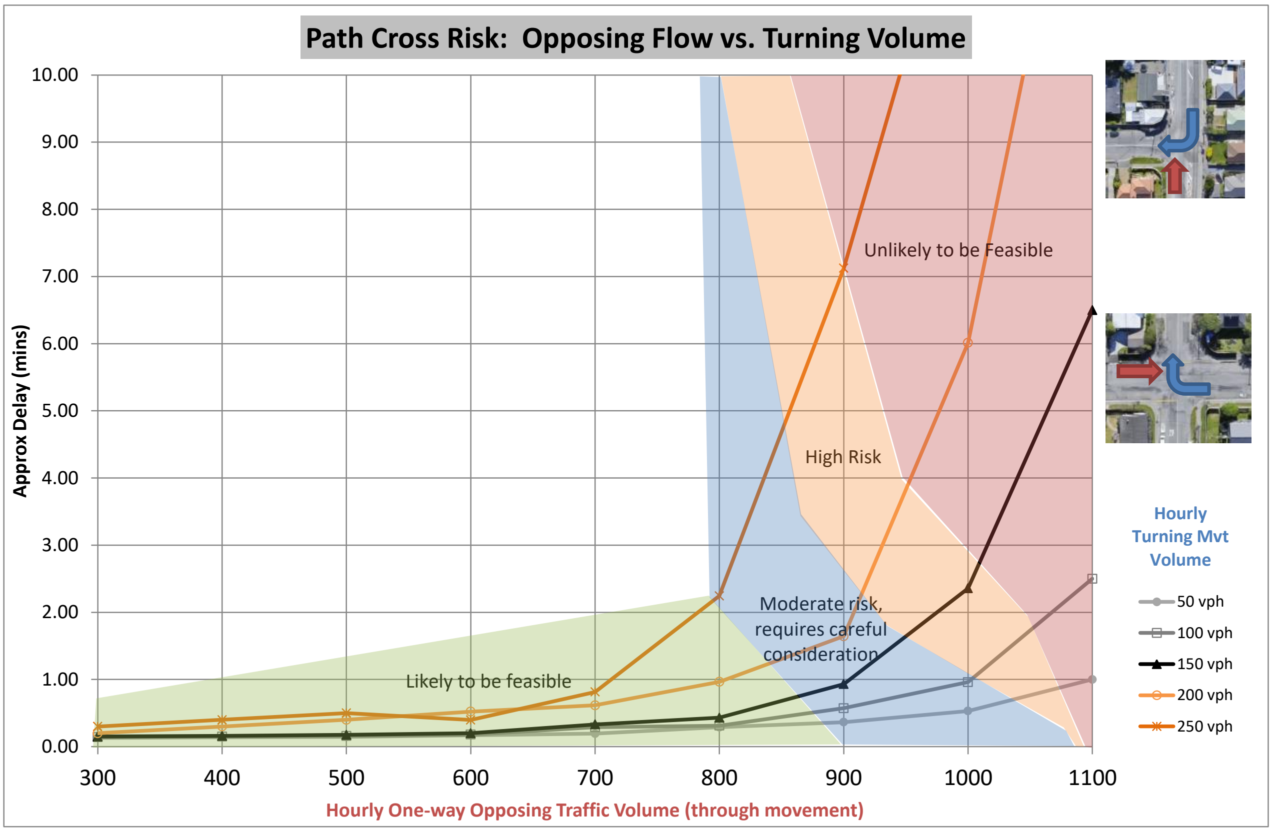


Figure 3: Opposing Traffic Volumes: Path Cross Risks

Volume of Traffic Joining (e.g. turning left) Opposing Major Flow

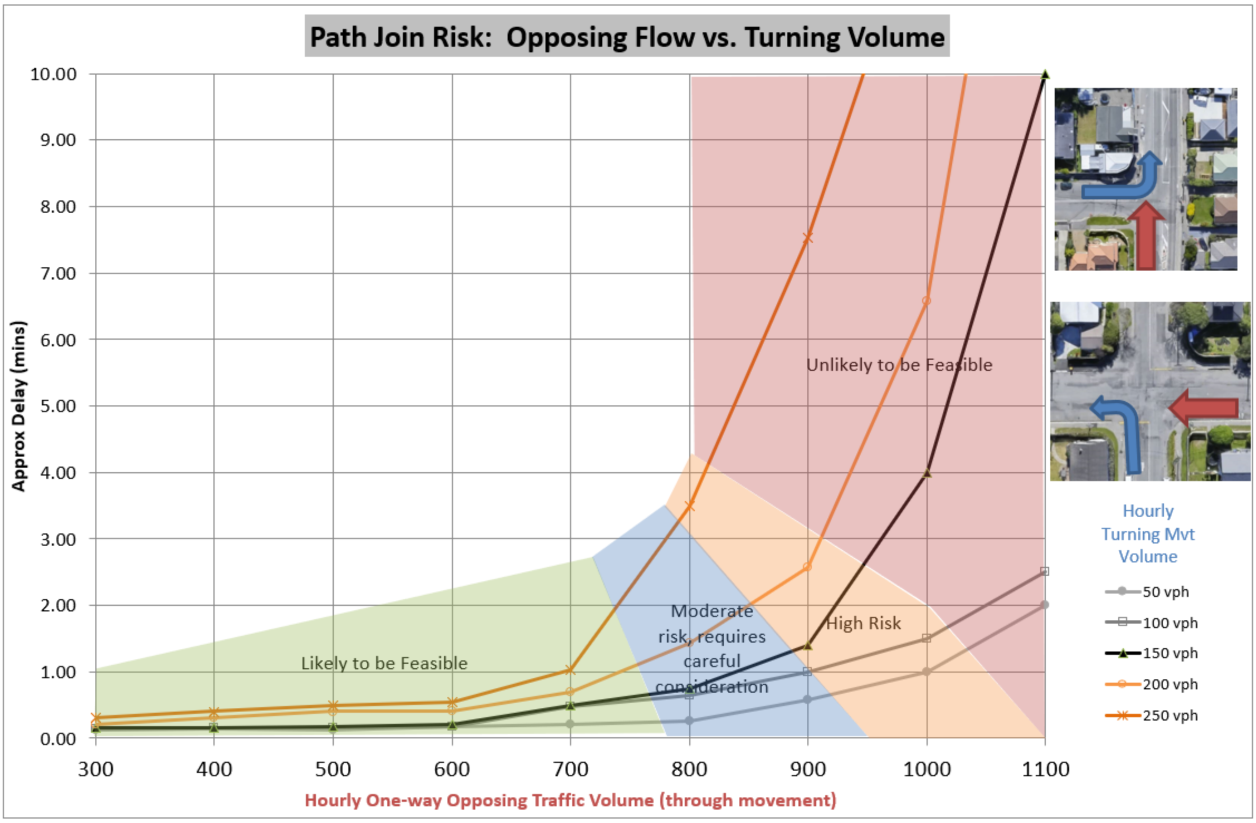


Figure 4: Opposing Traffic Volumes: Path Join Risks

Combined Cross and Join Main Traffic Flow (e.g. right turn out of side street)

