Traffic Monitoring on Local Roads

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Abstract

Southland District Council in conjunction with MWH has developed a Traffic Monitoring Strategy which has set a series of goals to ensure that the Districts traffic counting is aimed at picking up and processing the most suitable information for the management of the roading asset.

Having set these goals a detailed analysis of all the historical data has been carried out to establish:

- *the quality of the existing data in terms of traffic volume and mix of vehicles*
- *trends within the forestry, dairy, tourism and general categories*
- *consistency of these trends within the above categories across the network*
- *if the average trend per category is able to predict reliable annual average daily traffic counts from minimal counts on previously uncounted roads.*
- *if there are any gaps in the data in terms of areas not counted and insufficient counts on roads*
- *what the forward traffic counting programme will need to be to effectively establish the above and meet the Council's requirements of being able to efficiently and safely maintain and monitor the roading network and to plan developments.*

Introduction

Southland District Council (SDC) has 1790 roads totalling approximately 2,000 km sealed and 3,000 km unsealed and 947 bridges.

Currently SDC has 5782 ADT counts from 1970, 739 classification counts from 1981 and 109 manual commodity surveys from 1980 to 1993.

This paper outlines the development of a Traffic Monitoring Strategy which aims to ensure that the Districts traffic counting is aimed at picking up and processing the most suitable information for the management of the roading asset.

History of counting

SDC has ADT counts starting from 1970 to present, manual classification counts from 1980 to 1993 and classifying counter data from 1981 to present. The counters used over this time have been punched tape machines, single tube counters (GK3000's), dual tube counters (GK5000's & MetroCount 5500's). The latest counters record each individual vehicle's data such as time, direction, number of axles and speed. This has enabled a more detailed analysis of the recorded data. Prior to 1991 all the ADT data was initially stored in its own database and the vehicle breakdown data stored on paper. After 1991 with the implementation of RAMM all data was transferred to the appropriate RAMM tables and further count data added as it was recorded.

In 1991 SDC documented its traffic data collection policy and this is the general framework for the current traffic monitoring process. However over time with the changes in personal, counter reliability issues (batteries, tube problems, counter thefts) and the changes in the traffic numbers and composition this policy required a review. As with most reviews it is important to look at what has been achieved and compare this against what is required, developing a strategy and goals to achieve this. This strategy is outlined in the following section.

Development of Strategy and Goals

The strategy and goals aim to provide better information on which to make decisions, relating to projects and long term planning, with the ability to produce a wide variety of reports. The results will allow the SDC and its advisers to better know what is happening out on the road, thus taking some of the guesswork out of loading calculations or use of default figures.

The Advanced Road Asset Management Plan (ARAMP) has established that the overall aim of Council with regard to the roading network is:

"*To meet community's required level of service for present and future customers by the appropriate creation, operation, maintenance, rehabilitation and replacement of roading assets".*

This aim leads on to the Traffic Monitoring Aim:

"Pro-actively collect the information required by the Southland District Council and its advisers to efficiently and safely maintain and monitor its roading network and to plan developments."

Goals

GOAL A: Building sufficient data to accurately show and predict traffic growth and the change in traffic distribution.

EXPLANATION: Growth data on vehicle flow and distribution is valuable for asset management. This information will enable SDC and its advisers to more accurately predict growth and distribution of traffic within the Southland District and forward plan in areas such as the five-year works program, maintenance works, seal extensions and potential locations for stock underpasses.

With the increase in the dairy, forestry and tourism sectors in Southland within the last few years, the above goal will be an asset for predicting growth and distribution in various areas in the region. This gives the potential to increase the standard of some areas of the roading network prior to those areas falling below the expected level of service, thus enabling the ARAMP aim to be achieved.

Good data will avoid the need to use the default values in the Project Evaluation Manual (PEM) which tends to understate the heavy traffic in Southland.

GOAL B: Having accurate heavy vehicle loadings for; all bridges on the ten year bridge replacement programme, all posted bridges and those with a structural rating of less than 6.

