Christchurch Transport Operations Centre

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

Keeping Christchurch Moving

Transport Impact Assessment (TIA) Guide June 2017

PURPOSE AND USE OF GUIDE

Guideline Purpose

1 The purpose of this document is to provide guidance on carrying out assessment of potential transport impacts from Traffic Management (TM) activities.

Using the Guide and Key Sections

2 This guide contains a range of information. The notes below provide an overview of the key sections, and how these can be useful to specific roles.

Traffic Management Planners, **TMP Designers, Approving Engineers** and **Traffic Management Coordinators**:

- Objectives, concepts, and requirements for TIA: Sections 1, 2 and 3
- Finding traffic count data: Section 4
- Estimating and sense-checking impacts: Section 5
- Mitigation and options: Section 6

Traffic Engineers, Transport Planners, and Contract Managers preparing tenders and managing delivery contracts:

- Background (impact estimation and mitigation/options): Sections 5 and 6
- Where modelling may be required: Section 7
- Likely impact profile: Appendix A

STMS's:

- Risk of potential congestion onsite: Section 3, tables 1 and 2
- Site traffic counts: Section 4, paragraph 30 - 35
- Background (impact estimation and mitigation/options): Sections 5 and 6

1: TRANSPORT IMPACT ASSESSMENT OBJECTIVES

3 The purposes of carrying out a Transport Impact Assessment (TIA) are to;

3.1 Estimate the potential **impact** (i.e. risk) to the transport network

3.2 Identify **mitigation** requirements

3.3 Assess the **balance** of the approach being put forward by the programme owner

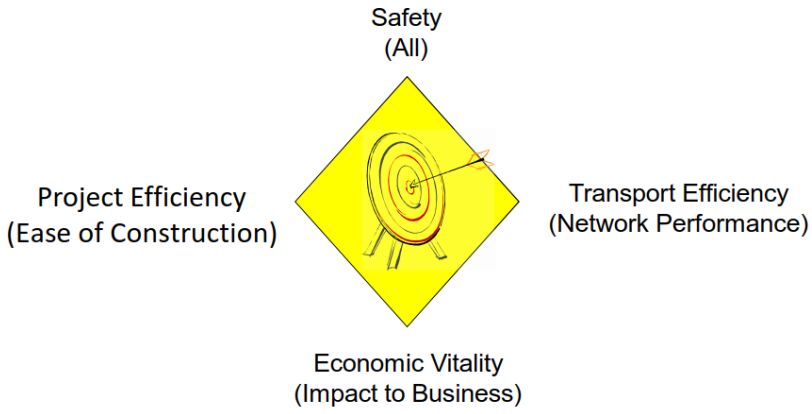
3.4 Consider **alternative** options for carrying out the work where necessary

4 TIAs enable review of the balance between safety, project requirements, transport network performance, and commercial impacts. For example, it is unlikely to be acceptable to close the Northern Motorway during the AM peak to carry out a road surface repair - this would be a significant transport impact against a relatively small project requirement. Balancing the considerations to arrive at *'best for NZ'* outcomes is illustrated by the "TTM Diamond" below;

4.1 **Safety** remains a key consideration in all activities.

4.2 **Project** efficiency (methodology, timing, programming etc.) and **Transport** efficiency (traffic delays, bus impacts, accessibility etc.) are generally reviewed alongside each other because they are often in conflict, e.g. a more efficient project delivery approach typically has a greater transport impact.

4.3 **Commercia**l business impacts (removing of passing foot / vehicle traffic, restricting access etc.) should also be considered where relevant.



5 Along with the other checks and procedures (e.g. collaboration and coordination), TIA outcomes are used by CTOC to support construction methodology choices, TM layouts and associated impacts. In other words, after we are satisfied that the proposal is adequately balanced we will support it alongside the programme owner against potential queries and criticism.

2: KEY CONCEPTS

6 TM activities occupy road-space and this will have some impact on customers using the transport system (commuters, freight, trade, buses, cyclists, pedestrians etc), and also businesses/residents in the local area and relying on passing through the area as part of their daily activities.

7 This guideline focusses on works with more significant impacts to customers and businesses. Low impact works such as temporary lane diversions, shoulder, and footpath works etc. generally don't require assessment of transport impacts.

8 For the purposes of this guide, TM work type arrangements have been classified as follows;

8.1 **Lane drop:** A reduction in the number of lanes along a road section between intersections. Broadly from 80m downstream of the first intersection to 100m prior to the second intersection.

8.2 **Intersection capacity reduction:** Removal of a through traffic lane or turning lane at a major intersection[1].

8.3 **Stop-go:** Control of conflicting traffic movements through a single-lane road section (between intersections) by Manual Traffic Control (MTC) or temporary traffic signals.

8.4 **Detour** (one-way or both directions): One-way or full-closure of a road section.

8.5 **Bus route detour:** One-way or full closure of a section which includes a bus route.

8.6 **Intersection reconfiguration:** Changes to the way in which a major intersection operates. For example a significant change to the signal phasing, MTC or temporary signal control of an existing priority intersection, installation of temporary roundabout etc.

8.7 **Significant works at key location**: Significant change to major intersection and/or road sections (usually on Level 2 or higher roads). For example, the construction of the grade-separate interchange at Johns Rd / Memorial Ave via a series of significant changes to intersection layout.

[1] Major intersections are defined as signals, roundabouts, and some busy priority intersections.

3: TRANSPORT IMPACT ASSESSMENT REQUIREMENT

9 Some form of Transport Impact Assessment (TIA) is expected for works of the above nature. The tables below provides a guide for the level of assessment expected, based on the traffic flow and proposed timing of the work.

Location of Mid-block Works (between intersections)	Approx. daily volume	Overnight	Weekend	Weekday Inter-Peak	Weekday AM and PM Peak
Low volume link	< 5,000vpd	Check	Check	Review	Review
Moderate volume link	5,000 - 10,000 vpd	Check	Review	Assess	Assess
High volume link	> 10,000 vpd	Review	Assess	Assess	Robust Assess

Table 1: Guide to requirement to carry out transport impact assessment, works on mid-block road sections

Location of Intersection Works	Combined daily volume of intersecting routes	Overnight	Weekend	Weekday Inter-Peak	Weekday AM and PM Peak
Low volume intersection	< 10,000 vpd	Check	Review	Assess	Assess
Moderate volume intersection	10,000 - 15,000 vpd	Review	Assess	Assess	Robust Assess
Moderate-to-High volume intersection	15,000 - 25,000 vpd	Assess	Robust Assess	Robust Assess	Robust Assess
High volume intersection	>25,000 vpd	Assess	Robust Assess	Robust Assess	Full Assess

Table 2: Guide to requirement to carry out transport impact assessment, works on intersections

10 The levels of transport impact assessment are:

10.1 **Check:** Quick verification that traffic flow is as expected and that risk of transport impacts is low - generally no requirement to assess delays.

10.2 **Review:** Review of traffic flow data, site location, and potential for impacts.

10.3 **Assess:** Assessment of traffic flows, assess possibility for delays, identify potential customer impacts and if necessary mitigation of impacts. Alternative options for work approach should be considered and this may be requested by CTOC.

10.4 **Robust Assessment:** Assess traffic flows, estimate delays, consider strategies to reduce risk and impacts. Alternative options for work approach must be considered.

10.5 **Full Assessment:** Potential requirement for expert advice, transport modelling, full assessment of alternative options, optimisation of strategy (layout, programme etc). Alternative options for work approach must be considered.

11 Note that the levels above are a guide and escalation to a more detailed level may be appropriate and may be requested by CTOC if there are any doubts around the accuracy / robustness of the output arrived at from the initially selected level.

4: TRAFFIC COUNT DATA

Christchurch Earthquakes February 2011 and Historical Data

12 The transport network, traffic volumes, and recurrent congestion areas were significantly altered by the earthquakes in 2011. For a period of time following 2011 the Christchurch City Council (CCC) suspended their regular traffic counting programme due to on-going instability in traffic patterns.

13 Ideally, and as a general principle, the most up-to-date counts should be sourced. Data from before 2011 should be used with caution due to its age, and because traffic conditions in 2011, 2012, and to a lesser extent 2013 may be different to current conditions.

