Guidelines for Traffic Counting

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# ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADT</td>
<td>Average Daily Traffic</td>
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<tr>
<td>AADT</td>
<td>Annual Average Daily Traffic</td>
</tr>
<tr>
<td>HCV</td>
<td>Heavy Commercial Vehicle</td>
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<tr>
<td>HPMV</td>
<td>High Productivity Motor Vehicle</td>
</tr>
<tr>
<td>NZTA</td>
<td>NZ Transport Agency</td>
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<tr>
<td>RAMM</td>
<td>Road Asset and Maintenance Management</td>
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<tr>
<td>RCA</td>
<td>Road Controlling Authority</td>
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<tr>
<td>TMS</td>
<td>Traffic Monitoring System</td>
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<tr>
<td>VKT</td>
<td>Vehicle kilometres travelled</td>
</tr>
</tbody>
</table>
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1. Introduction

This guide is based on the results of research aimed at improving the quality of traffic flow data collected by RCAs and stored in their Road Asset and Maintenance Management (RAMM) databases. Traffic count data is important because it forms the basis for the national and local traffic flow estimates used in many planning and decision-making contexts.

The research results propose a minimum standard for a traffic monitoring framework to significantly improve the overall accuracy and efficiency (and therefore value for money) of typical traffic data collection regimes.

The sampling framework’s key foundations are based around one key assumption and two types of sample:

- A traffic link model based on the assumption that adjacent sections of road carrying similar levels of traffic can be amalgamated or related. As this model reduces the sampling framework, the number of road sections for which traffic flow data are required decreases.

- A core annual monitoring sample of between 3% and 7% of total traffic links (selected as a stratified random sample based on expected Annual Average Daily Traffic (AADT) that allows travel activity monitoring in the RCA as a whole)

- A rotational sample drawn to cover the bulk of road network travel (the top 20% of traffic links, based on the contribution that each link makes to total vkt in the Road Controlling Authority (RCA) – the 20% typically carries around 80% of travel activity). On some networks this sample may be collected annually while on others the sample could be spread over two years.

The degree to which the new traffic counting framework overlaps with existing practices depends greatly on the size and structure of the current monitoring strategy.

1.1 Background

Access to reliable data on the number and types of vehicles using New Zealand’s roads has been an important input for a range of road asset management, transportation planning, and transport and environmental policy activities. The primary source of traffic volume and vehicle travel data in New Zealand is an aggregation of the individual Road Assessment and Maintenance Management (RAMM) databases operated by RCAs. Primarily a road management tool, RAMM databases contain a variety of information about the physical road asset, including traffic count data and estimates of the AADT.

The RAMM databases for the state highway network are populated with traffic volume data from the NZ Transport Agency’s (NZTA) Traffic Monitoring System (TMS). TMS uses a combination of continuous and non-continuous traffic counts to generate estimated AADT on every section of the state highway network.

Unlike the arrangements for monitoring traffic on state highway network, each local authority operates their own database, populating the traffic data fields with traffic volumes collected, typically from short duration (seven-day) traffic counts, or from estimates based on previous traffic counts, traffic counts undertaken on adjacent road sections, or local knowledge. The average of the counted data provides only an Average Daily Traffic (ADT), as the data is not adjusted seasonally.

The currency, quality and completeness of the traffic information contained in these databases is extremely variable.
1.2 RATIONALE

The clear message is the provision of up to date traffic count data on New Zealand’s local roads is extremely variable and generally poor overall, making it unlikely to meet planning and policy needs.

The lack of consistent and reliable data on the traffic using New Zealand’s local authority roads is not a new problem. Over the past 14 years there have been various attempts at creating a national traffic monitoring system to meet the needs of a range of agencies for a range of purposes. Centrally driven, these initiatives have lacked the resources necessary for a nationwide initiative and have failed to provide on-going development and support. As a consequence, these national traffic databases have not been maintained, and their usefulness has declined.

This guide represents a significant change in thinking, proposing a bottom-up process that seeks to provide RCAs with the knowledge, tools and systems to improve their local traffic monitoring.

In general terms the approach seeks to improve and rationalise the traffic counting programmes operated by individual RCAs, and to automate propagation of these traffic counts across the road network models held within the RAMM databases. In doing so, the project seeks to improve traffic monitoring practices by:

- Not placing undue pressures on the limited staff and financial resources of the RCAs
- Providing recognisable efficiency benefits to those using the system.

Improvements in the coverage and quality of local traffic monitoring will benefit the RCAs collecting the data. It will also improve the basis for a national traffic monitoring system as well as network performance monitoring and benchmarking.
2. Why Collect Traffic Data?

The ADT or AADT is a figure used to describe the current traffic demand on the network (showing how busy the roads are). A large number of asset management processes use the ADT or AADT figure to provide decision making information.