EXPLANATION: Heavy vehicle numbers are required to calculate the effect on the traffic stream of restricting or removing a bridge from the network. Bridge replacement justifications are very sensitive to traffic volumes and require good Annual Average Daily Traffic (AADT) and Equivalent Standard Axle (ESA) estimates. This information will allow for bridges to have pre-emptive maintenance and aid the justification of bridge replacements or upgrades.

GOAL C: Having accurate ESA for all Group 1, 2 and 3 roads and those expected to be on the 5-year forward works programme.

EXPLANATION: Local axle load information is available from enforcement records held by the Ministry of Transport. The closest Weigh-In-Motion (WIM) site to Southland is in Canterbury on SH1 at Waipara. ESA information is required for modelling pavement performance and designing rehabilitation works.

Predicting remaining life based on accurate ESA counts could also lead to more accurate identification of depreciation of the asset.

GOAL D: Having sufficient information available to be able to predict an AADT and vehicle breakdown to within ± 20% for 80% of roads.

EXPLANATION: Having this basic information available to within a reasonable accuracy will allow for projects such as reseals, seal extensions, need for stock underpasses and maintenance works to be more economical, defendable or extend their potential design life.

GOAL E: Having good speed data could justify the use of higher speed increases than the default in the Project Evaluation Manual (PEM).

EXPLANATION: The PEM is the criteria for funding from Transfund. Having good speed data may increase the amount of funding for a roading project.

Vehicle speed characteristics are required for calculating vehicle operating costs and travel-time savings for re-alignment options. Vehicle speed distributions are also used for minor safety projects (eg traffic calming) and when reviewing posted speed limits through local communities.

GOAL F: Having sufficient information available to be able to enhance safety improvement measures.

EXPLANATION: Speed is one factor in the design of the roading network. Today's vehicles are manufactured to go faster than most roads are designed for. Accidents occur because drivers are travelling too fast for the conditions. By having accurate information available to SDC advisers, specifically speed data, trends can be found and safety measures put in place where necessary.

Specific Work / Findings

Before trying to achieve the above goals all the available data needs to be reviewed to see what is already available and what it can show.

The data was analysed to find the roads with the highest number of ADT counts on them. From this a short list of 21 roads or sections of road (284 km) was produced and then using local knowledge each road or section of road was classified as Forestry, Dairy, Tourist or General. Due to the limited data available at each individual count location, count locations on each road were grouped to best represent that road or section of road. This data was then sorted into a year and month matrix. Where multiple data existed for the same year and month this was averaged to produce an ADT for that year and month. From this matrix where possible growth figures were calculated across the years for the same months to establish an average growth factor. At this stage any data that was considered strange was ignored.
(see table 1 below as a sample)

Historical Average Monthly Traffic Count Data for Rimu Seaward Downs Rd from Mokotua Rd to Mataura Island Rd (0 – 15.9 km)

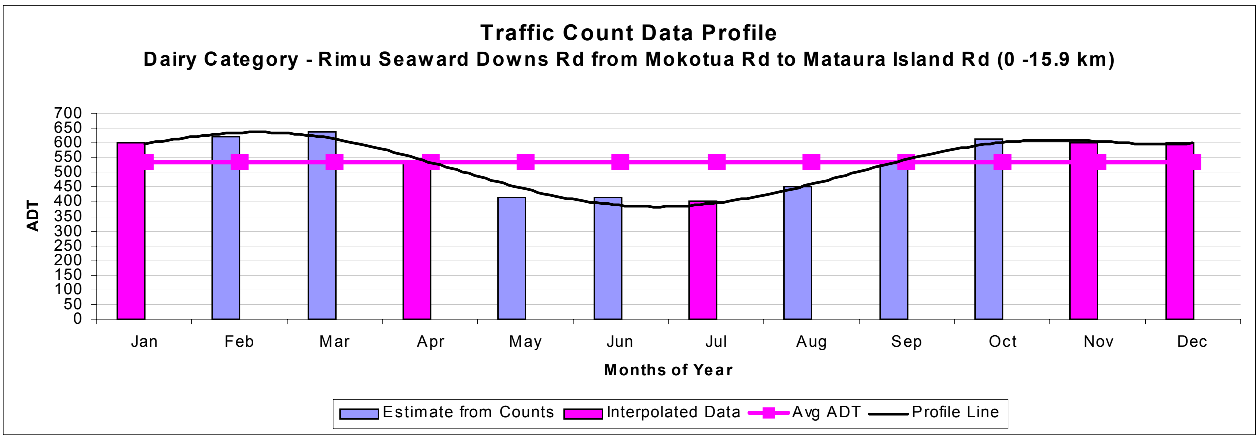
Months	Years																	Estimate from Counts	Avg ADT	-20%	+20%	Check
	1976	1980	1982	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002					
Jan																		🟪 600	535	428	642	🟨 498
Feb								465			485							🟪 620	535	428	642	🟨 510
Mar										554				589				638	535	428	642	🟨 563
Apr						401				🟩 701								🟪 530	535	428	642	🟨 491
May											370					401		412	535	428	642	🟨 461
Jun		231											337		393			415	535	428	642	🟨 546
Jul																		🟪 400	535	428	642	🟨 542
Aug												🟩 299						450	535	428	642	🟨 551
Sep				367					354		460							537	535	428	642	🟨 584
Oct			304			335	418	390				539						614	535	428	642	🟨 606
Nov					431													🟪 600	535	428	642	🟨 569
Dec	338																🟩 425	🟪 600	535	428	642	🟨 547