14 Under a typical city growth scenario, historical traffic counts may be 'growthed up' to estimate current levels using a rule-of-thumb 2% growth per annum. However it is often not feasible to apply this approach post-quakes in Christchurch because traffic volumes in some areas of the network have grown much faster than typical (e.g. the north and west), whereas other areas have decreased (e.g. red-zone areas). If a post-2013 count is not available, then older sources of data should be used with caution. An onsite count of current traffic may be appropriate to verify actual volume.

Traffic Volume Data

15 The starting point for most TIA's is traffic volume data:
(i) link count information (between intersections), and/or
(ii) intersection movement counts (includes both through and turning volumes).

16 There are currently four sources of count data in the Christchurch area; the up-to-date CCC traffic count database, the older CCC traffic count website, traffic volume estimates on the TMPforChch website, and the NZ Transport Agency (NZTA) TMS system for state highways.

17 Because of the issues described above arising from the Christchurch earthquakes, it can be a good idea to check several sources of traffic count data. These can be cross-referenced to identify if any data appears to be incorrect or out-of-date, to average across several data sources, or to select the highest count which can be a good low-risk approach. If there is any doubt about which source or approach to use, please contact CTOC to discuss.

Up-to-Date CCC Traffic Count Database

18 The first port-of-call for traffic counts in the Christchurch area is likely to be the CCC count database which is kept up-to-date with the most recent intersection and link counts available. The database does not require a logon or password;

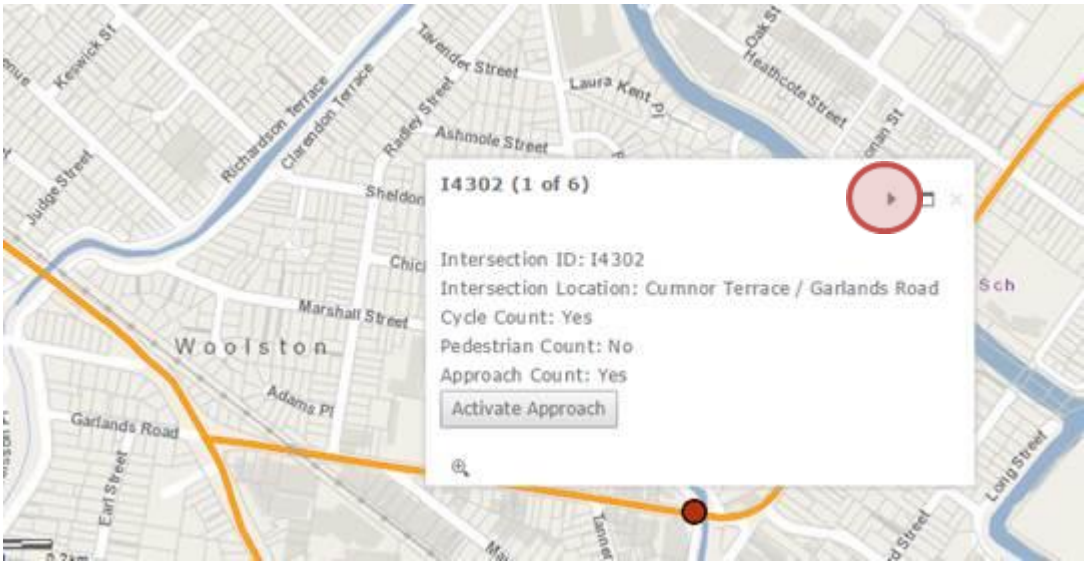
http://ccc.interpret.co.nz/trafficcount/

19 The data on this site is typically traffic counts from a single week or day (i.e. a small sample, that is intended to be sampled during 'typical' non-holiday periods). For unusual situations during the year e.g. long weekends, School Holiday periods, Christmas Holidays etc. this data is unlikely representative of actual volumes

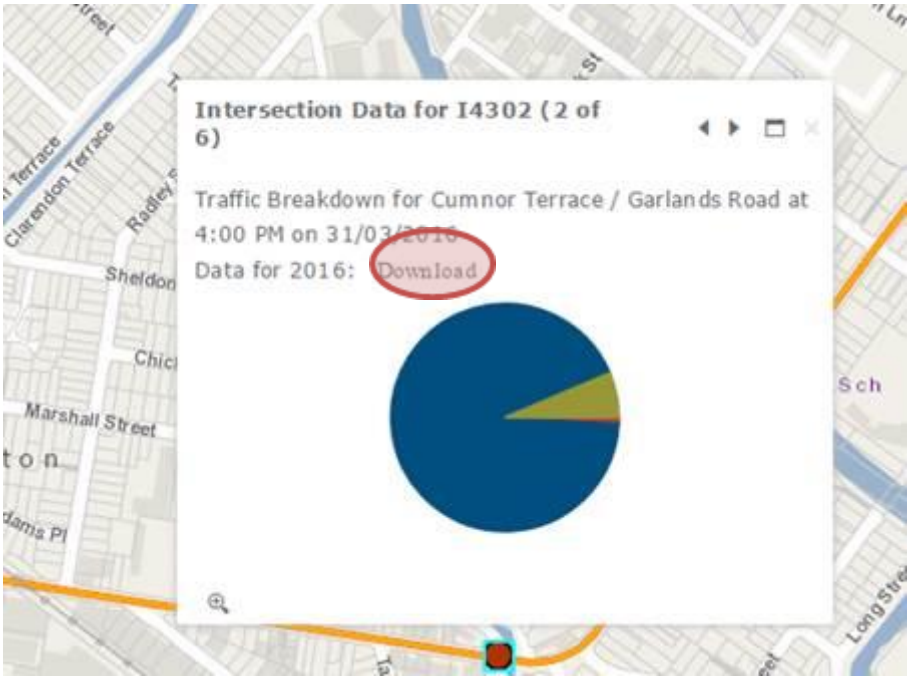
20 In the database; Intersection counts are shown with a Green Circle, Vehicle link counts are shown with a Blue Triangle, and Cycle link counts are shown with a Brown Square. The data can be filtered by the Year of the count in the top right. To download the data, follow the steps below.

For Intersection Counts

1. Click on the green circle which will open up a small dialog window. Click the right arrow, top right corner of this dialog, which will take you to a second tab on this dialog



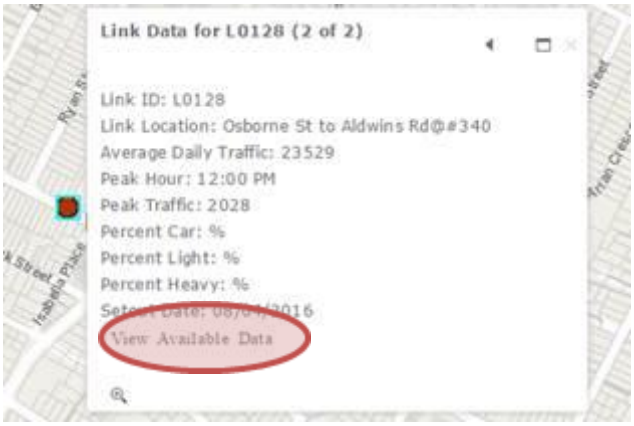
2. Click the download button and you will get the spreadsheet with the raw traffic count data

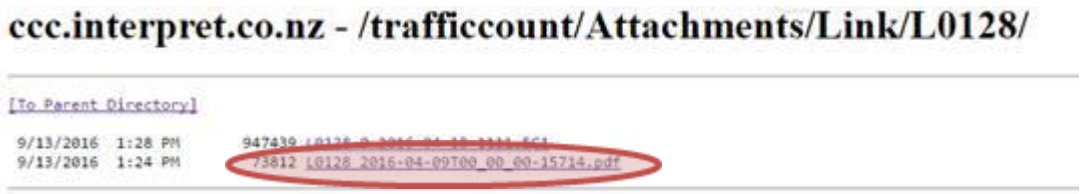


For Link Counts

1. Follow same steps as above, selecting a Blue Triangle for link count

2. When you get to the 2nd tab of the dialog, you will have the option of 'View Available Data', and this will take you to a screen with a link to either a PDF of the counts, or an ".ods" file which can be opened in MS excel.





Older CCC Traffic Count Website.

21 If up-to-date counts are not available on the CCC database, the older CCC website is available to find historical and older counts. This is straightforward to use and does not require a logon or password. Appendix A describes how to find and download link counts.