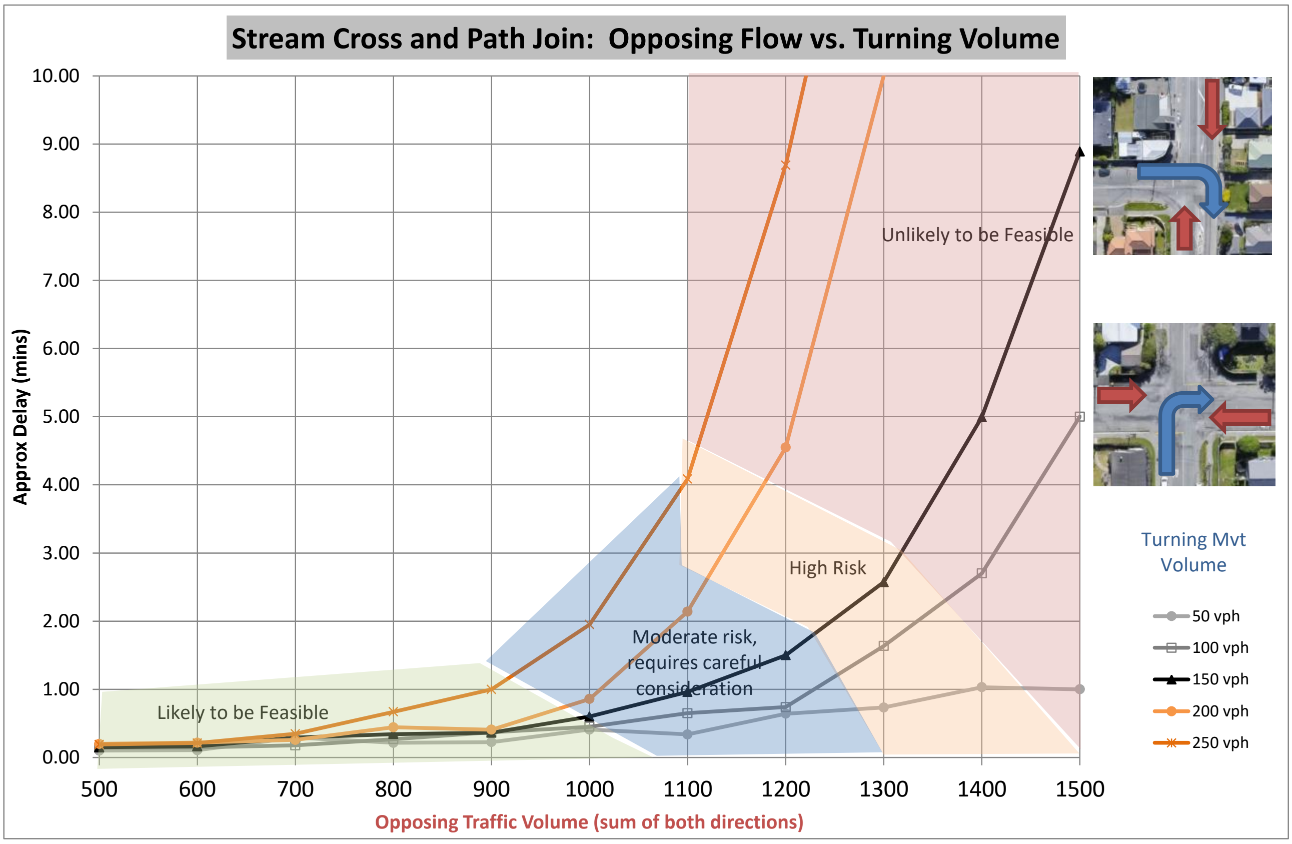


Figure 5: Opposing Traffic Volumes: Stream Cross and Path Join Risks

4: SHARING THROUGH AND RIGHT TURN MOVEMEMNTS IN ONE-LANE

13 Closing a lane, either a right turn pocket or the adjacent through traffic lane, so that the right turning traffic and through traffic ends up sharing the lane can often be a high risk setup; right turners waiting for a gap in the opposing traffic will prevent the following through traffic from travelling there is a risk of large queues forming and as a result potential safety concerns.

14 The figure below shows two examples of worksites which create a shared through and right turn lane. This arrangement can occur at either signalised or priority-controlled intersections.

Figure 6: Work area resulting in combined through and right turn shared lane

15 The graphs below show the delays to traffic using the shared lane, i.e. right turners and importantly the following through traffic. There are three aspects to these graphs;

15.1 **Right turn volume**: Shown by the grey->orrange lines on the graph

15.2 **Opposing traffic volume**: The volume of on-coming traffic, which is along the horizontal x axis.

15.3 **Volume of through traffic following the right turners**: Three graphs are provided, for 500vph, 750vph, and 1000vph following through traffic volume.

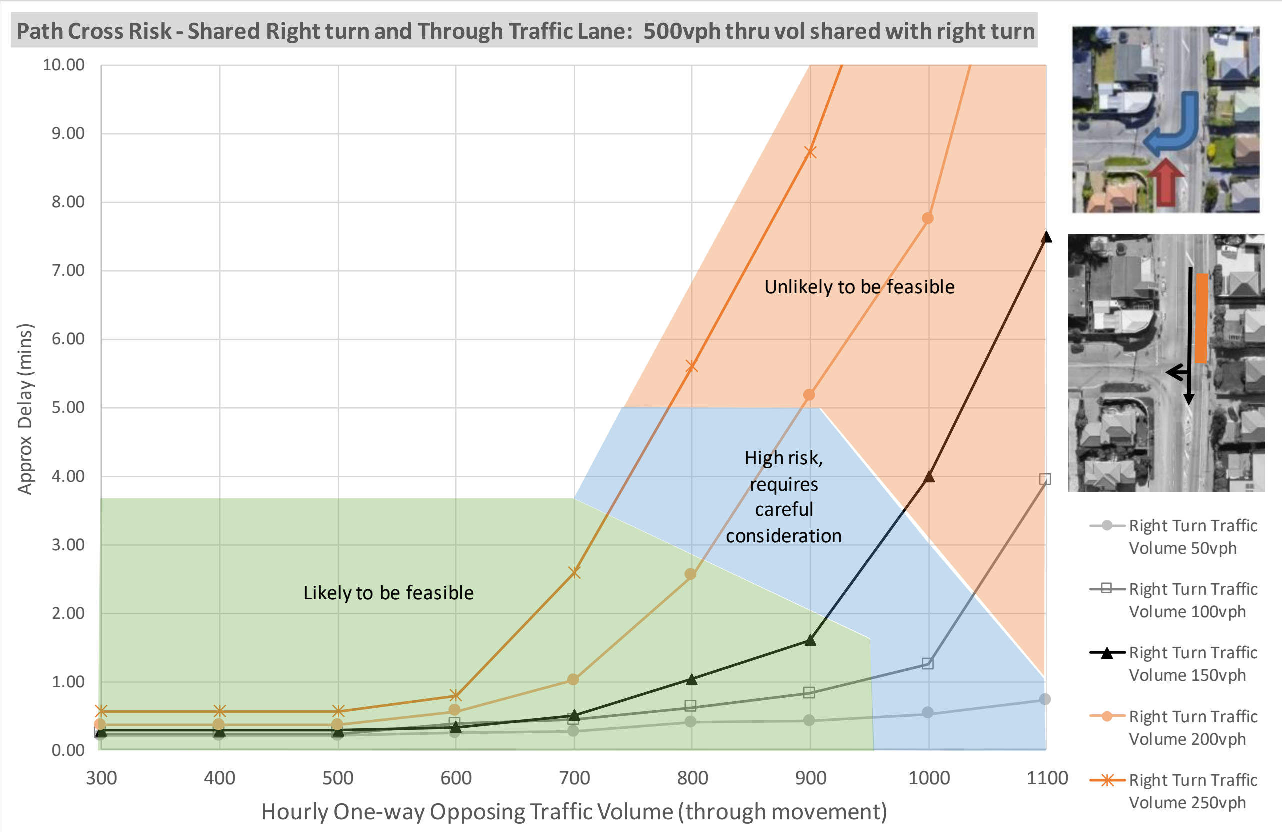


Figure 7: Path Cross Risk: Shared Right Turn and Through Traffic (500vph Through Volume)