🟩 Data ignored 🟪 Interpolated data 🟨 Check if Estimate within + or - 20% using average Dairy correction Factors

Table 1 Historical ADT Data for Rimu Seaward Downs Rd

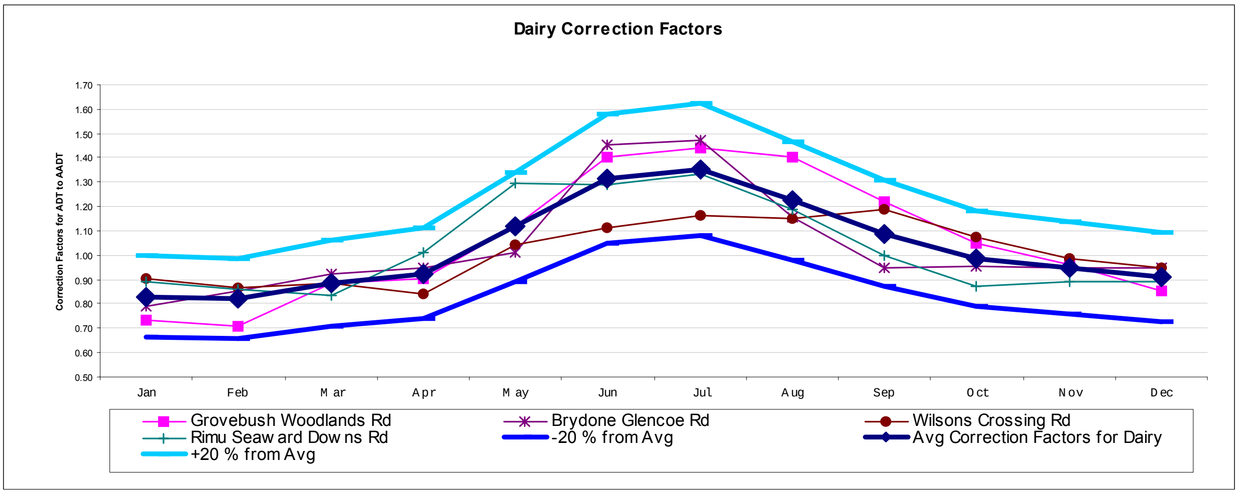
Using these average growth figures for each road an estimate for each month was developed and then graphed to produce a yearly profile. This profile was then reviewed and adjusted to develop a smooth profile. From here the average of each road was used to calculate a correction factor for each month.

(see Graph 1 below as a sample)



Graph 1 Yearly Profile on Rimu Seaward Downs Rd

These results were then plotted and averaged by the Forestry, Dairy, Tourism and General groups. From these averages plus and minus 20% parameters were calculated and this found reasonable correlation and consistency within the groups producing correction factors throughout the year to convert ADT to AADT.
(see Graph 2 below as a sample)



Graph 2 Dairy corrections Factors

Display of Historical Data using GIS

The aim here was to define graphically the quality and spread of the data (5700 counts) using colours for the ARAMP groups and line thickness for the quality of data recorded. Weightings were assigned to the years and the type of counter used.