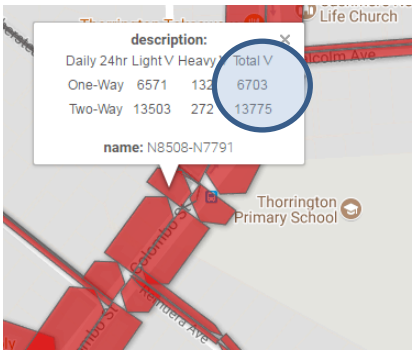
https://www.ccc.govt.nz/transport/road-improvement-projects/traffic-count-data/

TMPforChch Link Volume estimates

22 The TMPforChch website includes link volume estimates on the map index. These can be useful as a cross-check or double-check of other count data.

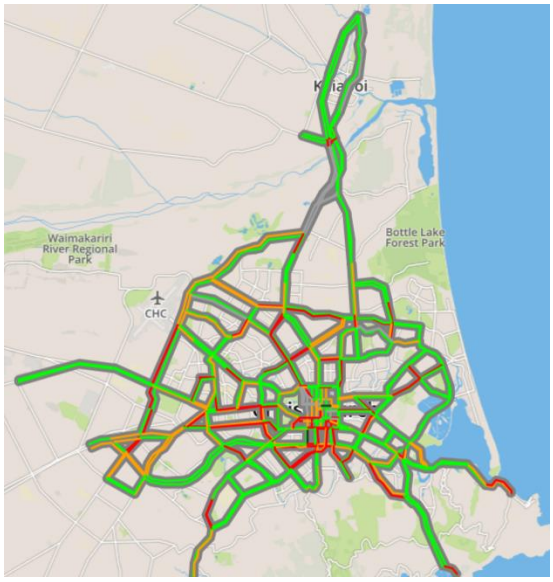
23 To access the data go to the TMP map, http://tmpforchch.co.nz/tmp/map/index. To navigate and select information easier, set the start date and end date several years into the future so that minimal TMPs are shown on the map. Then click the 'Traffic Volume' tick box at the top right of the screen and left click on a road link to display the volume.

24 This data is an estimate of daily traffic volume (i.e. 24 hour volume) from the Council's CAST traffic model. In other words it is estimated and not actual count data. It should be used with caution as it can be inaccurate in some locations.



5 Travel Times and Delays

25 CTOC has access to real-time 15min travel time information on many arterial routes across the Christchurch network. This information can be useful to determine if there are existing delays and problems on a route, and the potential impact of adding TM sites. Data is available on request from CTOC. The network coverage is shown in the figure below.



26 CTOC use this data to monitor delays when TM sites are installed and to review the impacts on customers following a TM project, event etc. Live conditions can be viewed on TFC to check operation after site installation; http://www.tfc.govt.nz/current-conditions/journeytimes/

27 This data can help to assess risk and impact post-installation, but generally doesn't help with TIA preparation..

NZTA TMS Website

28 The NZTA Traffic Monitoring System (TMS) website provides more detailed information on the State Highway network: https://tms.nzta.govt.nz/

29 This website requires a log-on and password and is more detailed and complicated to navigate. This data could be used when carrying works on the State Highway network. NZTA or CTOC can provide more assistance and advice on using this system.

Site-Specific Traffic Counts

30 Carrying out a traffic count at the site prior to the works is potentially the best option for obtaining robust current traffic counts, particularly when works are proposed to be carried out across morning and evening peak periods.

31 Counts should not be carried out during School Holidays or immediately before / after holiday weekends as traffic volumes are generally abnormal during these periods. The exception to this would be where works are programmed to be carried out over similar periods.

32 Ideally traffic count data should be collected in 15 minute intervals for 30 minutes to 1 hour across the AM and PM peaks. A 15 minute sample is often used to obtain an estimate of hourly peak traffic flows (this is acceptable to CTOC).

33 CTOC's Local Operating Procedures (LOPs) provide information on the peak traffic periods on the network and are available on the TMPforChch website. Peak periods can be different

in different locations around the network. Notably the AM peak can be earlier in locations further from the central city, e.g. the AM peak hour on the northern motorway Waimakariri Bridge is currently 06:15 – 07:15. In areas on the outskirts of the City, it is recommended that traffic data (e.g. from the CCC or NZTA systems) is sourced to confirm the peak period in advance of doing a site survey.

34 For very significant works (e.g. a major intersection reconfiguration) commissioning a data collection company to carry out a comprehensive survey would be recommended if accurate information is not available. This is likely to involve surveys using cameras and would cover the full AM and PM periods to capture the build and dissipation of traffic flows.

Vehicles Per Hour (VPH) and Vehicles Per Day (VPD)

35 Different count sources will provide different breakdowns of traffic volumes, e.g. the CAST model indicates vehicles per day (vpd) and a site count will usually provide vehicles per hour (vph). As a rough rule of thumb, the peak hour vph is typically 10% of the total daily weekday flow (vpd). VPD can be converted to VPH by dividing by 10, and conversely VPH to VPD by multiplying by 10.

36 If dealing with two-way flows (i.e. both directions) there is often a need to calculate the directional peak hour traffic flows. Traffic flows are typically tidal, i.e. inbound to the city in the morning and outbound from the city in the evening. To account for this, 60% of the two-way peak hour volume may be used as a rough estimate for the directional peak. In areas on the fringe of the city tidal effects increase (e.g. on the northern motorway) and closer to the city centre tidal effects decrease and inter-peak flows are typically higher.

37 The paragraphs above should provide some ideas to estimate traffic volumes from basic onsite traffic counts. For example, if the one-way peak hour flow (tidal peak direction) has been measured as 720vph, this can be used to estimate: 720 / 0.6 = 1200vph two-way peak. 1200 * 10 = 12,000vpd (this is likely to be Level 2 road environment).

38 Appendix B provides some simple guidance on analysis of count data in excel.

5: HIGH LEVEL ASSESSMENT GUIDE

39 The section below can be used as a guide to estimate transport impacts of certain TM project arrangements, and how likely they are to be acceptable to CTOC. It is based on obtaining a confident estimate of the average weekday two-way volume, estimated in vehicles per day (vpd), and/or the directional peak hour volume estimate in vehicles per hour (vph).

40 The guide can be applied by looking up the daily flow or hourly flow against a broad description of the proposed TM Activity. It is based on a flow range, and estimates the potential impact of different types of TM configurations. It should be used as rough guide of risk and a cross-check against TIA outputs. It is not a replacement for carrying out a site specific TIA, particularly for sites with moderate or greater potential impact.

Daily weekday two-way traffic flow:	< 5,000 vpd	5,000 - 15,000 vpd	15,000 - 25,000 vpd	25,000 - 35,000 vpd	35,000 - 45,000 vpd	>45,000
Approx. directional weekday peak hour volume:	< 300vph	~ 600vph	~ 1200vph	~ 1800vph	~ 2400vph	~ 2700vph
Example road:	Marine Parade	Gloucester St	Riccarton Rd	Russley Rd (around Airport)	Moorhouse Ave	Northern Motorway
TM Activity	Potential Impacts During AM and PM Peak Periods					
Lane drop (mid-block reduced to 1-lane)	Low / no impact	Minimal impact	Moderate impact	Significant impact	Unlikely to be feasible	Unlikely to be feasible
Lane drop (mid-block reduced to 2-lanes)	Low / no impact	Low / no impact	Low / no impact	Minimal impact	Moderate impact	Significant impact
Intersection capacity reduction (reduced to 1 thru lane or remove key turning lane)	Minimal impact	Moderate impact	Significant impact	Unlikely to be feasible	Unlikely to be feasible	Unlikely to be feasible
Intersection capacity reduction (reduced to 2 thru lanes or remove key turning lane)	Low / no impact	Minimal impact	Moderate impact	Significant impact	Significant impact	Unlikely to be feasible
Mid-block Stop-Go	Moderate impact	Significant impact	Unlikely to be feasible	Unlikely to be feasible	Unlikely to be feasible	Unlikely to be feasible
One-way diversion	Moderate impact	Significant impact	Significant impact	Unlikely to be feasible	Unlikely to be feasible	Unlikely to be feasible
Bus route diversion	Moderate impact	Significant impact	Significant impact	Unlikely to be feasible	Unlikely to be feasible	Unlikely to be feasible
Intersection reconfiguration	Minimal impact	Significant impact	Significant impact	Significant impact	Significant impact	Significant impact
Significant works	Minimal impact	Moderate impact	Significant impact	Significant impact	Significant impact	Significant impact

Figure 1: Transport Impact Assessment Guide

41 The impacts noted in the above figure are described in broad terms below;

41.1 **Low / no impact:** No real delay to vehicular traffic anticipated. Local access, bus-stop, pedestrian, cycle, and commercial impacts to be managed.