There are two principal reasons for RCAs to have accurate estimates of road traffic volumes:

» **Funding**
   NZTA Planning and Investment group have auditors to check the accuracy of the information provided to support funding applications.

» **Better Decision Making**
   More accurate information leads to more consistent and robust analysis and confidence in results. This improves credibility and enables councils to better direct resources.

**Table 1: Uses of traffic count data in a typical RCA.**

<table>
<thead>
<tr>
<th>LONG TERM PLANNING</th>
<th>NETWORK RENEWAL &amp; DEVELOPMENT</th>
<th>CUSTOMER SERVICE</th>
<th>OPERATIONAL</th>
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<tbody>
<tr>
<td>Understanding route use and hierarchy</td>
<td>Project planning [e.g. optimum working periods]</td>
<td>Responding to enquiries</td>
<td>Traffic management requirements</td>
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<td>TSA &amp; Predictive condition modelling [dTIMS etc]</td>
<td>Deriving traffic loads for pavement design</td>
<td>Development control and planning</td>
<td>Regulatory requirements</td>
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<tr>
<td>Safety studies and crash analysis</td>
<td>Deriving traffic loads bridge design</td>
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<td>Network monitoring</td>
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<tr>
<td>Traffic modelling and simulation</td>
<td>Project economics (BCR)</td>
<td></td>
<td>Deriving traffic loads for planning and design of maintenance intervention strategies [e.g. reseal programme]</td>
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<td>Setting and measuring levels of service</td>
<td>Enables a network by network comparison.</td>
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<td>Policy development</td>
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<td>Vehicle Kilometres Travelled (VKT)</td>
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<td>HCV &amp; HPMV management</td>
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3. Objectives

A traffic counting strategy’s primary objective is to ensure traffic volumes across the network are known in sufficient detail and to an appropriate level of accuracy to inform the tools and processes used by RCAs and NZTA that rely on traffic volumes. Traffic count data should be collected as efficiently as possible to meet this objective.

4. Principles

Traffic counting needs vary depending on the intended use for the data. The following matrix describes each core activity’s traffic volume requirements.

Table 2: Traffic Data Demands.

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<td>Classification</td>
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<td>Class speed</td>
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<td>Cycle counts</td>
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The principle of the traffic counting strategy should be to collect data to inform the above activities in a manner that accurately estimates, and is sensitive to the changes in:

- Network use (volume and classification)
- Speed and direction of travel
- Growth
- Seasonal variation.
5. Traffic Counting Module

The ideal means of establishing the traffic usage of the network would be to count the traffic using every road section, every day of the year. Clearly this is not practical. The alternative is to undertake short duration traffic counts on a sample of road sections, and use this data to develop informed estimates of the actual traffic usage on the network. However, this approach results in a number of consistency and data accuracy issues.

To help address these issues, a traffic counting model has been developed by MWH New Zealand Limited on behalf of the Ministry of Transport and the NZTA. It was implemented within the RAMM dataset system by RAMM Software Limited. The RAMM module was commissioned to improve the quality of RAMM’s traffic count data, and to address three issues identified in this study and previous studies by:

- Improving traffic counting programme efficiency by:
  - Increasing existing traffic counting programmes’ coverage
  - Improving national cost effectiveness
  - Improving traffic counting programme targeting

- Improving traffic estimates by:
  - Improving AADT estimates from short term traffic counts
  - Understanding network-wide traffic mix distributions better
  - Improving estimate updating
  - Improving uncounted road section estimates.

This guide uses the RAMM module process to describe and illustrate the proposed framework’s principles. However, the principles and framework described could be equally applied to developing a traffic counting strategy independent from RAMM.
6. Improving traffic counting programmes' efficiency

6.1 Increasing a traffic counting programme's coverage

The RAMM database contains a schedule of road sections that make up the highway network. The sections are typically defined in terms of the road asset's physical characteristics, rather than the traffic travelling on particular sections. For example, the road section between the two side roads (see below) is broken into three carriageway sections, representing the changes in the physical attributes of the road, the bridge and two sections on either side of it. However, the traffic using each of the three carriageway sections is the same.

Figure 1: Traffic Link and Carriageway Section Relationship.

The traffic counting module introduces the concept of traffic links, or aggregations of RAMM road sections that carry essentially the same traffic. This is similar to the method used by NZTA Highways and Network Operations group on state highways. The principal reason for creating a traffic link network is to provide a means of reducing the overall size of the database for which traffic data will be required.
There are various ways in which a traffic link network can be created:

- One way is to review each historic traffic count site and determine whether the carriageway sections either side can be combined with that which has been monitored historically. This process is continued working out from each site.
- Where the RCA operates a traffic model, this is effectively the traffic link network, and the carriageway sections in the RAMM database can be combined to mirror the traffic model network.
- Another way is to use the routine developed within the RAMM Traffic Counting module to suggest which RAMM carriageway sections might be combined, based on the current traffic estimates. A pre-requisite for this process is to update all traffic estimates to the same base year.