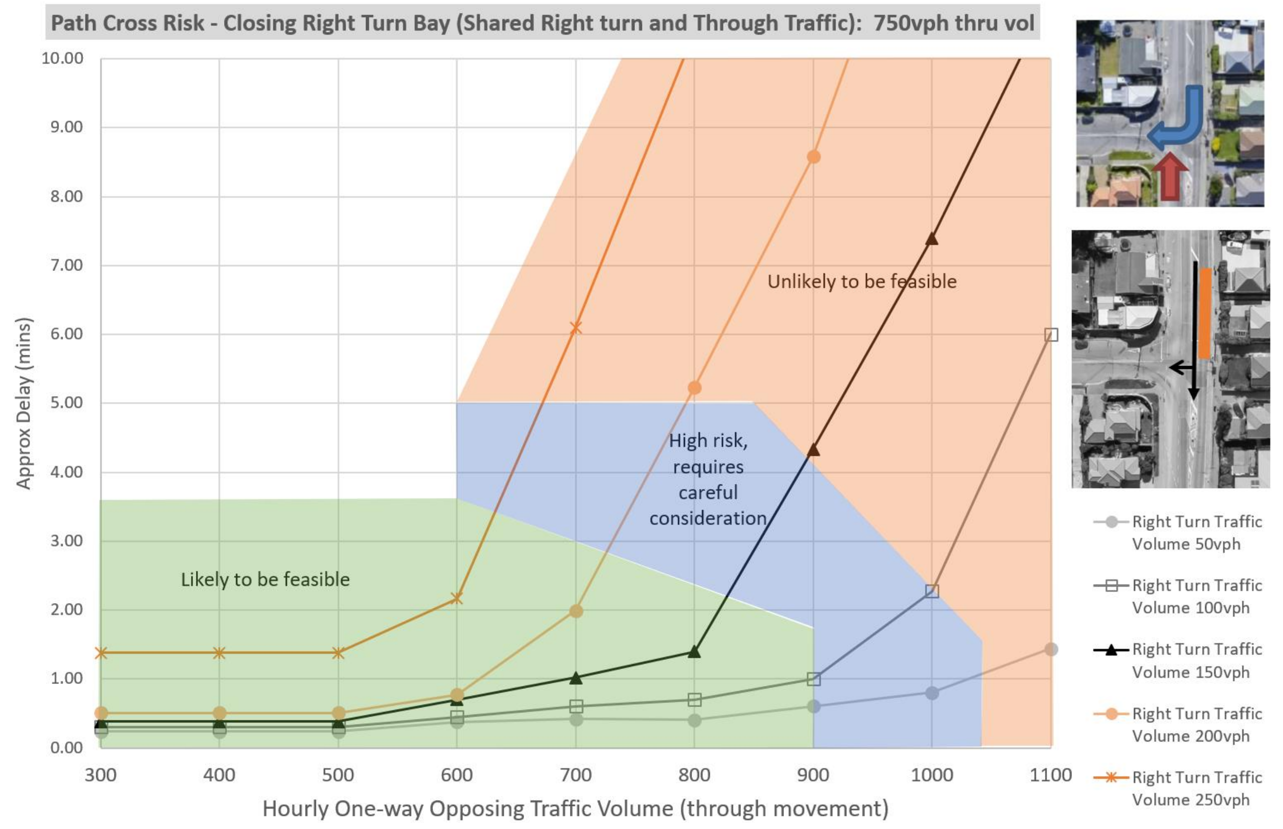


Figure 8: Path Cross Risk: Shared Right Turn and Through Traffic (750vph Through Volume)

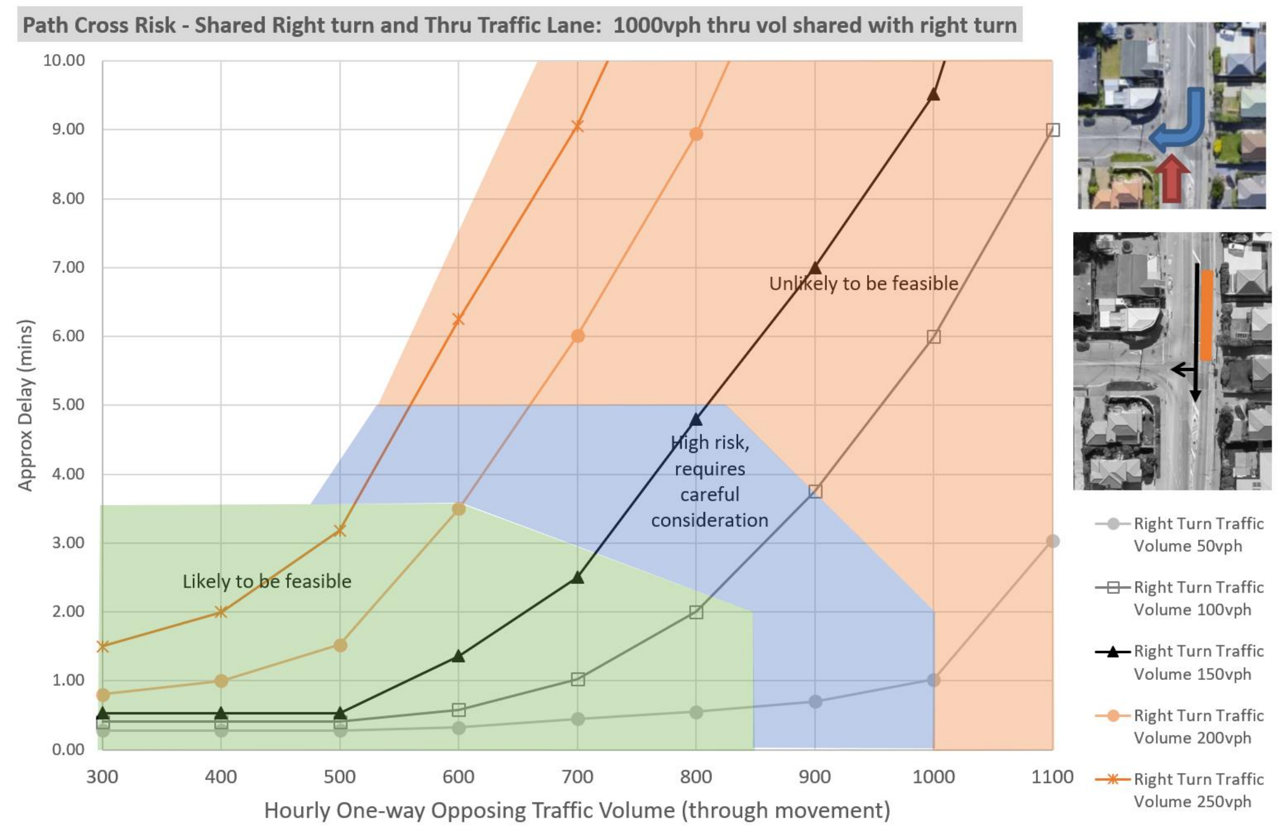


Figure 9: Path Cross Risk: Shared Right Turn and Through Traffic (1000vph Through Volume)

5: 4-WAY SIGNALISED INTERSECTIONS: REMOVING LANES

16 A moderately sized signalised intersections features;

16.1 A main arterial road with two through lanes in each direction.

16.2 Intersected by a smaller-to-medium road (e.g. collector or minor arterial) which typically has 1-lane in each direction, but flares to 2 or 3 lanes at the approach to the intersection.

17 An example of a typical moderately sized intersection is shown below, the Memorial Ave / Ilam Road intersection in Christchurch. The Main Road runs northwest-southeast and the Side Road southwest-northeast. Notably the Main Road has two formed through lanes, whereas the Side Road has a single through lane (Side Roads can have two through lanes at signalised intersections, with a short 'merge-like-a-zip' merge on the downstream exit).