41.2 **Minimal impact**: Delays of several minutes to vehicles during peak times anticipated. Traffic flow remains relatively stable and unlikely that many drivers will respond to delays and adjust routes or re-time journeys.

41.3 **Moderate impact**: Around 5-10 minute delays anticipated. Potential for queues to form and block adjacent intersections. Potential for unreliable travel in area.

41.4 **Significant impact**: Greater than 10 minute delays anticipated. Impacts anticipated on adjacent alternative routes and reliability of travel around area likely to adversely affected.

41.5 **Unlikely to be feasible**: Without the strong possibility of significantly successful mitigation, carrying out work during peak periods is unlikely to be supportable.

Example of Estimating Traffic Volume, Applying Guide and Providing a Basic TIA

42 Works are being considered on Harper Ave with the potential to reduce from 2-lanes to 1-lane between intersections.

43 Currently there is no new link count the updated CCC database. The next check is the older CCC website link counts. There is 2012 link count west of Carlton Mill corner.

44 For weekday traffic flows;

44.1 The 2012 link shows high flows in the AM and PM Peak, greater than 1400 vph in the peak direction.

44.2 The inter-peak volumes are in the range of 900 – 1100 in the 2012 count. This is 5 years old. The new CCC website has an intersection count completed in March 2017.

44.3 Comparing the eastbound and westbound 2012 link flow with the peak hour 2017 intersection counts shows some significant increases and changes in traffic flows (particularly eastbound in the AM peak and westbound in the PM peak).

44.4 Conservatively this suggests flows have increased by 10-15% since 2012, which results in inter-peak flows in the range of 1000-1250.

44.5 The 2012 Saturday and Sunday link flows show volumes similar to the inter-peak, in the range of 950-1100 from 10am to 5pm.

45 This suggest the following Traffic Impact Assessment outcomes;

- Weekday AM and PM peak period lane drops will be difficult to support (significant impact).
- Weekday inter-peak (9:30am-3pm) and weekend (10am-5pm) lane drops are potentially high risk and would need to be carefully managed.
- Night works (6:30pm – 7am) may provide the longest period for uninterrupted work (12hours, opposed to 5-7hours inter-peak and weekends).

6: MITIGATION AND ALTERNATIVE OPTIONS

Background

46 The level of impact identified in the TIA provides a good indication on the extent of mitigation measures required and how extensive consideration of alternative strategies for carrying out the work needs to be. This section provides some high level guidance on these elements.

Mitigation

47 A baseline level of mitigation, e.g. communication with effected parties, is expected for the majority of worksites. There are range of communications and pre-warning that may be necessary:

47.1 **Letter Drops and pre-warning signage** (usually static signs): Typically a base level requirement for worksites with minimal to moderate impact to customers and businesses. This level of communication should *not* be anticipated to provide any level of significant or notable reduction in traffic impact, but simply sets expectation levels of customers that they may experience delays/impacts in this location.

47.2 **More extensive comms and targeted messaging** (eg VMS, newspaper, radio, social media): May be required for works with a significant impact, particularly over a short term (e.g. a public event), or for works where it is critical to advise the public of alternatives and the potential impact (e.g. closures or impacts on a lifeline route, or a key route impact with viable alternative route(s) options). Again this may not provide a significant reduction in impact, the objective is often to advice Customers of alternatives and the potential need / way to avoid impacts.

Alternative Options

48 Alternative options are potentially a key form of mitigation. If viable, they may provide significantly greater reduction of impacts than communication options described above. The more extensive the impact - the more fully alternative options must be explored, documented, and their viability (or lack off) established. Some key options are described below, and combinations of these options can be particularly effective.

48.1 **Re-timing the work:** Work phases or entire projects can be considered for re-timing to avoid peak periods (AM, PM, midday over weekends) and minimise consequent delays. E.g. identifying low traffic demand opportunities (overnight, during holidays, inter-peak, weekends), or re-programming to avoid clashes / cumulative effects with other worksites or events.

48.2 **Alternative work methods:** E.g. methodologies which require less road-space, but may take longer to complete.

48.3 **Upscaling Resource:** To complete works in a shorter duration, e.g. day / night shifts or several crews working within a work area at once.

48.4 **Low cost alternations to permanent fixtures:** E.g. removal and re-instatement of kerb-buildouts / islands to keep live lanes open.

48.5 **Reconfiguration or control of minor movements**: E.g. banning or restricting minor conflicting movements to keep major traffic movements flowing, MTC to control and manage conflicting movements and to minimise queue lengths etc.

Driver Response to Impacts

49 Experience has demonstrated that there may be two phases of impact and driver response to continuously deployed TTM worksites:

49.1 An immediate (up to 1 week) 'Acute' phase.

49.2 A longer term 'Chronic' phase.

50 Acute Phase: The deployment of a TTM worksite destabilises the normal road environment and it may take up to 1 week for roadusers and stakeholders to adjust to it. This includes roadusers reassessing their journey routing options, their time of travel, and their expectation of delay/disruption, corridor managers adjusting signal phasings and network controls, and the TTM Provider optimising the TTM configuration. After this period, it is possible that the transport network may have adjusted to the worksite.

51 Chronic Phase: After around 1 week, the 'adjusted transport network' state is in effect. If the worksite has reduced network capacity by a moderate-to-significant level, this will include higher travel times, be more unstable than the normal road environment, and less reliable in terms of average journey times. The network should not be considered to have "settled down" but to be operating differently, and in a higher risk state.

52 CTOC has been collecting data on traffic delays associated with TM worksites to build knowledge of impacts and delays over time. This indicates;

52.1 **The highest delays often do not occur on the first day**; high delays can occur during a regular high traffic demand period, which may not be the first day the site is established e.g. a site deployed on a Sunday night may not experience the highest delays until Thursday PM peak.

52.2 **Delays increasing over time**; In all examples examined there is strong evidence of delays increasing over time – to the extent where, in some cases delays towards the end of a project reached the highest levels.

52.3 **There may be limited or no change in delay patterns over time:** In some locations a high impact site can simply result in continuous high delays and unstable conditions across the area, with no discernible pattern of increasing or reducing delays.

53 This evidence indicates that there is no guarantee of delays decreasing over time. Any expectation of users or network adjusting to the change (sometimes referred to as 'settling') is unlikely to be credible. An expectation of adjusting to the change should **not** be considered a technique to mitigate impacts of a TM activity.

54 Three examples showing delay patterns over time are presented in Appendix C. These suggest that the potential for a driver response to delays and adjusting, relate to the opportunity drivers have to avoid the area. Eg in the Moorhouse Ave example which does demonstrate reductions in delays following high delays, there are a reasonable number of alternative routes and other ways to avoid the particular location at that particular time. In the other two examples the opportunities to avoid the area are limited.

7: TRANSPORT MODELLING

55 Where a robust or full assessment is required (ref. Table 1), or a number of sites are planned across an area across the same time period, transport modelling may provide valuable information to support TIAs. Modelling can be used to;

- Estimate the delays and impacts of a proposed site
- Refine and optimise the site layout to reduce the impact on customers
- Evaluate the benefits of alternative options to assist with selecting a preferred option
- Estimate the effect of changes designed to reduce impacts to certain levels via mitigation (eg a 10% suppression of trips will reduce delays by X minutes)

56 Ideally a relatively comprehensive survey of current traffic volumes covering the full peak periods would be carried out as the basis of any transport modelling. The exception to this would be where the CCC and/or NZTA observed count data is up-to-date and considered to robustly represent current conditions. In most locations throughout Christchurch, the CTOC Bluetooth travel time system can provide 15 minute travel times to calibrate or validate models.

57 There are two transport modelling options that are generally suitable for assessing the impact (i.e. delay estimates) of TM activities;

57.1 **SIDRA:** Tool for assessing straightforward intersection reconfigurations where the intersection is isolated from the effects of adjacent intersections and network features.

57.2 **Microsimulation:** Can be used for intersection assessment, to investigate more significant reconfigurations (e.g. the Memorial Ave / Russley Rd interchange stages), to assess a road corridor, series of intersections, or area wide effects. Microsimulation has a good track record both in NZ and overseas of accurately estimating delays, queues, and effects of short-term planned and unplanned events.

