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Andrew G. Macbeth, BE, MEng, Reg Eng, MIPENZ

Group Leader, Transportation
MWH New Zealand Ltd (formerly Montgomery Watson)
7 Deans Avenue, PO Box 13-249, Christchurch
(03) 343-8756
andrew.g.macbeth@mwhglobal.com

Road Classification Systems – Christchurch and Toronto

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Abstract

Functional road classification systems are potentially very useful in all aspects of traffic planning, traffic operations and road asset management. Considerable effort should be invested to keep them current, relevant and consistently applied within and across jurisdictions. With increasing emphasis being placed nationally on cost-effective and equitable management of transport infrastructure, road classification systems should be better designed and implemented than is currently the case.

This paper compares the functional road classification systems of Christchurch and Toronto. Both systems have local, collector, minor arterial and major arterial roads, but Toronto has expressways as well. The classification systems have a number of common criteria used to classify roads. In addition, each city has some requirements not used by the other.

The paper then looks in detail at how Christchurch's system is designed and implemented. With Christchurch's wide and overlapping traffic volume ranges for its road classes, almost all roads in a class should be expected to fit within the appropriate range. This, however, is demonstrated to be not the case for a significant proportion of roads. It is argued that many of Christchurch's roads are incorrectly classified, based on the traffic volume ranges established for each class under the city's official plan. In addition, the thresholds which distinguish one class from another are considered to be too low, based on Toronto's experience. This results in many roads being classified too high up the hierarchy, generating unrealistic (and unnecessarily expensive) expectations about roading geometric standards.

Christchurch's road classification system is probably not very different in quality from others around New Zealand. This paper makes a case for reviewing the country's road classification systems and then reviewing the classification of individual streets, jurisdiction by jurisdiction, based on commonly-agreed criteria.

1 Introduction

This paper compares the functional road classification systems of Christchurch and Toronto. It then looks in detail at how the two systems are designed and implemented, by analysing traffic volumes and total traffic on different road classes. The accuracy and consistency of Christchurch's road classifications is discussed, based on the city's own classification system. The paper finishes with commentary and conclusions.

Christchurch and Toronto are two great cities. They remain competitive within their respective countries and spheres of influence because, amongst other things, they have well-developed transportation systems compared with their competitors. The transportation systems in both cities owe their success to forward planning and investment in infrastructure over the last 50 years.

In Christchurch, public transport plays a minor role and the roading system has generally been adequate to accommodate all traffic demands placed on it. In Toronto, "rush hour" lasts two or three hours, twice a day; it lasts 15 to 30 minutes in Christchurch!

In Toronto, the first elements of an underground heavy rail passenger transport system came into service in 1953 to complement surface public transport systems of buses and streetcars (trams). The system has steadily expanded in coverage and integrates well with surface transit, so that Toronto's is often regarded as North America's best public transport system.

Roading investment has also been extensive, although ambitious plans to build new urban motorways were shelved in the 1970s because of community and political concerns and economic constraints. Toronto has continued to sprawl, so that now the City of Toronto with its 2.4 million people is surrounded by a similar population living in low-density (and very car-dependant) suburbs. These generate much of the through traffic in Toronto and probably result in a more intense road network than would otherwise have been the case.

The City of Toronto spans approximately 50 km from west to east, and roughly 25 km in the north-south direction, for a total area of about 1,250 km^2. Christchurch, by comparison, has a built-up area roughly 15 km in diameter, or approximately 180 km^2, although the whole city covers approximately 400 km^2. Christchurch has a population of about 320,000 people and a population density overall of about 800 persons per km^2, with the urban area having a density of about 1,700 persons per km^2 compared to Toronto's 1,900 persons per km^2.

Christchurch and Toronto have approximately 1,600 and 5,400 km of road within their respective jurisdictions. Christchurch residents have about 5 linear metres of road per person; Toronto residents have 2.3 m per person. Christchurch thus has about twice as much road length per person, reflecting the large rural component of Christchurch relative to Toronto.

Both cities have functional road classification systems that have been in place for decades, influencing (and influenced by) traffic and land use planning. Well-designed and implemented road classification systems can rationalise traffic planning, traffic engineering and road maintenance operations with consequential improvements in public service and transportation resource allocation.