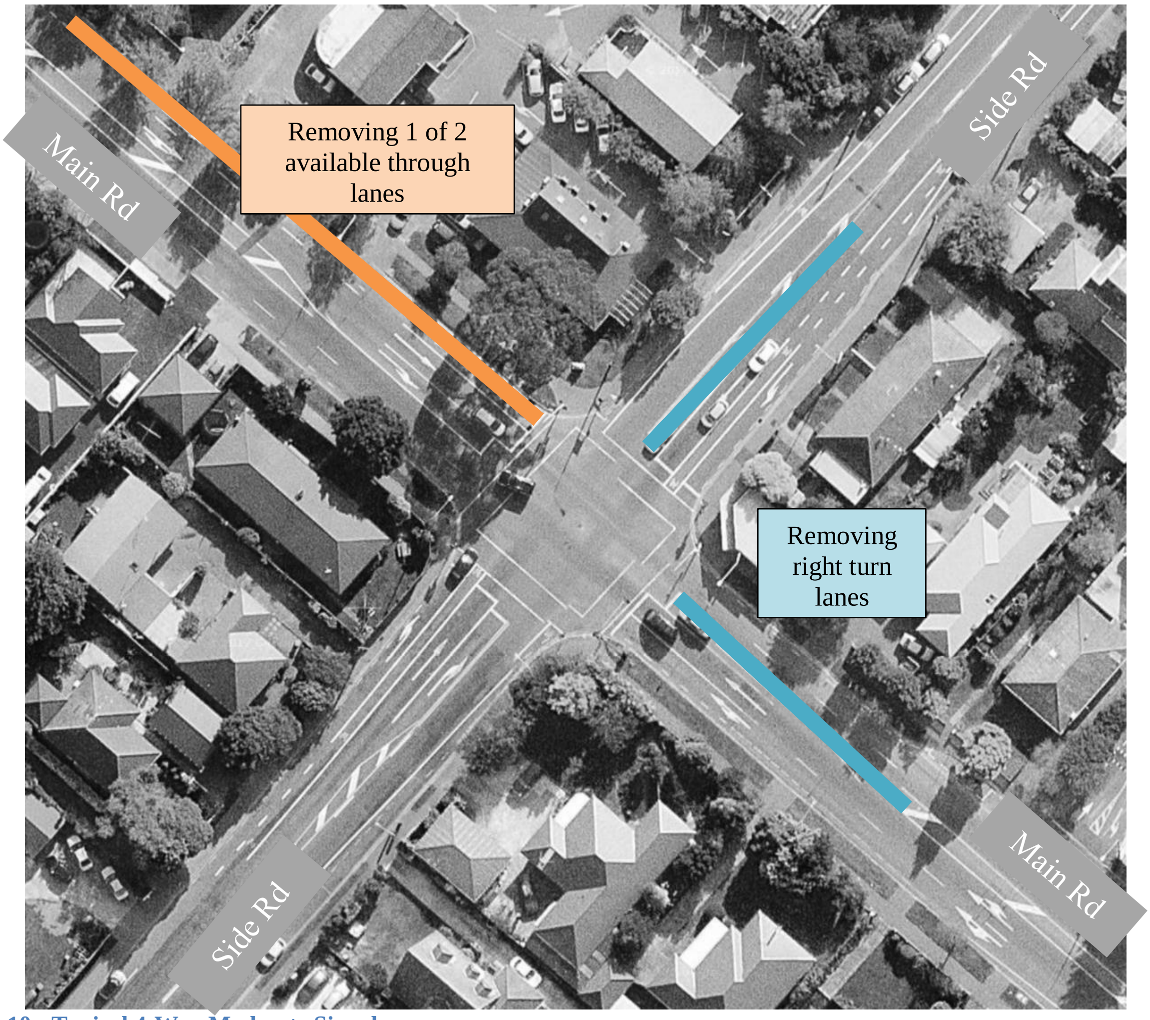


Figure 10: Typical 4-Way Moderate Signals

18 The graphs below demonstrate the potential risk profile from removing lanes at an intersection of this general form. The lanes removed are marked on Figure 10 above. The graphs show two delay lines; the actual delay experienced will depend on the ability to reallocate time at the signals to different movements and in some circumstances to maintain the operation of corridor. The two lines provide a range to indicate this potential.

19 Affecting the capacity of signalised intersections on busy traffic corridors carries high risk. Intersection layouts, turning volumes, and operation vary from place-to-place. The graphs below should only be used as a **guide** to the approximate risk profile of certain arrangements. Impacting intersections in key locations may require fuller assessment and traffic modelling.