58 The two current network transport models maintained in the Christchurch region by the RCA's (the Chch Transport Model (CTM) and the Chch Assignment and Simulation Traffic (CAST)) may be used by planning staff to provide supporting and interpretative analysis of TM effects (e.g. the magnitude of work effects based on volumes rerouting and hotspot-style analysis of diverted traffic routes). However, generally these models should **not** be used to estimate delays and economic impacts of roadworks and events.

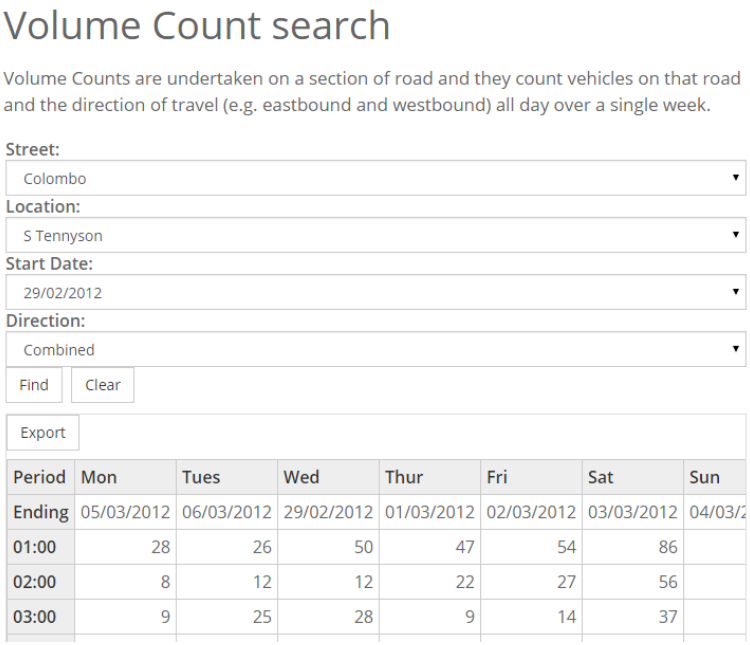
59 The reason these models cannot be used to directly measure delays and economic measures for temporary works is because they assign traffic to the network using approaches which assume drivers can minimise their travel times in combination with all other drivers on the network. This means that these models significantly underestimate the delays from TM and temporary planned / unplanned events[2]. This is particularly true of the CAST model which uses an equilibrium assignment method (i.e. it estimates traffic delays and volumes assuming perfect network knowledge and user choice) such that all drivers can minimise delays and optimise performance across the network). This is unrealistic for real life situations, and analysis of actual network performance has verified that modelled outcomes underestimate actual impact.

[2] Reference NZTA Research ART14-17: Economic Benefits of Network Operations Activities

APPENDIX A: CCC WEBSITE - LINK AND INTERSECTION COUNTS

CCC Volume Count search (link counts)

60 The CCC Volume Count (link counts between intersections) is a key source of traffic count information. The "Volume Count search" hyperlink leads to a simple interface to find and download (export) counts. The interface is shown below. Select the street and location closest to the worksite, select the most recent date, and either the combined (two-way) flows or the particular direction of interest.



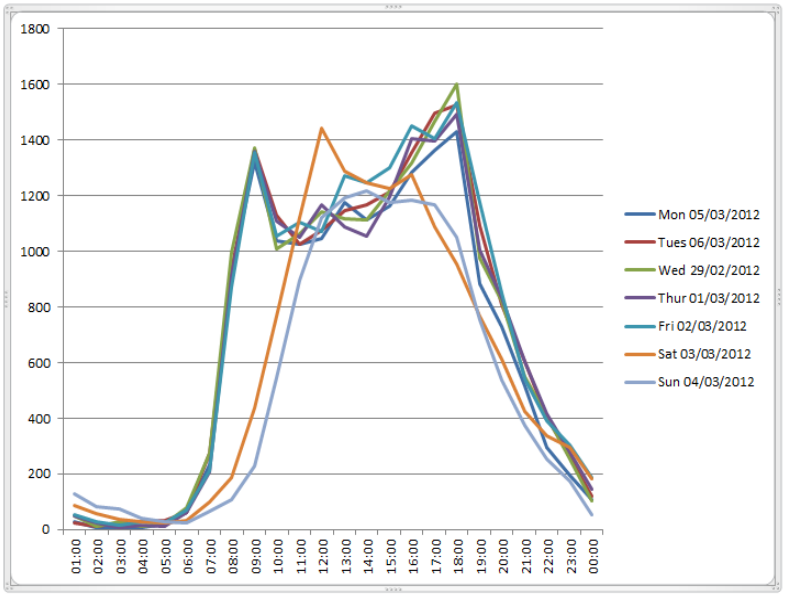
Period Ending	Mon	Tues	Wed	Thur	Fri	Sat	Sun
	05/03/2012	06/03/2012	29/02/2012	01/03/2012	02/03/2012	03/03/2012	04/03/2
01:00	28	26	50	47	54	86	
02:00	8	12	12	22	27	56	
03:00	9	25	28	9	14	37	

61 The 'Find' button will display the counts on the webpage, and the export button will download the data into a spreadsheet. The example below shows the downloaded traffic data and a graph of the hourly flows.

62 It demonstrates typical AM and PM weekday traffic peaks (Mon-Fri) and typical mid-morning / midday peaks on the weekends (Sat, Sun). A key value is the 4Day 24 hour average; 16,762 highlighted below (this is explained further in paragraph 35 onwards).

Street: Colombo
Location: S Tennyson
Start Date: 29/02/2012
Direction: Combined

Period	Mon	Tues	Wed	Thur	Fri	Sat	Sun	Averages	
Ending	05/03/2012	06/03/2012	29/02/2012	01/03/2012	02/03/2012	03/03/2012	04/03/2012	4Day	7Day
01:00	28	26	50	47	54	86	130	38	60
02:00	8	12	12	22	27	56	81	14	31
03:00	9	25	28	9	14	37	76	18	28
04:00	9	29	12	15	29	27	40	16	23
05:00	19	32	19	12	26	25	28	21	23
06:00	60	63	78	60	70	34	22	65	55
07:00	231	276	274	206	210	99	64	247	194
08:00	930	931	998	913	869	188	109	943	705
09:00	1320	1368	1370	1358	1354	438	228	1354	1062
10:00	1036	1131	1007	1107	1053	767	545	1070	949
11:00	1027	1024	1061	1050	1106	1120	894	1041	1040
12:00	1045	1075	1141	1168	1072	1442	1120	1107	1152
13:00	1175	1146	1115	1087	1273	1288	1192	1131	1182
14:00	1114	1166	1113	1053	1245	1246	1218	1112	1165
15:00	1163	1215	1219	1195	1300	1224	1174	1198	1213
16:00	1283	1354	1318	1404	1452	1275	1184	1340	1324
17:00	1365	1497	1469	1398	1405	1088	1166	1432	1341
18:00	1430	1525	1599	1492	1534	954	1051	1512	1369
19:00	885	1090	975	1004	1175	765	753	989	950
20:00	731	808	822	832	852	614	537	798	742
21:00	518	604	550	605	542	425	375	569	517
22:00	297	405	408	418	392	337	255	382	359
23:00	196	262	252	278	302	294	175	247	251
00:00	109	122	104	145	187	183	55	120	129
Totals									
12hr 19:00	13773	14522	14385	14229	14838	11795	10634	14227	13454
24hr 24:00	15988	17186	16994	16878	17543	14012	12472	16762	15868



CCC Intersection Count search

63 The intersection count search provides hourly light and heavy vehicle turning movement counts for 07:00-08:00, 08:00-09:00, 14:00-15:00, 16:00-17:00 and 17:00-18:00. The data can be displayed by selecting the 'Find' button, and then exported into excel format with the 'Export' button.

64 The intersection counts provide 15min and hourly totals for light and heavy vehicles for the left, thru (through), and right turn movements at the intersection. For TM planning, this data is particularly useful to check volumes of turning movements (e.g. right turning volumes) where the worksite affects these movements, combines different movements into fewer lanes, or changes intersection layouts.

Intersection Count Search

Vehicles are counted by type (heavy vehicle, light vehicle, and bicycle) and by movement (straight through, turning left, turning right or U-turn) over five hours on a single day.