Although creating a traffic link system is not essential, it will improve the traffic counting programme’s efficiency. If in doubt, a couple of very short duration counts (an hour or so) may be used to determine if sections can be combined. It is however, worth noting that while the decision to combine adjacent sections may be easy to make where the vast majority of vehicles pass from one section to another, more care is required where there is a lot of turning traffic. As this process is based on traffic volumes, if traffic volumes and composition are expected to remain essentially equal on adjacent sections, the sections can be combined to form traffic links.

When setting up the traffic link model, asset managers need to be diligent in incorporating network knowledge and understanding of forecast growth and network change. This will ensure the traffic link model appropriately reflects changes in network characteristics such traffic mix/composition as well as volume.

### 6.2 IMPROVING THE TARGETING OF TRAFFIC COUNTING PROGRAMMES

The traffic data module does not specify detailed traffic counting programmes, but together with the associated RAMM manual, guidance is given and tools provided that allow the user to create or revise their traffic counting programme.

Two components of traffic counting strategies are suggested:

- **Core Sample** – a randomly selected sample, typically of between 3% and 7% of traffic links, that when surveyed annually will provide an estimated mean AADT. This can be multiplied by network length to provide an estimate of network travel (vehicle kilometres of travel-VKT) that will be within +/- 10% of the true volume of travel at least 90% of the time. The guide provides details of the likely sample size for each RCA as well as the method of selection.

- **Rotational Sample** – that portion of the traffic network, typically around 17% of traffic links) on which more than 80% of total network travel is undertaken. The software provides the means by which these links can be identified and managed.

In practice, it is possible to ensure the bulk of the Core sample is contained within the Rotational Sample. Because the Rotational Sample covers the bulk of network travel, this sample will provide network wide growth estimates as well as ensuring year by year information is collected on the key traffic links.
7. Improving Traffic Estimates

The RAMM database holds estimates of the AADT for each section of road on a network. These estimates are accessed and used in applications such as pavement deterioration modelling. The estimated AADT figures are typically based on one or more short duration (typically seven-day) traffic surveys, either on the road section in question or an immediately adjacent road section.

This creates confusion and raises three issues, confirmed by a survey of local authority traffic monitoring practices:

- The “conversion” of a short duration traffic count to a “reliable” estimate of AADT
- The manner in which traffic counts on one road section may or could be used to estimate traffic volumes on an adjacent road section
- Efficiently up-dating traffic estimates.

7.1 Improving the Estimation of AADT from Short Duration Traffic Counts

The volume of traffic using a particular road varies throughout the year depending on the road type. In some cases this variation can be as much as +/- 30%. If a seven-day traffic count is undertaken in late January on a road leading to a popular beach area, average daily traffic measured in the survey is likely to be a significant over estimate of the AADT. Similarly, a traffic count undertaken during winter months will under estimate the true AADT. While it is possible to undertake a series of short duration traffic counts throughout the year, this simply increases the cost associated with obtaining a reliable estimate.

To assist, the traffic counting module enables the user to allocate traffic count sites to a series of seasonal profiles; a series of criteria are provided to aid allocation. The seasonal profiles are used to obtain an estimate of AADT from the short duration traffic count. If there are multiple short duration traffic counts undertaken in a year, each traffic count provides a separate estimate of AADT and these are averaged by the software to provide a more reliable estimate of AADT on the counted link. This routine ensures that estimates are updated when new counts are entered.

7.2 Improving the Updating of Estimates

As the majority of local authority traffic count data in RAMM is typically incomplete, many associated applications use the estimated AADT values, not the traffic count data. It is therefore important that estimates are kept up to date.

The traffic data module enables the user to allocate the various traffic count sites/traffic links to traffic growth groups. When the update routine is run, the traffic growth recorded for those links with a traffic count history is reported and used to update those links in the group that were not counted in the last year.

Currently there is no basis or routine for recommending traffic links and updating estimates on anything other than traffic volume and count history. Other important factors already discussed in Section 6.1 need to be considered when defining the traffic link model to ensure updated estimates accurately reflect factors such as traffic mix (classification) as well as AADT.
7.3 IMPROVING THE ESTIMATES ON UNCOUNTED ROAD SECTIONS

The traffic link concept described in section 6 effectively links the carriageway sections so:

Estimate on section 1 = 100% of estimate on section 2.