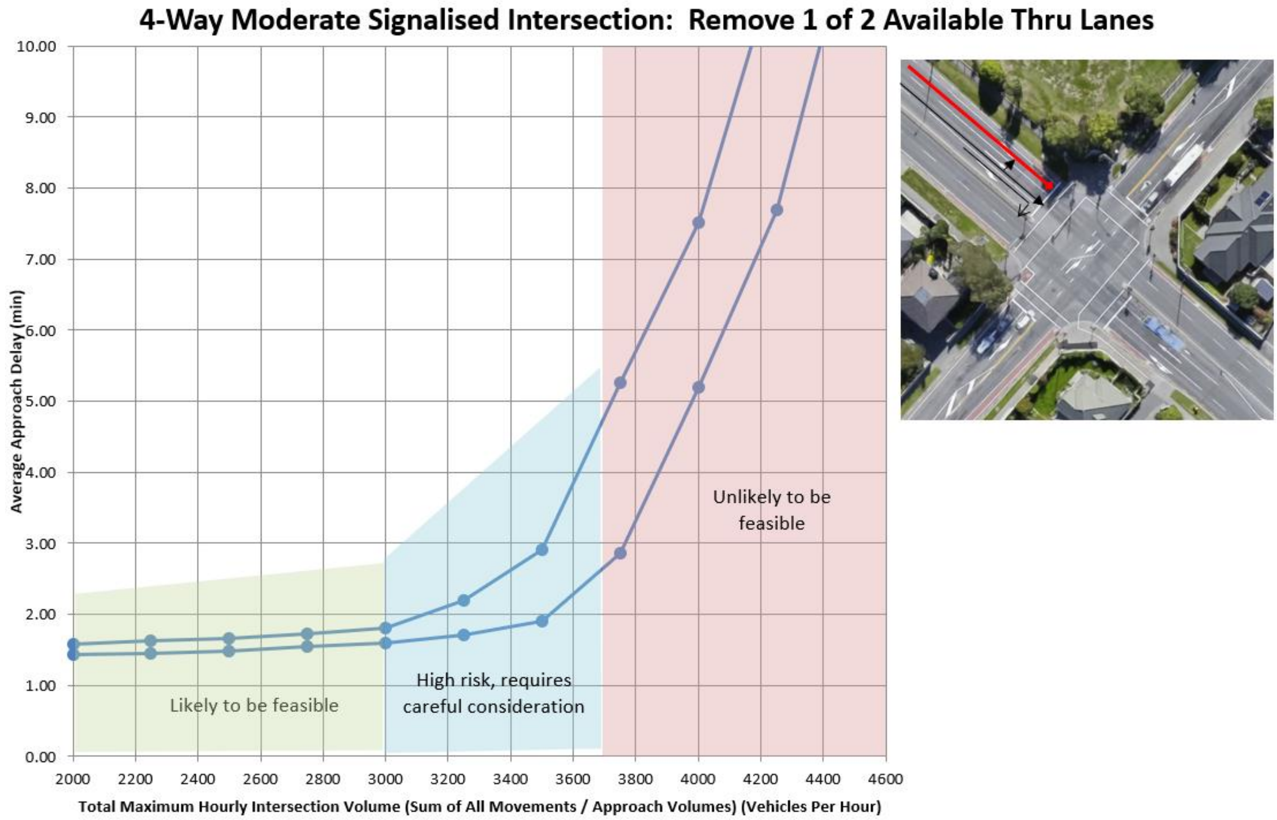


Figure 11: 4-Way Moderate Signalised Intersection: Removing 1 Through Lane

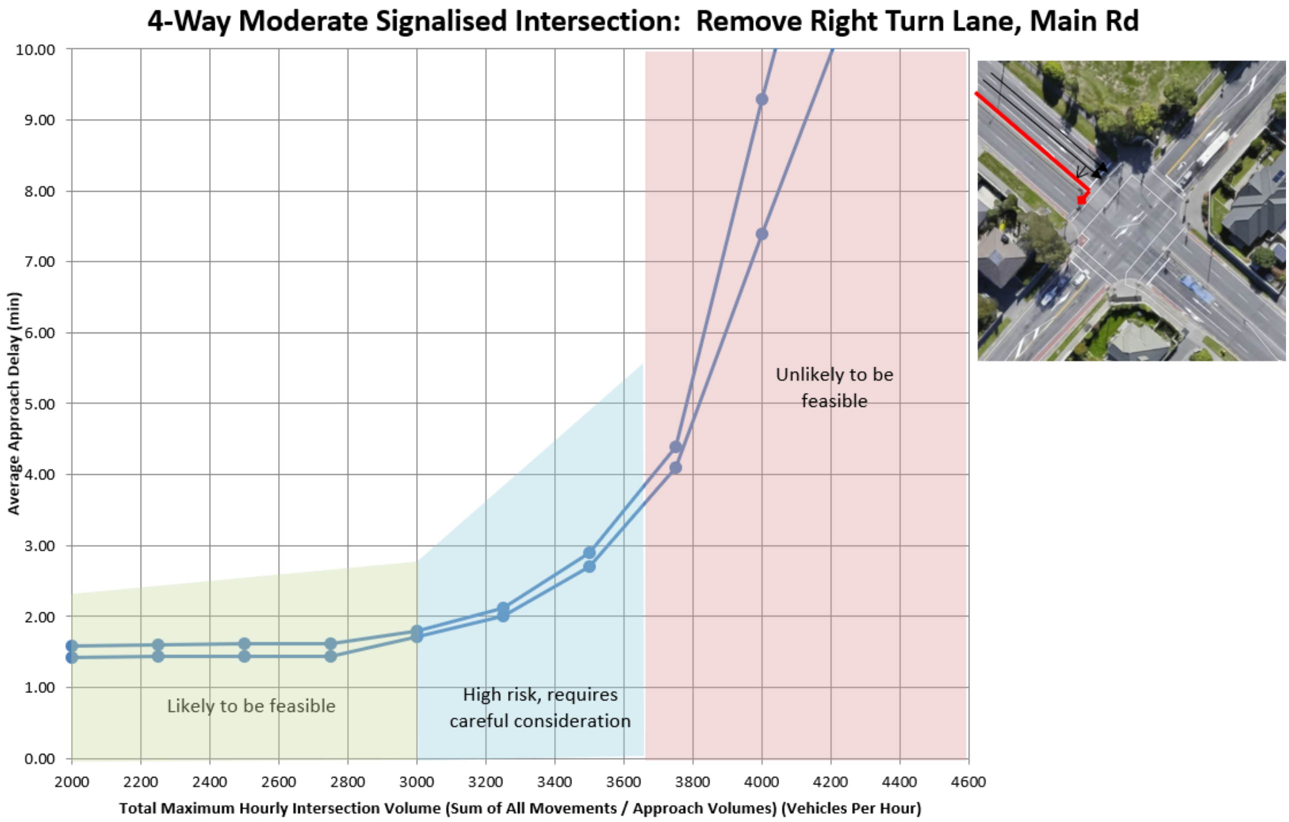
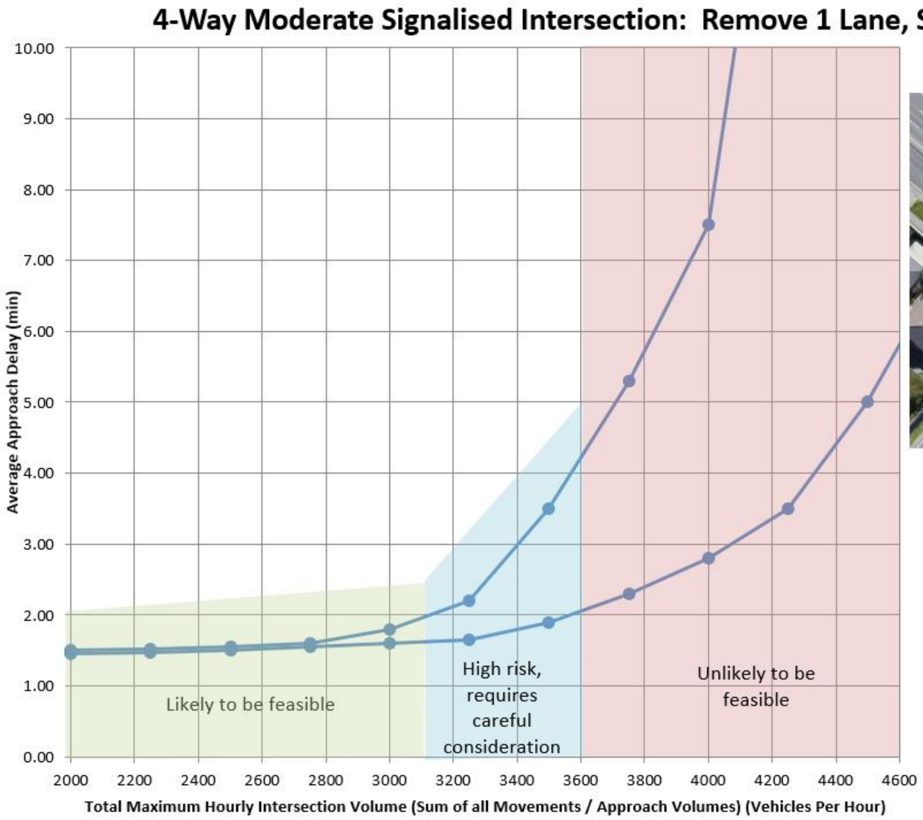


Figure 12: 4-Way Moderate Signalised Intersection: Removing Right Turn Lane from Main Road



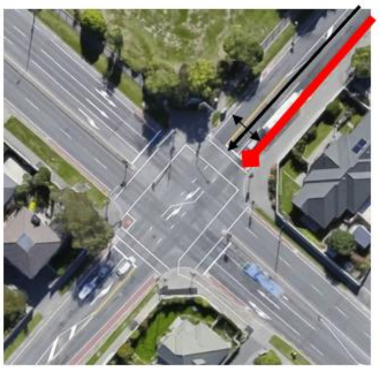


Figure 13: 4-Way Moderate Signalised Intersection: Removing Right Turn Lane from Side Road

6: 3-WAY SIGNALISED INTERSECTIONS: REMOVING LANES

20 A moderately sized 3-way signalised intersection is formed where a busy side road connects with a main arterial route. An example is shown below, the Fendalton Road / Glandovey Road intersection in Christchurch. The Main Arterial Road runs east-west and the Side Road is the north approach.

Figure 14: Typical 3-Way Moderate Signals

21 The graphs below demonstrate the potential risk profile of removing lanes at an intersection of this general form. The lanes removed are marked on Figure 14 above.

22 Removing a right turn bay from the Main Road at a 3-way 'T' intersection requires case-by-case assessment, and is not covered in this guide.

23 Affecting the capacity of signalised intersections on busy traffic corridors carries high risk. Intersection layouts, turning volumes, and operation vary from place-to-place. The graphs below should only be used as a **guide** to the approximate risk profile of certain arrangements. Impacting intersections in key locations may require fuller assessment and traffic modelling.