Location: Colombo/Malcolm

Start Date: 21/09/2011

Time: 08:00

Find Clear

Export

Start Date: 21 September 2011 | **Time:** 08:00 | **Observers:** TLD (Electronic) | **Weather:** Fine

Movement Data (totals (excluding cycles) with 15 minute splits by vehicle type)

Clolmbo Napp

Left					43
Light	4	13	12	9	38
Heavy	0	1	2	2	5
Cycle	0				

Thru					382
Light	84	94	100	82	360
Heavy	7	8	2	5	22
Cycle	6				

Malcolm Eapp

Left					135
Light	30	34	46	22	132
Heavy	1	1	0	1	3
Cycle	5				

Right					80
Light	19	23	21	16	79
Heavy	0	1	0	0	1
Cycle	7				

Colombo SWapp

Thru					667
Light	172	176	156	167	651
Heavy	2	6	6	2	16
Cycle	19				

Right					45
Light	10	5	17	11	43
Heavy	2	0	0	0	2
Cycle	1				

This is the count for the following hour (08:00 – 09:00)

hour totals

15 min data

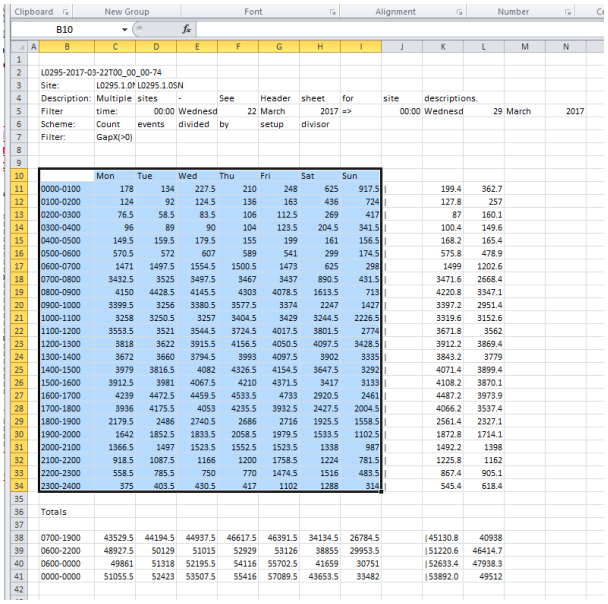
APPENDIX B: SIMPLE EXCEL ANALYSIS OF COUNT DATA

Excel Analysis of Link Count Data

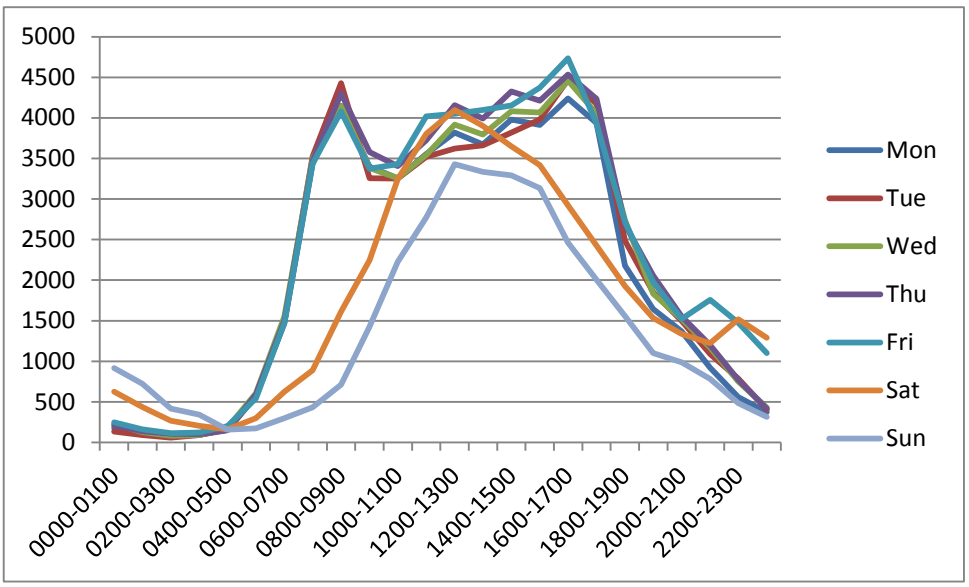
65 A simple and effective way of reviewing the potential traffic impacts of a site is to use MS excel to review the traffic counts, particularly link counts. Most link count data comes in the format showing below and will either open directly in excel (.xls, .xlsx, .csv and .ods files) or can be copied pasted into excel from other programmes (.pdf, .doc, .txt files).

	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages 1 - 5	Averages 1 - 7
Hour									
0000-0100	178.0	134.0	227.5	210.0	248.0	625.0	917.5	199.4	362.7
0100-0200	124.0	92.0	124.5	136.0	163.0	436.0	724.0	127.8	257.0
0200-0300	76.5	58.5	83.5	106.0	112.5	269.0	417.0	87.0	160.1
0300-0400	96.0	89.0	90.0	104.0	123.5	204.5	341.5	100.4	149.6
0400-0500	149.5	159.5	179.5	155.0	199.0	161.0	156.5	168.2	165.4
0500-0600	570.5	572.0	607.0	589.0	541.0	299.0	174.5	575.8	478.9
0600-0700	1471.0	1497.5	1554.5	1500.5	1473.0	625.0	298.0	1499.0	1202.6
0700-0800	3432.5	3525.0	3497.5	3467.0	3437.0	890.5	431.5	3471.6	2668.4
0800-0900	**4150.0**	**4428.5**	**4145.5**	**4303.0**	**4078.5**	1613.5	713.0	**4220.8**	3347.1
0900-1000	3399.5	3256.0	3380.5	3577.5	3374.0	2247.0	1427.0	3397.2	2951.4
1000-1100	3258.0	3250.5	3257.0	3404.5	3429.0	3244.5	2226.5	3319.6	3152.6
1100-1200	3553.5	3521.0	3544.5	3724.5	4017.5	**3801.5**	**2774.0**	3671.8	**3562.0**
1200-1300	3818.0	3622.0	3915.5	4156.5	4050.5	**4097.5**	**3428.5**	3912.2	3869.4
1300-1400	3672.0	3660.0	3794.5	3993.0	4097.5	3902.0	3335.0	3843.2	3779.0
1400-1500	3979.0	3816.5	4082.0	4326.5	4154.5	3647.5	3292.0	4071.4	3899.4
1500-1600	3912.5	3981.0	4067.5	4210.0	4371.5	3417.0	3133.0	4108.2	3870.1
1600-1700	**4239.0**	**4472.5**	**4459.5**	**4533.5**	**4733.0**	2920.5	2461.0	**4487.2**	**3973.9**
1700-1800	3936.0	4175.5	4053.0	4235.5	3932.5	2427.5	2004.5	4066.2	3537.4
1800-1900	2179.5	2486.0	2740.5	2686.0	2716.0	1925.5	1558.5	2561.4	2327.1
1900-2000	1642.0	1852.5	1833.5	2058.5	1979.5	1533.5	1102.5	1872.8	1714.1
2000-2100	1366.5	1497.0	1523.5	1552.5	1523.5	1338.0	987.0	1492.2	1398.0
2100-2200	918.5	1087.5	1166.0	1200.0	1758.5	1224.0	781.5	1225.8	1162.0
2200-2300	558.5	785.5	750.0	770.0	1474.5	1516.0	483.5	867.4	905.1
2300-2400	375.0	403.5	430.5	417.0	1102.0	1288.0	314.0	545.4	618.4
Totals									
0700-1900	43529.5	44194.5	44937.5	46617.5	46391.5	34134.5	26784.5	45130.8	40938.0
0600-2200	48927.5	50129.0	51015.0	52929.0	53126.0	38855.0	29953.5	51220.6	46414.7
0600-0000	49861.0	51318.0	52195.5	54116.0	55702.5	41659.0	30751.0	52633.4	47938.3
0000-0000	51055.5	52423.0	53507.5	55416.0	57089.5	43653.5	33482.0	53892.0	49512.0