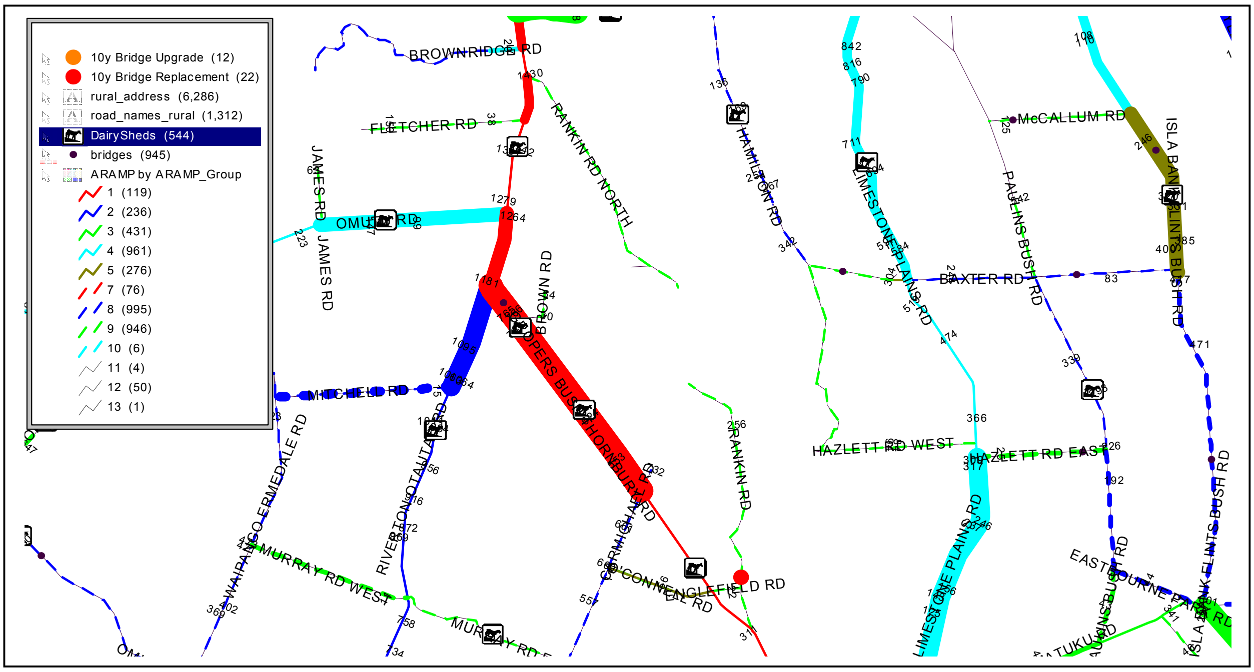
Years 1970 to 1980 weighting	0.0
Years 1980 to 1990 weighting	0.5

Years 1990 to 2000 weighting	1.5
Years 2000 to today weighting	2.5
GK3000 counter weighting	1.0
GK5000 counter weighting	2.0
MetroCounter weighting	3.0

These calculated weightings were then binned into 6 categories.

Bin 1	no data
Bin 2	very limited data
Bin 3	limited data
Bin 4	average data
Bin 5	good data
Bin 6	excellent data

Once the GIS had displayed the data considerable work was required to make the data presentable in terms of clarity. Solid lines were chosen for sealed roads and broken lines for unsealed roads. The 5 sealed groups in the SDC ARAMP required 5 colours that would not clash (Red, Green, Blue, Cyan and Khaki). The 3 unsealed groups also used the first 3 colours but were broken lines. The bridges, dairy sheds and rapid signs were also added with the future aim of assisting in new counter locations.
(see Graph 3 below as a sample)