In Christchurch, the road classification system is enshrined in the City Plan (1999). The system has evolved from the regional transport planning schemes of the former Christchurch Regional Planning Authority and its descendants prior to local body amalgamation in 1989. All roads are classified into four classes – local, collector, minor arterial and major arterial roads. These classes are subdivided into urban and rural, and the urban local roads are also further subdivided according to traffic volume and adjacent land use.

In Toronto, the road classification system was updated and harmonised following local body amalgamation in 1998. It was formalised by City Council in May 2000. The system uses the same four classes, but there is one other road class in the Toronto hierarchy. Expressways, which feature grade-separated interchanges and 90 km/h or 100 km/h speed limits, are the backbone of the roading system. But because of the size of Toronto and its urban hinterland, these carry much more traffic than Christchurch's busiest roads.

Highway 401, for example, the main expressway running east-west across the middle of Toronto, carries over 300,000 vehicles per day. It comprises up to fourteen lanes of traffic. This one road accounts for a quarter of Toronto's daily vehicle kilometres travelled (VKT), and three times as much as all of Christchurch's daily traffic! Maps of Toronto and Christchurch are contained in Appendix 1.

2 Comparisons of the two systems

With major arterials, minor arterials, collectors and locals, the two cities' classification systems are very similar in nomenclature, although the classes mean different things in the two cities. In addition, Toronto has expressways.

Most of the roads in both cities are owned and operated by the two municipalities, although a small proportion in each case is owned by others, principally a higher level of government. In Christchurch, Transit New Zealand owns and operates the State Highways within the city, although Christchurch City Council has responsibilities for some aspects, such as the traffic signals. In Toronto, Highway 401 and most of the other expressways are owned and operated by the Province of Ontario's Ministry of Transportation.

The classification systems of the streets of the two cities have resulted in a similar distribution of roads amongst the classes. Both systems have 77% of their length as local and collector streets. The distribution of road length by class for both cities is illustrated in Table 1 below. In the case of dual carriageway roads (usually major arterials), the average length of both carriageways is used, so as to avoid double counting their length.

Road Class	**Christchurch**		**Toronto**	
	Length (km)	**Percent**	**Length (km)**	**Percent**
Local	1,020	63%	3,500	64%
Collector	220	14%	700	13%
Minor arterial	260	16%	400	8%
Major arterial	120	7%	700	13%
Expressway			120	2%
Total	**1,620**		**5,420**	
Note: Dual carriageway roads (major arterials and expressways) are measured in one direction only.				

Table 1: Road length by class

Both the Christchurch City Council and the Toronto City Council have established various criteria for classifying roads. These criteria help them determine the appropriate class for a particular road (or section of road). In turn, the criteria help determine how to operate roads in terms of traffic management, land use controls, maintenance cycles, design standards and other issues under the city's jurisdiction. The criteria are listed in Table 2 below, sorted into three groups depending on whether both cities use the particular criterion or whether just one or the other uses it. Summaries of the criteria for the two cities, as published by them, are contained in Appendix 2 to this paper.

Criteria common to both cities	**Criteria in Christchurch only**	**Criteria in Toronto only**
Typical daily traffic volume ranges	Medians	Desirable connections (to other road classes)
Footpaths	Amenity strips	Legal speed limit ranges
Cycle facilities	Parking	Flow characteristics
Road (ROW) width ranges	Carriageway width ranges	Heavy truck restrictions
Minimum number of lanes		Public transport (routes and passenger volume ranges)
Property access controls		Spacing ranges between traffic control devices

Table 2: Road classification criteria

Of the criteria common to both cities, the daily traffic volume ranges appear to show the greatest diversity. In Christchurch, for example, a minor arterial road should carry between 3,000 and 15,000 motor vehicles per day, according to the proposed City Plan (1999). In Toronto, the range is 8,000 to 20,000. (The actual traffic volumes on roads for each class are discussed later in this paper.) The traffic volume ranges established in each city for each road class are as shown in Table 3.