66 With data in excel, highlight the hourly data and daily area as shown below;



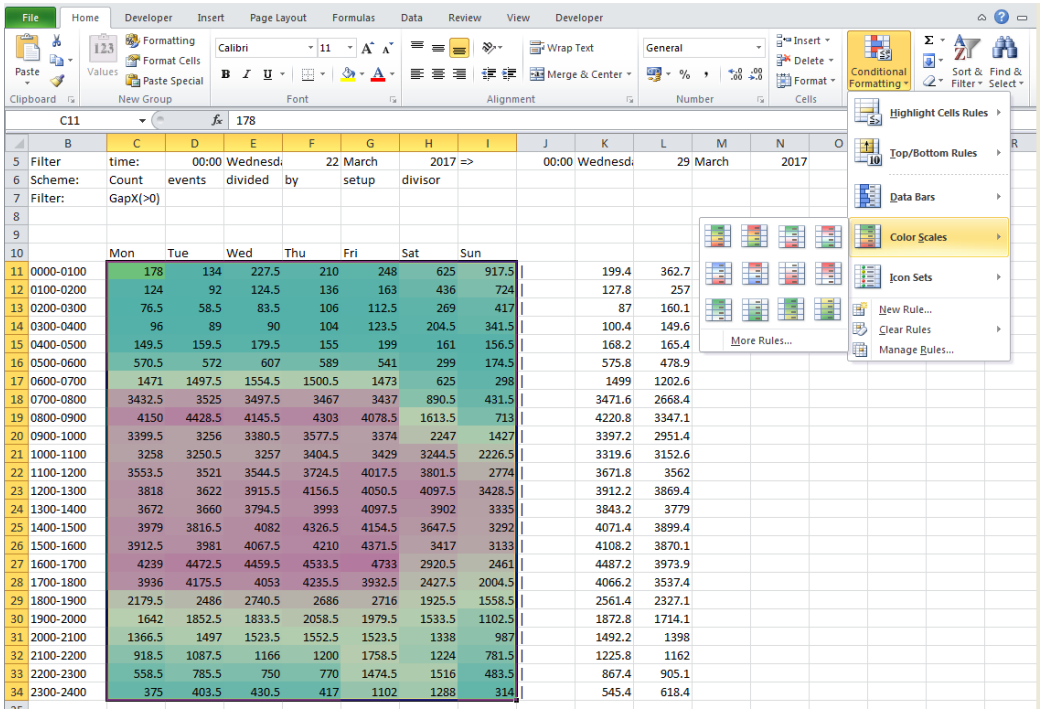
67 With the area highlighted in Excel, select Insert>>Line Graph>> and click on one of the 2D line graph options. This will create a graph like the one below;



68 The graph shows the hourly traffic volume on the Y axis and the time-of-day on the X axis with a line for each day of the week. This is useful for determining a range of aspects;

- The time-of-day and day-of-the-week where the volumes are highest / lowest.
- How long, and at what times, traffic is above a certain threshold (e.g. 1000vph).
- The direction and time of peak traffic volumes (if the data is by direction and a graph is created for each direction).

69 Another simple way to do the above analysis is to use the conditional formatting function in Excel. With the *count* data area highlighted, select the Conditional Formatting option and choose either Data Bars or more commonly a Colour Scale;



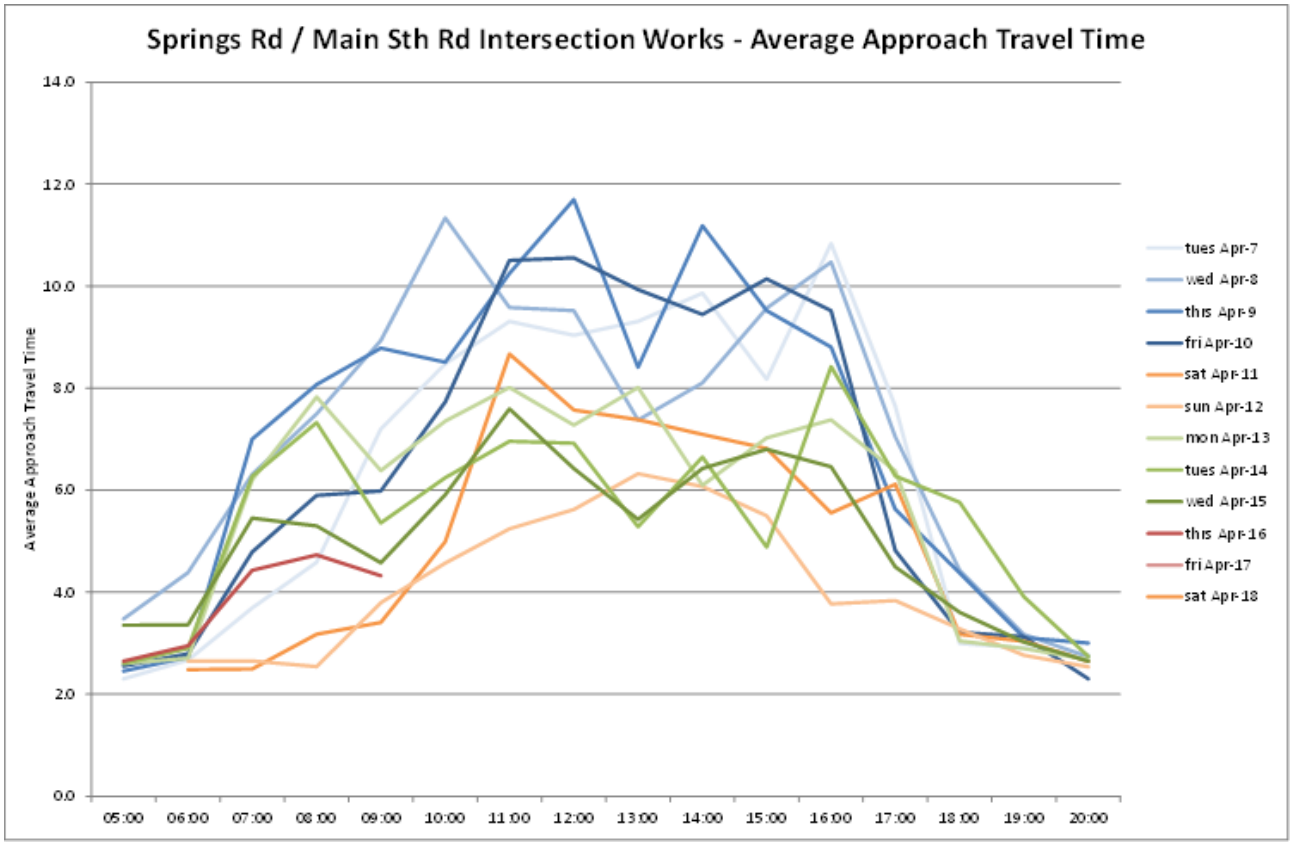
	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	Filter	time:	00:00	Wednesd	22	March	2017	=>	00:00	Wednesd	29	March	2017	
6	Scheme:	Count	events	divided	by	setup	divisor							
7	Filter:	GapX(>0)												
8														
9														
10		Mon	Tue	Wed	Thu	Fri	Sat	Sun						
11	0000-0100	178	134	227.5	210	248	625	917.5		199.4	362.7			
12	0100-0200	124	92	124.5	136	163	436	724		127.8	257			
13	0200-0300	76.5	58.5	83.5	106	112.5	269	417		87	160.1			
14	0300-0400	96	89	90	104	123.5	204.5	341.5		100.4	149.6			
15	0400-0500	149.5	159.5	179.5	155	199	161	156.5		168.2	165.4			
16	0500-0600	570.5	572	607	589	541	299	174.5		575.8	478.9			
17	0600-0700	1471	1497.5	1554.5	1500.5	1473	625	298		1499	1202.6			
18	0700-0800	3432.5	3525	3497.5	3467	3437	890.5	431.5		3471.6	2668.4			
19	0800-0900	4150	4428.5	4145.5	4303	4078.5	1613.5	713		4220.8	3347.1			
20	0900-1000	3399.5	3256	3380.5	3577.5	3374	2247	1427		3397.2	2951.4			
21	1000-1100	3258	3250.5	3257	3404.5	3429	3244.5	2226.5		3319.6	3152.6			
22	1100-1200	3553.5	3521	3544.5	3724.5	4017.5	3801.5	2774		3671.8	3562			
23	1200-1300	3818	3622	3915.5	4156.5	4050.5	4097.5	3428.5		3912.2	3869.4			
24	1300-1400	3672	3660	3794.5	3993	4097.5	3902	3335		3843.2	3779			
25	1400-1500	3979	3816.5	4082	4326.5	4154.5	3647.5	3292		4071.4	3899.4			
26	1500-1600	3912.5	3981	4067.5	4210	4371.5	3417	3133		4108.2	3870.1			
27	1600-1700	4239	4472.5	4459.5	4533.5	4733	2920.5	2461		4487.2	3973.9			
28	1700-1800	3936	4175.5	4053	4235.5	3932.5	2427.5	2004.5		4066.2	3537.4			
29	1800-1900	2179.5	2486	2740.5	2686	2716	1925.5	1558.5		2561.4	2327.1			
30	1900-2000	1642	1852.5	1833.5	2058.5	1979.5	1533.5	1102.5		1872.8	1714.1			
31	2000-2100	1366.5	1497	1523.5	1552.5	1523.5	1338	987		1492.2	1398			
32	2100-2200	918.5	1087.5	1166	1200	1758.5	1224	781.5		1225.8	1162			
33	2200-2300	558.5	785.5	750	770	1474.5	1516	483.5		867.4	905.1			
34	2300-2400	375	403.5	430.5	417	1102	1288	314		545.4	618.4			

APPENDIX C: TRANSPORT IMPACT EXAMPLES

Springs Road / Main South Road intersection:

70 Lanes removed on intersection approach over school holidays. The figure bellow shows the delays following the installation of the site, these delays were much greater than the typical travel times before the site was installed.