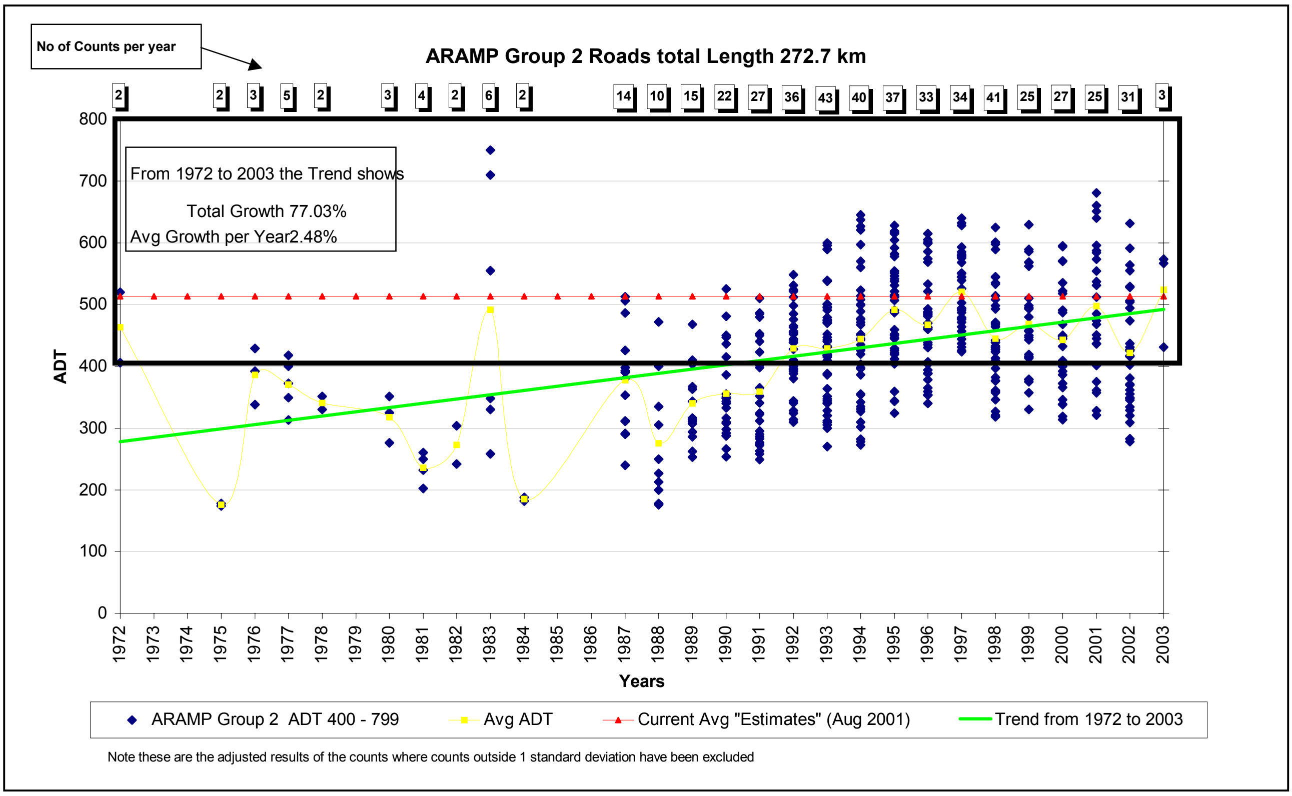


Graph 3 GIS Display of Data

Once finalised these plots can be used to review the status of the current data and help determine where the critical gaps are.

Growth of AADT's and HCV's

The data was also analysed to see what it could show about growth for ADT and HCV's.
The ADT data was sorted by ARAMP group and year and put into an ACCESS database. From here each year had data outside one standard deviation excluded and the average ADT per year calculated and then plotted on an XY scatter graph. A straight line trend was also added to the graph along with the average RAMM estimate per ARAMP group. Using the trend line equation, growth from the earliest records to the current was calculated along with the average growth per year for the time frame shown.
(see Graph 4 below as a sample)



Graph 4 ADT Growth for ARAMP Group 2

A review of the results showed some consistencies within the groups and some anomalies.