Figure 15: 3-Way Moderate Signals: Remove 1 Lane on Side Road

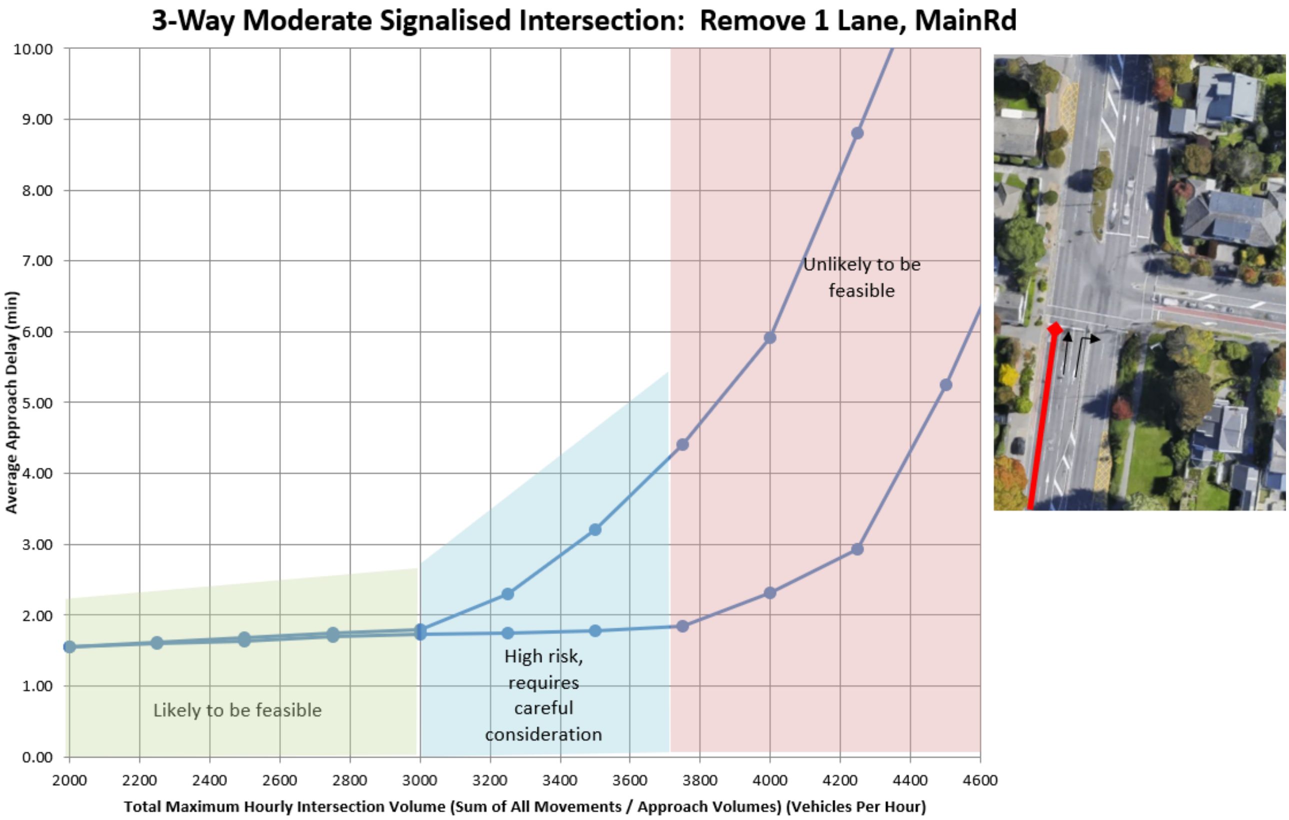


Figure 16: 3-Way Moderate Signals: Remove 1 Lane on Main Road

7: 2-LANE 4-WAY MODERATE ROUNDABOUTS: REDUCING LANES

24 Moderately sized 2-lane roundabouts are used in a diverse range of locations in the transport network. For example, locations where traffic flows are not strongly tidal and can be managed with traffic signals and along arterial routes where there is the potential desire to maintain higher speeds on the arterial corridor and not stop traffic at traffic signals. Because of this, roundabout of this nature have a range of features but typically include;

24.1 An arterial route intersected by a lower level side road, or the intersection of two arterials.

24.2 A larger circular central island; diameter 30 – 60m.

24.3 Two-lanes on all approach arms and two circulating lanes.

24.4 Flared approach arms and splitter islands separating the approaches and exists

25 An example of a typical moderately sized roundabout is shown below, the Johns Road / Sawyers Arms Road intersection in Christchurch. The Main Road runs east-west and the Side Road north-south. The Main Road has two formed through lanes with a separated median and the Side Road has a single lane in mid-block sections, flaring to two-lanes on approach to the roundabout.

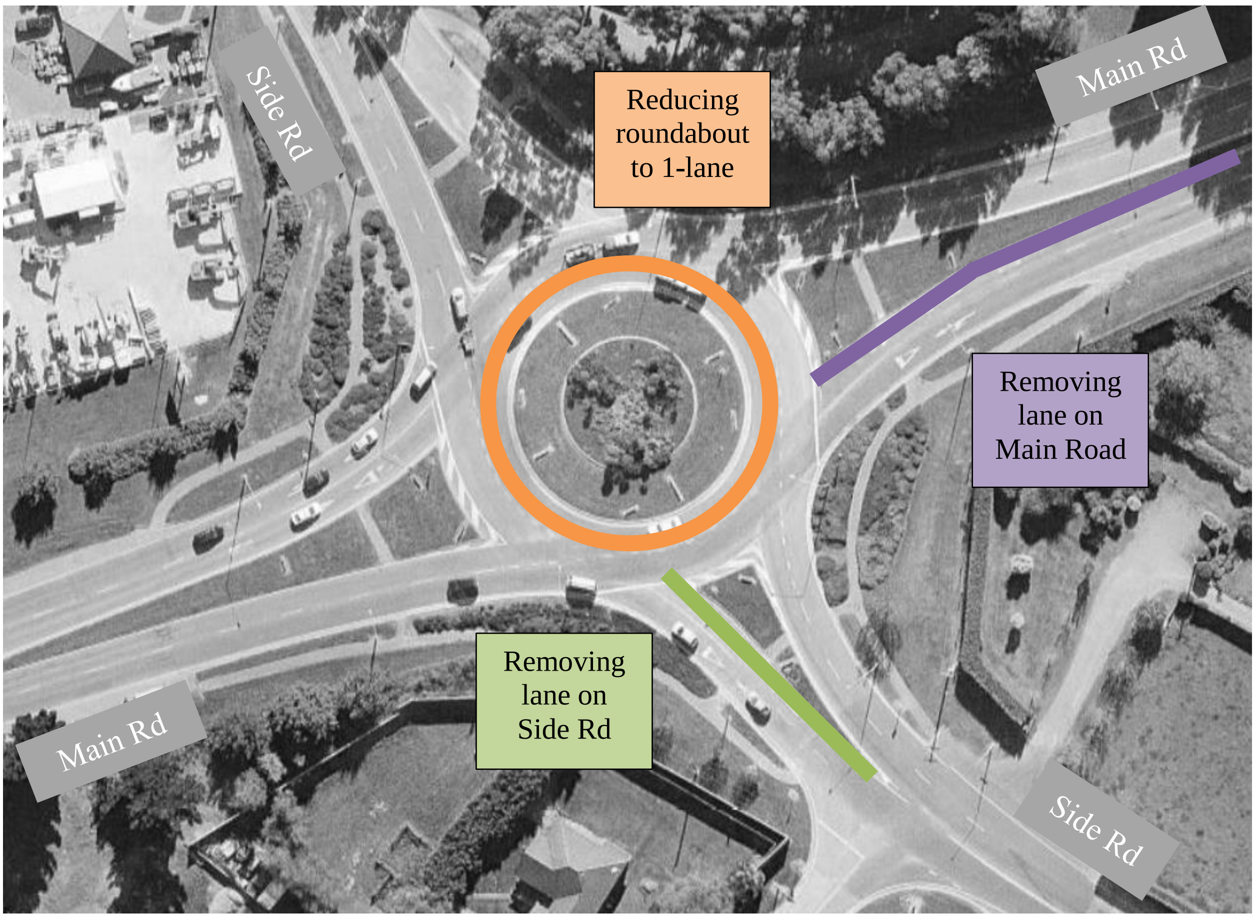


Figure 17: Example of Moderate 2-lane Roundabout

26 The graphs below demonstrate the potential risk profile from removing lanes at an intersection of this general form. The lanes removed are marked on Figure 17 above. Affecting the capacity of moderate sized roundabouts on busy traffic corridors carries high risk. Layouts, turning volumes, and operation vary from place-to-place. The graphs below should only be used as a **guide** to the approximate risk profile of certain arrangements. Impacting intersections in key locations may require fuller assessment and traffic modelling.