- There was no immediate day 1 response. Days 2 & 3 experienced some of the higher delays
- There is some evidence of a minor degree of traffic 'adjustment' over a longer period (several weeks)
- In general delays are quite variable. There is some evidence of the delays switching between the Main South Rd / Springs Rd approaches.
- The delays through the Inter-Peak period are particularly high

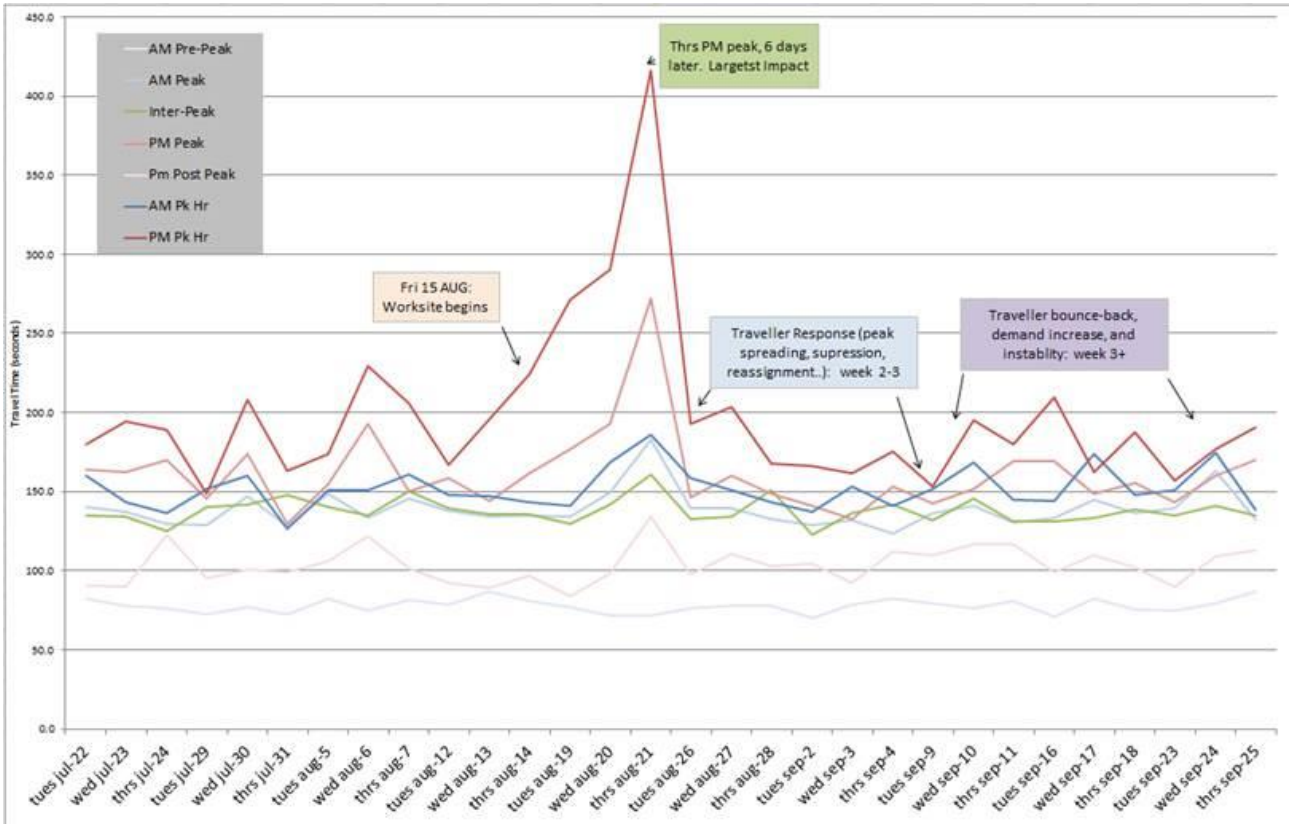


Moorhouse Ave

71 Key turning lane removed on west intersection approach to a major arterial road (left turn into Montreal St);

- Week 1: Most significant delays occurred nearly 6 days after site was established (Thursday PM peak).
- Week 2-3: After high delays, appears that drivers respond and a period of lower delays occurs.

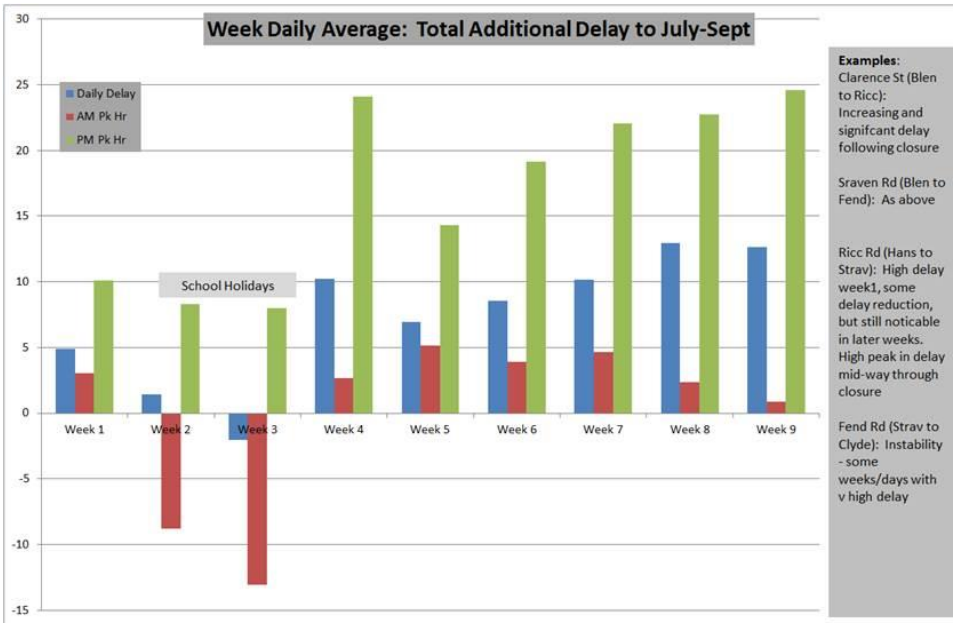
- Week 3+: Following this the demand appears to increase (i.e. drivers return) and delays / instability increase.



Kahu Rd

72 Full closure of Kahu Rd bridge at Riccarton House for 9 weeks;

- Initial delays relatively low, probably associated with extensive comms
- In week 4, immediately after the school holidays, there was a level of more ‘acute’ impact, followed by a drop (week 5)
- In the subsequent weeks, delays increased steadily week-after-week until the worst impact was recorded in the final week of the closure (week 9)


Week Daily Average: Total Additional Delay to July-Sept
Daily Delay
AM Pk Hr
PM Pk Hr
School Holidays
30
25
20
15
10
5
0
-5
-10
-15
Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7
Week 8
Week 9
Examples:
Clarence St (Blen to Ricc): Increasing and signifcant delay following closure
Sraven Rd (Blen to Fend): As above
Ricc Rd (Hans to Strav): High delay week1, some delay reduction, but still noticable in later weeks. High peak in delay mid-way through closure
Fend Rd (Strav to Clyde): Instability - some weeks/days with v high delay