Road Class	**Christchurch**		**Toronto**
	Urban	Rural	
Local	0 – 1,500 *	0 – 550	0 – 2,500
Collector	1,000 – 6,000	100 – 2,500	2,500 – 8,000
Minor arterial	3,000 – 15,000	2,000 – 12,000	8,000 – 20,000
Major arterial	> 12,000	> 10,000	> 20,000
Expressway	–	–	N/A

* Christchurch's urban local roads are subdivided into three groups – those with fewer than 250 vehicles per day (vpd), those with over 250 vpd and "business" local roads. These distinctions are generally ignored in this paper.

Table 3: Average daily traffic volume range by class (planned)

The ranges in Toronto are discrete (non-overlapping), whereas in Christchurch they overlap. For example, an urban road in Christchurch with between 12,000 and 15,000 vehicles per day could be either a minor arterial or a major arterial. The upper limit for minor arterials (15,000 vpd) is five times the lower limit (3,000). In Toronto, the corresponding ratio is 2.5 for minor arterials. For collectors, the ratio is six in Christchurch and 3.2 in Toronto.

Provisions for pedestrians and cyclists are similar. Both cities require footpaths on both sides of collectors and arterial roads. (In the case of Christchurch, the rural roads are not required to have footpaths.) On local roads, footpaths are required on at least one side in Toronto, and on both sides in Christchurch if the traffic volume is over 250 vpd.

Cycle facilities are required in Christchurch on both minor and major arterial roads, but not on lower order roads. In Toronto, wide curb lanes or special cycle facilities are required on arterial roads, while special facilities "may" be provided on local and collector roads.

Road allowance widths are treated differently in the two cities. While Christchurch has specific minima and maxima, Toronto is less prescriptive and has "typical" ranges. Major arterials (urban) range from 30 to 40 m in Christchurch and 20 to 45 m in Toronto. This broad range reflects the difference between newer facilities in developing areas of the city where ample space exists, and where wider roads are necessary and feasible. On the other hand, some of the older "downtown" streets operate as major arterials in a dense urban environment and widening is not practical because of the impacts on adjacent property.

While Christchurch specifies carriageway widths and minimum number of lanes within its City Plan, Toronto specifies only the minimum number of "peak period lanes (excluding bicycle lanes)". In both cities, however, the number of lanes required is the same. A minimum of four lanes is required on major arterials in both cities, although in Christchurch they need to be dual carriageway roads. Lower order streets need a minimum of two lanes in both cities. This is clarified in Toronto in the case of local and collector roads, where one-way streets need have only one travel lane. This provides for the numerous narrow one-way residential streets in the older parts of Toronto, where two lanes are not practicable – or necessary.

For major arterial roads, Toronto's use of the term "peak period lanes" recognises that more efficient use of a four-lane or six-lane road can be made if all lanes are available during peak periods, even if parking absorbs the kerb lanes during off-peak periods. Intense kerb-side parking demand is common on many of these streets, especially in commercial centres. By prohibiting parking during peak periods, traffic capacity is retained when it is most needed, without requiring expensive and disruptive road widening.

In contrast, Christchurch requires parking on all road types. This is considered a luxury in Toronto, where parking is acknowledged as being of less importance than other functions of arterial roads. These roads are identified as having primarily a traffic movement function, and parking is provided, where space permits, when other uses (including pedestrian and cycling facilities) have been accommodated. In practice, of course, it is often difficult to remove parking to provide space for cycle lanes.

When Toronto's roads were being classified in 1999 and 2000, the presence of a bus route on a street was generally used to indicate that the road was a collector or above. Local roads typically should not be public transport routes. Higher public passenger volumes were associated with higher order roads, and patronage levels were built into the classification system as one of the criteria.

One other significant difference exists between the road classification systems. Toronto has determined the speed limits which are appropriate for each road class, where Christchurch has not. In Christchurch, no distinction is made within the road classification system between classes as to appropriate speed limits. By inference, 50 km/h is the routine speed limit on all urban streets (although a number of streets have speed limits set at 40 km/h or 60 km/h, and other higher speed limits exist in the rural fringe). In Toronto, speed limit ranges are defined for each road class. These are illustrated in Table 6 below:

Road Class	Christchurch	Toronto
Local	Not specified	40 – 50 km/h
Collector	"	40 – 50 km/h
Minor arterial	"	40 – 60 km/h
Major arterial	"	50 – 60 km/h

Table 4: Speed limit ranges by class

In Toronto, speed limits are sometimes set outside these ranges. In particular, speed limits are routinely set at 30 km/h on streets with significant traffic calming installations. At the other end of the spectrum, 80 km/h speed limits sometimes exist on controlled access or urban/rural fringe major arterial roads, and 90 or 100 km/h is the norm on expressways.