Figure 18: 2-lane 4Way Roundabout: Reducing Side Road to 1-lane

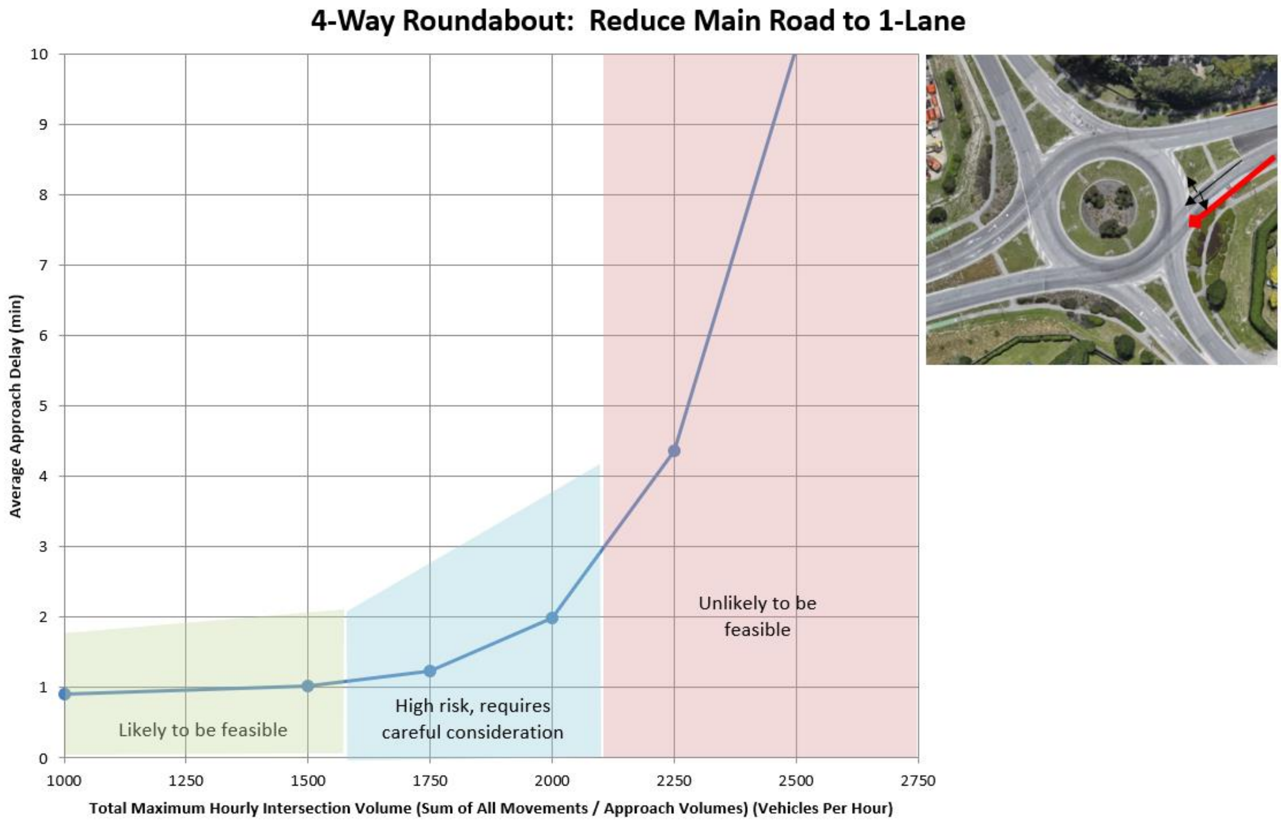


Figure 19: 2-lane 4Way Roundabout: Reducing Main Road to 1-lane

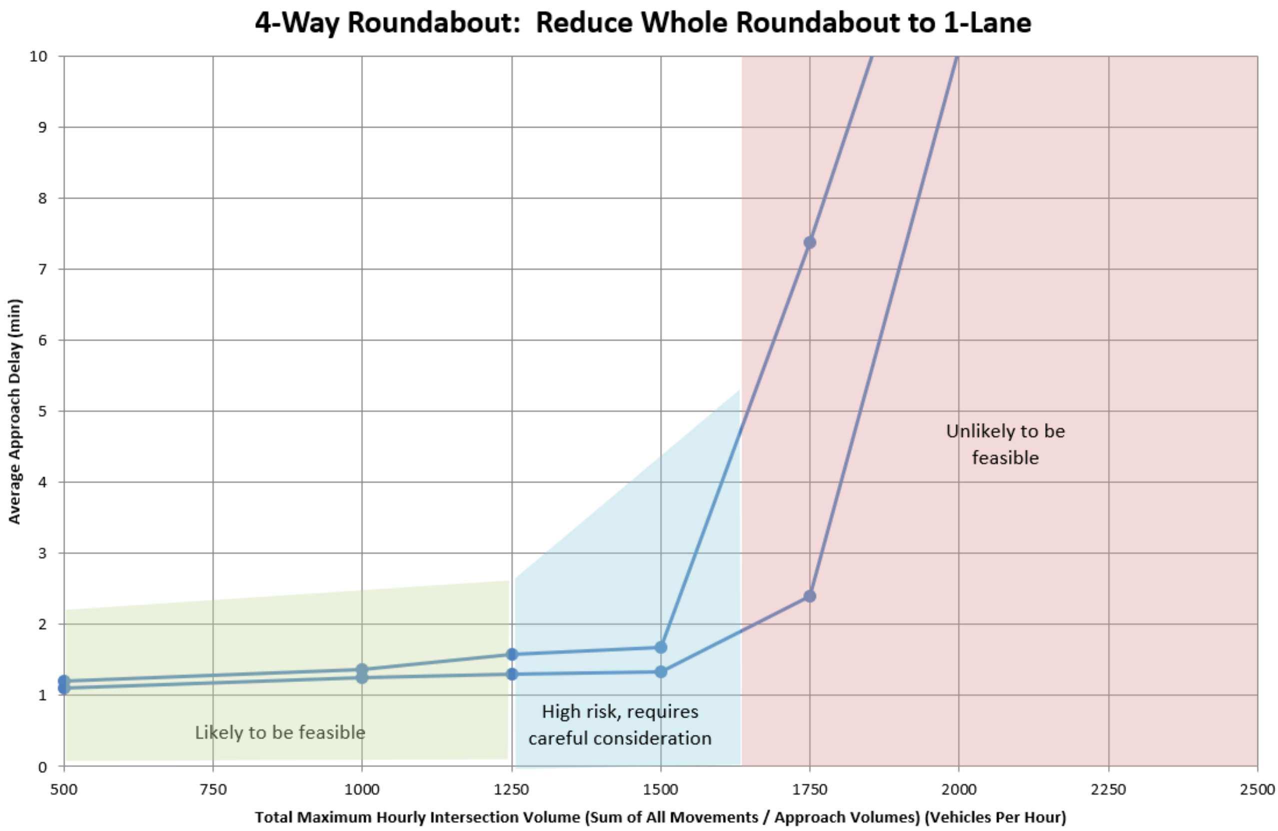


Figure 20: 2-lane 4Way Roundabout: Reducing Whole Roundabout to 1-lane

8: 3-WAY AND 4-WAY TEMPORARY CONTROL

27 Worksites on the immediate approach to an intersection, or within the central area of the intersection, can sometimes be managed by overriding the existing intersection controls and placing temporary controls (stop-go or temporary traffic lights) on the intersection approaches setback from the permanent intersection stoplines. This can be done on all forms of intersection; priority controlled, traffic signals, and roundabouts. An example at a 3-Way signalised intersection is shown in the figure below.

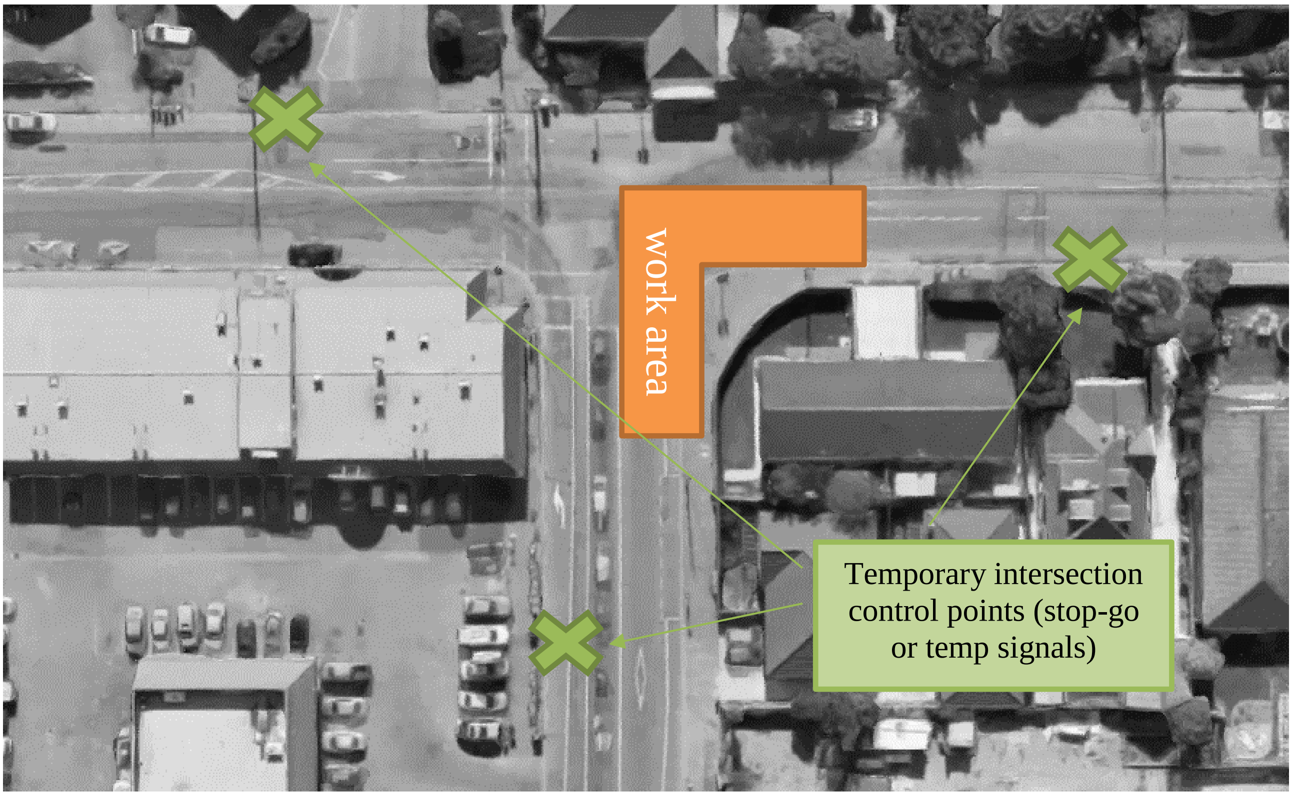


Figure 21: Example of 3-Way Temporary Intersection Control

28 Temporary control of this nature is generally significantly inefficient compared to the permanent intersection control arrangement. This is due to two factors;

28.1 Firstly, each intersection approach is run one-at-time[1] – whereas under permanent control arrangement usually multiple approaches run at-the-same-time.