- Group 1 did not have as good a correlation as the other groups as this group is the most affected by the factoring that was done in the ARAMP in an attempt to get the high use roads in terms of ADT and HCV into one group. Basically where the HCV percentage was above the Rural Other mix of 9 % the estimate was factored up
- Group 2, 3 & 4 have good correlation with approximately 75% of the counts within the ADT limits for each group
- Group 5 has a reasonable correlation but has very few counts. These roads are the lowest class of sealed roads and are generally short in length.

- Group 7 has a reasonable correlation but has very few counts. These roads are the highest class of unsealed roads.
- Group 8 has good correlation with approximately 75% of the counts within the ADT limits
- Group 9 has poor correlation and small number of counts especially lately.

Table 2 below summarises the indicated ADT growth results

ADT Results			
ARAMP Group	Date Range	Total Growth across Date Range	Average Growth Rate per Year
Sealed Roads			
1	1976 to 2003	35%	1.33%
2	1972 to 2003	77%	2.48%
3	1973 to 2003	58%	1.93%
4	1976 to 2003	75%	2.76%
5	1987 to 2002	-15%	-0.91%
Unsealed Roads			
7	1977 to 2002	48%	1.92%
8	1977 to 2003	43%	1.64%
9	1977 to 2003	7%	0.29%
All ARAMP Groups	1972 to 2003	18%	0.58%

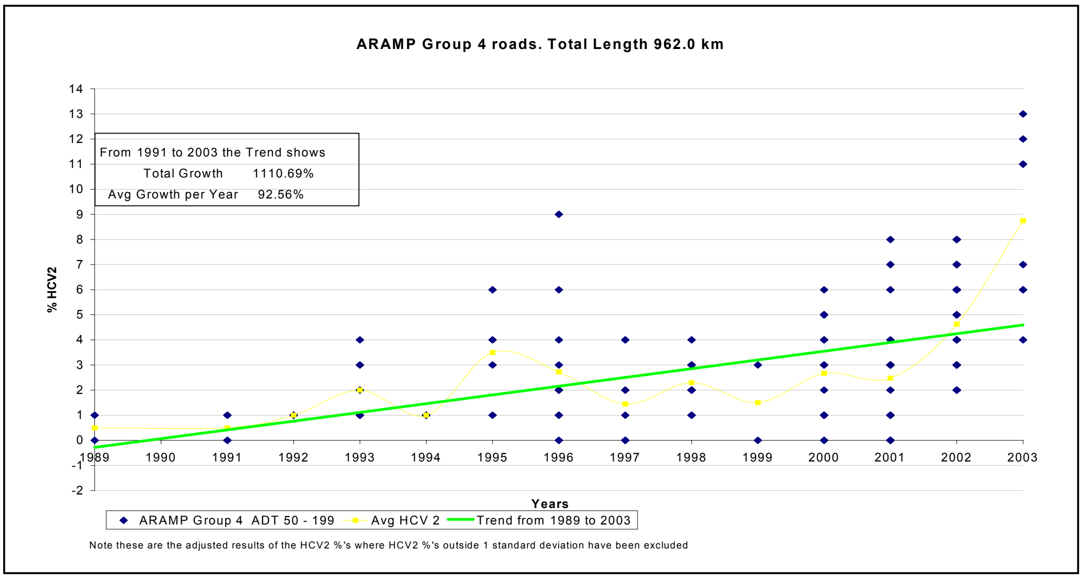
Table 2 Growth Results

The HCV data was also analysed by the same method as the ADT's and also including all data as the one standard deviation method was excluding counts of 0% in some years. These two methods of analysis demonstrate the dangers of statistics as in group 4 the results by the standard deviation method (see Graph 5) showed phenomenal growth where as the other method including all data (see Graph 6) showed more realistic growth figures.