3 Total travel and average daily traffic volumes

Daily vehicle-kilometres travelled (VKT) have been calculated from RAMM data for Christchurch and from the road classification Geographic Information System (GIS) for Toronto by multiplying the link length for each link in the road network by its estimated average daily traffic volume (ADT). These have been aggregated by road class, and are illustrated in Table 5 below:

Class	Christchurch		Toronto		
	Million VKT	Percent	Million VKT	Percent	Percent (excl. expressways)
Local roads	0.8	13%	3	5%	9%
Collector roads	1.0	16%	3	5%	9%
Minor arterial roads	2.2	37%	6	9%	18%
Major arterial roads	2.0	34%	21	35%	64%
Expressways			28	46%	–
Total	**5.9**		**61**		

Table 5: Million vehicle kilometres travelled per day (VKT) by class

The final column in the table shows the distribution of traffic across Toronto's network if the expressways are ignored, giving a basis for comparison with Christchurch. It can be seen that Toronto has succeeded, relative to Christchurch, in putting most of its traffic on its higher order roads.

Average daily traffic volumes for each road class have then been simply deduced by dividing the number of vehicle kilometres travelled by the length of road for each class, as illustrated in Table 6 overleaf.

Road Class	Christchurch (vpd)			Toronto (vpd)
	Urban	Rural	Total	
Local	780	410	750	900
Collector	4,900	1,700	4,300	4,500
Minor arterial	9,900	4,500	8,500	14,000
Major arterial	18,300	13,300	17,000	29,000
Expressway				230,000

Table 6: Average daily motor vehicle traffic volumes (actual) by class

In both cities, local roads and collectors carry similar traffic volumes. At around 800 vehicles per day for local roads and 4,500 for collectors, this is very encouraging from a planning perspective. Transport planners aim to have local roads carrying only low traffic volumes. The picture diverges between the cities when the minor and major arterials are compared, however. In Christchurch, minor arterials carry on average 8,500 vehicles per day, while in Toronto, they carry 14,000. A similar pattern exists for major arterials.

Thus arterial roads in Toronto are carrying approximately 60% per more traffic on average than their counterparts in Christchurch. In the case of major arterials, this could be explained by the fact that almost all of the Toronto major arterials operate with kerbside parking prohibited during five hours each weekday (two in the morning peak and three in the afternoon). This means that many roads ranging from 14 m to 16 m in width operate as four lane roads during peak periods and can accommodate significantly more traffic than their Christchurch counterparts, for which rush hour parking or stopping restrictions are rare. Major arterial roads are expected to carry heavy traffic volumes and parking is prohibited during peak periods when road space is most at a premium, to help accomplish this.

Another explanation could be that roads in Christchurch are generally classified too high. This would result in too many major arterial roads, with this class including some roads which really should only be classified as minor arterial. Major arterial roads are supposed to be four lane roads (or more). Minor arterial roads have a minimum of two lanes (according to the classification systems of both cities). But two lane roads can (and in Toronto, routinely do) accommodate up to 20,000 vehicles per day, so setting the upper limit on minor arterials at 15,000 vehicles per day (or 12,000 for rural minor arterials) is very conservative. Setting the lower limit of these roads at 3,000 (2,000 rural) is even more conservative. It could be argued that Christchurch is "lowering the bar" so that it can classify some collectors as minor arterials and "protect" the capacity of the system against future growth. This practice would also result in more major arterials being identified than was warranted. Defenders are likely to argue that this practice is simply good planning, allowing future road widening to be protected. But it also becomes a self-fulfilling prophecy. Traffic expands to fill road capacity. This philosophical debate is ultimately a political debate, and will not be resolved in this paper.

Major arterials (both urban and rural) should be dual carriageway and at least four lanes wide, according to the rules in Christchurch. Table 7 shows the amount of physical road widening required on major arterial roads in Christchurch, based on the RAMM data for the number of lanes for each road section, and whether or not each section is currently dual carriageway.

Designations for this widening may or may not exist; this analysis is merely quantifying the amount of physical road building required to provide four lane, divided carriageway facilities.