28.2 Secondly, the control points are often setback some distance from the permanent intersection stoplines which creates a longer 'wait time' for traffic to clear the area before the next approach can go.

29 The graphs below demonstrate the potential risk profile for an example setup of this nature at a 3-Way and 4-Way intersection.

30 Note, the distance that the control points are set back from the permanent intersection stoplines are noted in the graph titles (50m for the 3-Way intersection, 35-40m for the 4-way intersection). The further back from the intersection the control points are positioned, the less efficient the operation will be and the greater the risk of traffic delays.

[1] Either simply to allow the conflicting traffic to get around the site, or due to limitations in the ability for temporary control (temp signals) to robustly manage multiple approaches at-the-same-time.

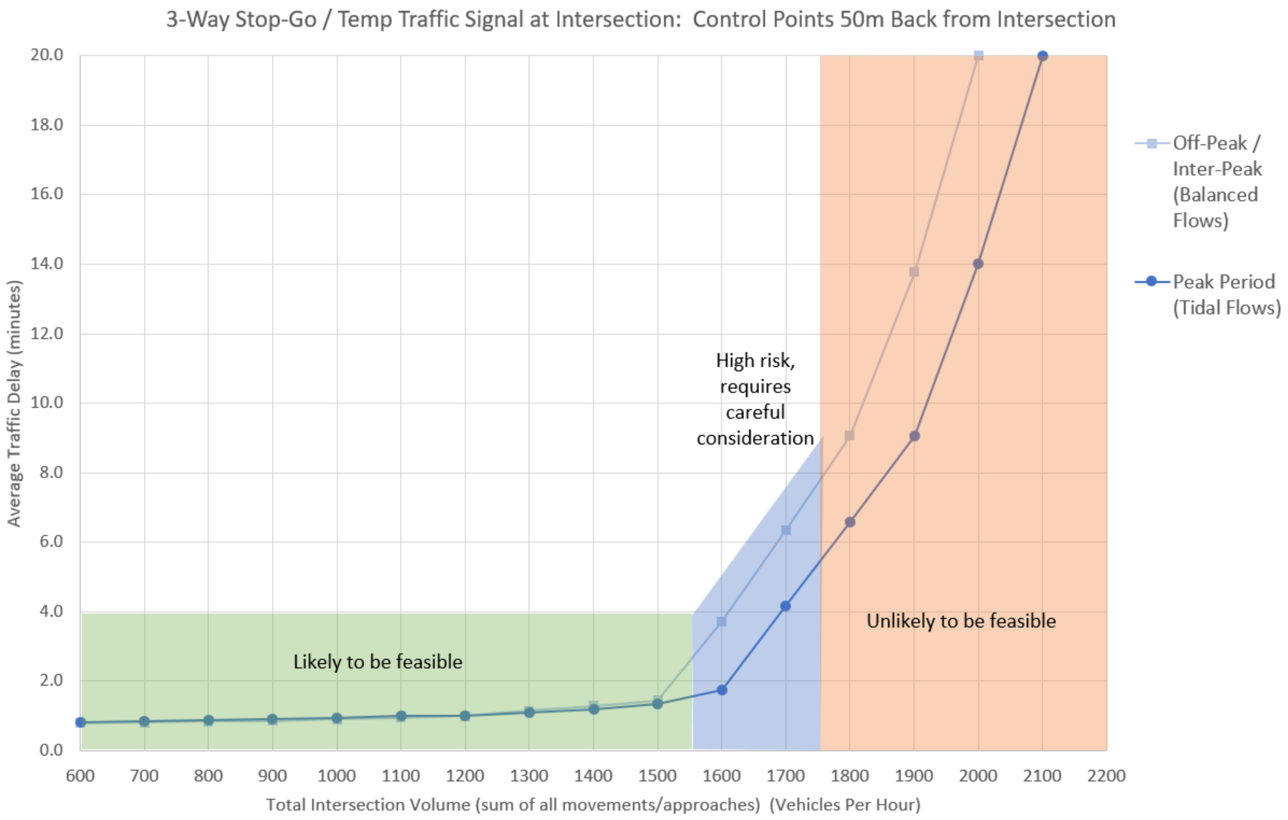


Figure 22: 3-Way Intersection Temporary Traffic Control

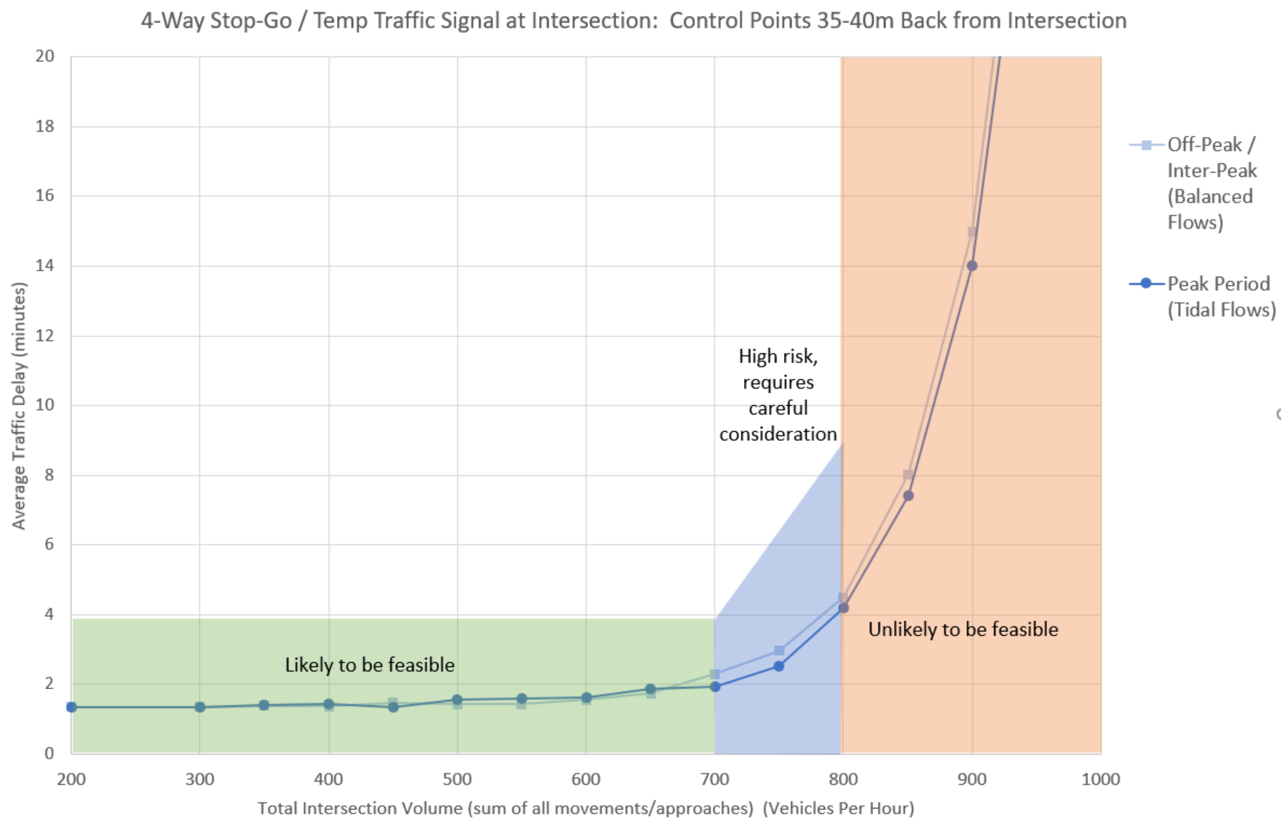


Figure 23: 4-Way Intersection Temporary Traffic Control