This concept can be extended further to identify relationships between the traffic volumes on adjacent or associated links and, in doing so, extend the coverage of the counting programme. In this way, the traffic on other uncounted carriageway sections or traffic links is related to a traffic count site and associated estimates. This means when a traffic count is undertaken at X, the estimated ADT (or some portion of it) is automatically used to update the estimates on road sections linked to that count site:

Figure 2: ADT Estimation on Uncounted Traffic Links

This ability to link road sections increases the network coverage of a particular traffic counting plan.
8. Other Considerations for a Traffic Counting Programme

There is a fundamental difference in the relationship between links for private vehicles and heavy commercial vehicles, particularly HPMVs that operate on permitted routes only. The RAMM module is not currently designed to establish different link relationships for different vehicle classifications so this element requires a manual audit after the annual update of link volumes. When auditing the count programme, it is also important to consider the following (you may wish to designate certain count stations as providing these additional functions).

» Growth Node:
Sites tracking strategic growth trends. Also absorbing the representative sites for verifying low volume road and growth estimation.

» Seasonal:
Sites tracking key tourism and industrial fluctuations and for establishing seasonal profiles

» Screenline:
It is important when providing traffic information for modelling purposes that counts are located on the road network in such a way that they form screenlines and/or cordons. A screenline is a notional line across the road network which delineates directional or sectoral movements across the area. A cordon is a notional “ring” which delineates movement in and out of an enclosed area such as a suburb or core part of a central business district (CBD). The figure below shows an example of two sets of screenlines and two cordons. These screenlines and cordons were chosen to both capture the primary movement patterns across the network while intersecting as few roads as possible (thereby lessening the monitoring effort).
GUIDELINES FOR TRAFFIC COUNTING

Figure 3: Count Screenlines and Cordons.

Table 3: Example of a Traffic Counting Framework.

<table>
<thead>
<tr>
<th>COUNT TYPE</th>
<th>PURPOSE</th>
<th>LOCATION</th>
<th>CRITERIA</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Monitoring Sample</td>
<td>Monitoring travel activity on the network as a whole</td>
<td>Whole Network</td>
<td>Random sample</td>
<td>Annually</td>
</tr>
<tr>
<td>Rotational Sample</td>
<td>Monitoring traffic flows to capture 80% of VKT on the network</td>
<td>Arterial, Collector, Distributor, Regional Arterial</td>
<td>High Level Traffic VKT &gt;5000 ADT + all Heavy Traffic VKT sites</td>
<td>Annually: randomly selected count dates.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Local, Local CBD</td>
<td>Based on Low Level VKT &lt;5000 ADT</td>
<td>Bi-annually: randomly selected count dates.</td>
</tr>
<tr>
<td>Growth Counts*</td>
<td>Track strategic growth trends</td>
<td>Nominated development areas and representative sites for verifying growth on low volume roads.</td>
<td>Urban and Rural count sites selected on their strategic and base line value.</td>
<td>Annually: counted in the same month each year.</td>
</tr>
<tr>
<td>COUNT TYPE</td>
<td>PURPOSE</td>
<td>LOCATION</td>
<td>CRITERIA</td>
<td>FREQUENCY</td>
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<td>------------------</td>
<td>----------------------------------------------</td>
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<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Seasonal</td>
<td>Track key tourism and industrial fluctuations</td>
<td>Nominated key tourism and industrial roads</td>
<td>Urban and rural count sites selected on their strategic and base line value</td>
<td>Each count site used once every five years. Seven-day counts every month within the count year.</td>
</tr>
<tr>
<td>Counts*</td>
<td></td>
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</tr>
<tr>
<td>Screenline</td>
<td>Assist with calibration of the strategic regional transport model and Hastings Urban model.</td>
<td>Located on North/South and East/West screen lines and an inner and outer cordon</td>
<td>All roads crossing screenlines and cordons</td>
<td>As per Rotational Sample sites</td>
</tr>
<tr>
<td>Cycle</td>
<td>Monitoring cycle flows to capture use of designated cycle routes</td>
<td>Routes as defined by cycling strategy</td>
<td>Urban and rural count sites selected on their strategic and base line value</td>
<td>Annually: counted in the same month as the Growth Counts</td>
</tr>
<tr>
<td>Counts</td>
<td></td>
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</tbody>
</table>

*Note: Sites to be within rotational sample to minimise addition of counts to programme*

### 9. Where to go to learn how to use the RAMM Module

The RAMM Traffic Count Estimation module uses the methodology described in this guide. It is designed to enable you to combine historical traffic data with intelligent Carriageway Section linking. This in turn enables you to produce a traffic counting and estimation programme which delivers the most Network coverage, and the most accurate and up to date ADT Estimates for the minimum number of counts.

To find out more on how to start using the RAMM Traffic Module, go to: [www.ramm.co.nz/manuals](http://www.ramm.co.nz/manuals) and select “Traffic Count Estimation”