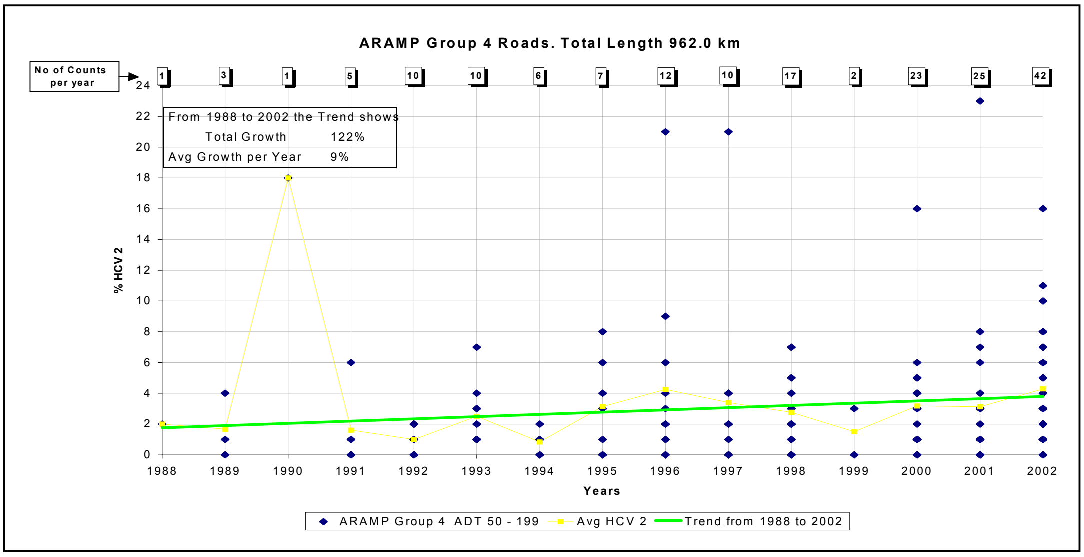
However during this process some strange data was discovered. Further analysis isolated the problem to the setting out of the counter tube lengths of some counters at the time they were in action. Basically the difference in tube length affects the speed and length of the vehicle which leads to classification problems. This seems to mainly affect the cars LCV's and MCV's.

These problems have led to a full review of all the HCV data that can be reviewed. Currently the tube length issue and methods to correct it are being discussed with the supplier.

The confidence in the HCV 2 results is not as high as the ADT results which is mainly due to the relatively small number of counts.
(see Graph 5 below as a sample)



Graph 5 HCV 2 Growth on Group 4 Roads (one standard deviation method)



Graph 6 HCV 2 Growth on Group 4 Roads (all Data included method)

Table 3 below summarises the indicated HCV 2 growth results

HCV 2 Results			
ARAMP Group Sealed Roads	Date Range	Total Growth across Date Range	Average Growth Rate per Year
1	1988 to 2002	96%	7%
2	1989 to 2003	170%	12%
3	1989 to 2003	78%	6%
4	1989 to 2003	122%	9%
5	Insufficient data		
Unsealed Roads			
7	Insufficient data		
8	Insufficient data		
9	Insufficient data		

Table 3 HCV 2 Growth Results

Further Work

The plan is to achieve all the Goals as define above:

- Goal A: Building sufficient data…
  ARAMP Groups 5, 7 and 9 show up as areas that are in need of additional counting to ensure that this goal is achieved. Group 9 will be a challenge as it consists of 793 roads totalling 1088.5 km.
  All the other ARAMP Groups still need to be reviewed to ensure that future counting is the most appropriate.
- Goal B: Having accurate heavy vehicle loadings for, all bridges….
  Review of these bridges and the nearest count locations has still to be done to ensure future counting will be appropriate.
- Goal C: Having accurate ESA for all Group 1, 2 and 3 roads….
  Investigation into the feasibility of Weigh in Motion strips (WIM)
- Goal D: Having sufficient information available to be able to predict an AADT…
  Further work is required to confirm that the roads analysed to date are the most appropriate for their classification (Dairy, Forestry etc). Future counts will either confirm or adjust the correction factors for the groups. Additional work is required on the lower ARAMP Groups as work to date has mainly focused on the upper groups.
- Goal E: Having good speed data….
  To achieve good speed data requires the use of late model counters. This will require a review of the current hardware as these latest counters have the ability to record ADT, HCV percentages and possibly ESA data when used with a WIM.
- Goal F: Having sufficient information available to be able to enhance safety ….
  This will be achieved when all the above goals have been achieved.

The ability of GIS to display all the current data in one big "picture" is seen as essential in the review process and for the future planning. The intention is to add to the GIS display actual count locations and any other major traffic generators to aid in this graphical review and future planning process.