Road Type	**Total**	**Physical road widening required**	
(Major Arterials)	Length (km)	Length (km)	Percent
Urban	90	50	55%
Rural	29	27	93%
Total	**119**	**77**	**65%**

Table 7: Road widening requirements for Christchurch's major arterial roads

Two thirds of all Christchurch's major arterial roads require widening, either to accommodate four traffic lanes or medians or both. This ignores any other road widening needed to increase beyond four lanes, or to widen other classes of roads. The cost of this will be considerable, in both economic and social terms.

4 Accuracy of Christchurch road classifications

It is useful to consider the success with which Christchurch's road classification system has met its own standards for traffic volumes. Christchurch's roads have been analysed to determine how well they have been classified in terms of their traffic volumes.

It is important to note, however, that traffic volumes are not the only consideration when classifying roads. Besides traffic volumes, other criteria within the classification system contribute to selecting a classification for a particular street. In addition, certain roads are given particular classifications for long-term strategic reasons, with the expectation that traffic volumes will change over time. Other roads may have short sections which do not meet the volume criteria but for the sake of consistency, are classified the same as adjoining road sections.

For the purposes of this paper, roads are described as "correctly" classified if they have a daily traffic volume within the range for that class. This assumes that the RAMM data are correct (inevitably there will be some errors in this database) and that other mitigating factors are not present which would justify classifying the road in the "wrong" class. Each road would need to be looked at on its merits to determine the best classification. Similarly, some roads might have current classifications supported by the existing traffic volume, although for valid planning reasons they might be better classified differently.

At a more strategic level, the traffic volume ranges themselves should be reviewed in the light of current traffic engineering and transport planning expertise. Road classification systems tend not to be reviewed and updated as frequently or as thoroughly as perhaps they should.

Notwithstanding the above, given the very wide (and overlapping) ranges for traffic volume in the Christchurch system, it should be expected that the vast majority of streets would fall within the expected ranges for each class. This is not the case, as can be seen in Table 8. Also shown is the proportion of travel (measured as vehicle-kilometres travelled, VKT) on each road class, of roads which are "correctly" classified.

Road Class	For average daily traffic volume (ADT) matching ADT criteria		
	Length (km)	Percent of total length for class	Percent of total VKT for class
Local	910	89%	60%
Collector	160	71%	50%
Minor arterial	160	63%	59%
Major arterial	80	67%	84%
Total	**1,310**	**81%**	**66%**

Table 8: Characteristics of "correctly" classified roads – Christchurch

The Christchurch system, as summarised in "Appendix 2 – Roading Hierarchy Standards" of City Plan (and reproduced in Appendix 2 of this paper), does not specify an upper limit for urban local roads, although a figure of 1,500 vehicles per day is suggested elsewhere in the Plan. For this analysis, it has been assumed that urban local roads are correctly classified if they have volumes of 1,500 vehicles per day or less. (Toronto uses a figure of 2,500 vehicles per day for local roads.)

Table 8 illustrates, for example, that the majority of collector roads (71% of them by length) are classified in the appropriate class, based on their traffic volume. (Traffic volume ranges were shown in Table 3 above.) These streets, however, carry only 50% of the traffic (calculated as VKT) which occurs on collector roads. Similarly, only 63% of the length of minor arterials are classified correctly based on their traffic volume, and these roads account for only 59% of the traffic on minor arterials.

In Toronto, by contrast, almost all roads meet the traffic volume range requirements (and these are non-overlapping ranges). During that city's classification exercise, roads which fell outside the range after the first attempts at classification were re-analysed to see whether other criteria or reasons might exist to put them in the "wrong" class. In almost all cases, traffic volume was the best determinant of road class.

Average traffic volumes are calculated for correctly classified roads and contrasted with the average traffic volumes of the streets in each class which are incorrectly classified. These are shown in Table 9 (urban roads) and Table 10 (rural roads).

URBAN	For roads with ADTs matching ADT criteria ("correctly" classified)		For roads with ADTs NOT matching ADT criteria ("incorrectly" classified)			
			Below range		Above range	
Road Class	km	Average ADT	km	Average ADT	km	Average ADT
Local	830	530		–	87	3,200
Collector	124	3,500	9	590	49	9,300
Minor arterial	123	9,100	29	720	38	19,400
Major arterial	66	22,000	25	8,500	–	–
Total	**1143**		**63**		**174**	

Table 9: Accuracy of classification in Christchurch – Urban roads

The local roads look relatively well classified. Fewer than 10% have volumes higher than the range. Of these incorrectly classified local roads, however, the average ADT of 3,200 seems well beyond the normal expectation for local roads.

Urban collectors look less robust. Over a quarter of this class (by length) has traffic volumes higher than the range (upper limit 6,000 vehicles per day). Of these, their average daily traffic volume is 9,300 vehicles per day, indicating that they are well within the minor arterial range (which starts at 3,000 vpd). Conversely, a better interpretation might be that the upper limit of the collector traffic volume range is too low. If the Toronto limit of 8,000 vpd for collectors were used, the length of road with traffic volumes higher than the range would drop from 49 km to 25 km. The small number of roads with traffic volumes below the range (9 km or 5% of the class) is perhaps more a reflection of the low threshold (1000 vpd) than the accuracy of the classification.

Minor arterials are more troubling still. With a huge range (3000 to 15,000 vpd) one would expect most roads in this class to have "correct" volumes. Some 15% have volumes lower than this, while 20% have higher volumes. Of the 29 km of roads below the range, they have a paltry average traffic volume of 720 – hardly minor arterials, on first appearances. Above the range, 38 km of roads have an average of 19,400 vehicles per day. Based on Toronto's experience, raising the limit for these roads to 20,000 would mean they would better fit the classification.

More than a quarter of the major arterials have traffic volumes below the 12,000 limit for this class, and they average 8,500 vpd. In Toronto's terms, they barely make it as collectors, let alone minor or major arterials. Amongst Christchurch's urban roads classified as collector and above, 32% have traffic volumes outside the ranges for their classes.

The rural roads fare less well than their urban cousins, with only 70% "correctly" classified, compared with 83% in the city. Most striking are the major arterials, where more than half of the road length has traffic volumes below the threshold of 10,000 vpd. Table 10 shows the analysis for rural roads.

RURAL	**For roads with traffic matching ADT criteria ("correctly" classified)**		**For roads with traffic NOT matching ADT criteria ("incorrectly" classified)**			
			Below range		Above range	
Road Class	km	Average ADT	km	Average ADT	km	Average ADT
Local	80	190	–	–	21	1,300
Collector	34	1,300	0	0	8	3,500
Minor arterial	39	4,300	20	550	8	15,200
Major arterial	14	19,400	15	7,600	–	–
Total	**167**		**35**		**37**	

Table 10: Accuracy of classification in Christchurch – Rural roads

5 Commentary

Functional road classification systems are potentially very useful in all aspects of traffic planning, traffic operations and road asset management, and considerable effort should be invested to keep them current, relevant and accurate. Based on this analysis, Christchurch's road classification system is due for an overhaul. Its "functional" road classification system could be said to be "dysfunctional". I can say this with some sense of personal responsibility, having been involved in regional transport planning with the Canterbury United Council and Canterbury Regional Council in the 1980s when the transport section of the regional planning scheme was developed. Much of the current classification system originates from this work. There is no need, however, to "point fingers" as to why the system is in need of revision; road classification systems should be reviewed frequently to ensure they continue to meet current needs, yet road controlling authorities are usually too busy keeping up with much more pressing day-to-day issues.

Christchurch is probably also being unfairly singled out. I have some knowledge of the street network and the road classification system here, having worked in this environment for many years. I have no doubt that it is just as well developed and managed a system as others around the country.

I think functional road classification systems will take on increasing importance in asset management, traffic and safety engineering and transportation planning, and we should collectively be considering the state of classification up and down the country. One of the issues is the relationship between urban and rural road classification systems. Another is relativity between cities and regions. If we are trying to rationalise the use of scarce resources (for example, road maintenance and construction funding), a consistent set of rules around road classification systems will help ensure that resources are allocated where they are most needed. Funding levels are likely to be tied increasingly to road classifications, and common benchmarks as to the definitions of each class will be necessary to ensure equity both within regions and between them.

The development of new systems would be enhanced by researching current functional road classification systems. In this way, recent local and international experience could be evaluated for application locally. The road classification system in any jurisdiction is typically not reviewed very often, so expertise tends to get lost from one "generation" to the next.

In addition to the need to revise Christchurch's system, I believe the individual streets should be analysed to see whether they are appropriately classified in terms of the new system. This job is a lot easier than it used to be, with the ready availability of geographic information systems, powerful desktop computers, and RAMM databases.

The application of any road classification system to the roads in its particular jurisdiction also requires a good dose of local knowledge. Individual road classifications can not be decided as an armchair exercise without the experience of local traffic engineering staff and fieldwork. Road classification decisions also need to be considered in a spatial context, to ensure continuity from one road to another and to provide a logical progression up and down the road hierarchy.

There seem to be several general problems with Christchurch's current classification system. Firstly, it seems to be set up primarily as a mechanism to protect road corridors for future expansion. As Christchurch develops, the focus should change from road building to road and traffic management. The road classification system should be an essential tool to help manage a variety of diverse matters.

In the policy arena, the determination of which streets are appropriate for what kinds of traffic calming installations is one such issue. Another is determining appropriate speed limits, at a time when LTSA/MOT are overhauling the rule on the setting of speed limits. This work is likely to liberalise the application of speed limits, allowing other than the customary 50 and 80 km/h limits. A well-defined road classification system will help implement differing speed limits. Road classification systems are already used to support road maintenance cycles, but given the inconsistencies in Christchurch's system (and presumably most others around New Zealand), one has to wonder about the effectiveness of this practice, even within jurisdictions, let alone between jurisdictions.

There are numerous potential applications for a good road classification system. In Toronto, for example, the road classification system was used to determine the locations for the installation of oversize street-name signs. All intersections between arterial roads (both minor and major) were selected. Toronto's snow ploughing and winter salting priorities are currently being redefined in terms of the road classification system. It has also been used as a base for establishing the city's cycling network.

Another concern I have with Christchurch's system is the overlapping volume ranges. In developing a system, it is much easier to use overlapping ranges, because it does not force the practitioner (or the politicians who will ultimately determine the classifications) to focus on the "borderline" cases. These roads come into sharp relief when discrete ranges are used. The Toronto ranges worked very well in Toronto, but different ranges may be preferable in Christchurch (or generally in New Zealand). The figure of 2,500 vehicles per day seemed to work well to distinguish locals from collectors. Somewhere around 2,000 vpd seemed to be a threshold for environmental sensitivity to traffic in neighbourhoods and 2,500 vpd had strong support from traffic engineers across the city as the desirable upper limit for local roads.

Daily traffic volumes of 20,000 vpd were found in Toronto to be about the upper limit for two lane roads (with extra capacity at main intersections). This therefore seemed the appropriate limit between minor arterials and major arterials. In Toronto's case, with very significant public passenger flows on some bus and streetcar routes, a number of streets with fewer than 20,000 motor vehicles per day but more than 5,000 public passengers per day were classified as major arterial. This recognised that these streets were important for moving people (not cars). When future decisions are made about managing traffic on these streets, they will be considered amongst the most important in the network (along with other major arterials) for their traffic function, where "traffic" has the wider meaning of "moving people".

The limit between collector and minor arterial roads was set at 8,000 vehicles per day in Toronto. This figure was found in practice to be at the upper limit of installations for many of the more aggressive forms of traffic calming installations, including speed humps, raised

intersections and traffic circles. It seemed to result in a logical break point between these two road classes. A figure in the range of 7,000 to 8,000 vehicles per day would seem appropriate for New Zealand, depending on what limits were chosen for the other two thresholds (local/collector and minor arterial/major arterial).

6 Conclusions

This paper has looked at the road classification systems of Christchurch and Toronto. The systems have been found to have many similarities but some important differences. It has been argued that classification systems are improved if they have non-overlapping traffic volume ranges, and that most roads will fit easily into judiciously chosen classes based principally on non-overlapping traffic volume ranges. Other criteria will result in road classifications falling outside the classes suggested by the traffic volumes, but these cases will be relatively few and far between. It is acknowledged that planning principles are also important in determining road classes, but planning for too much traffic growth can be a self-fulfilling prophecy. Providing excess capacity has just as many dire economic and social impacts as providing too little capacity.

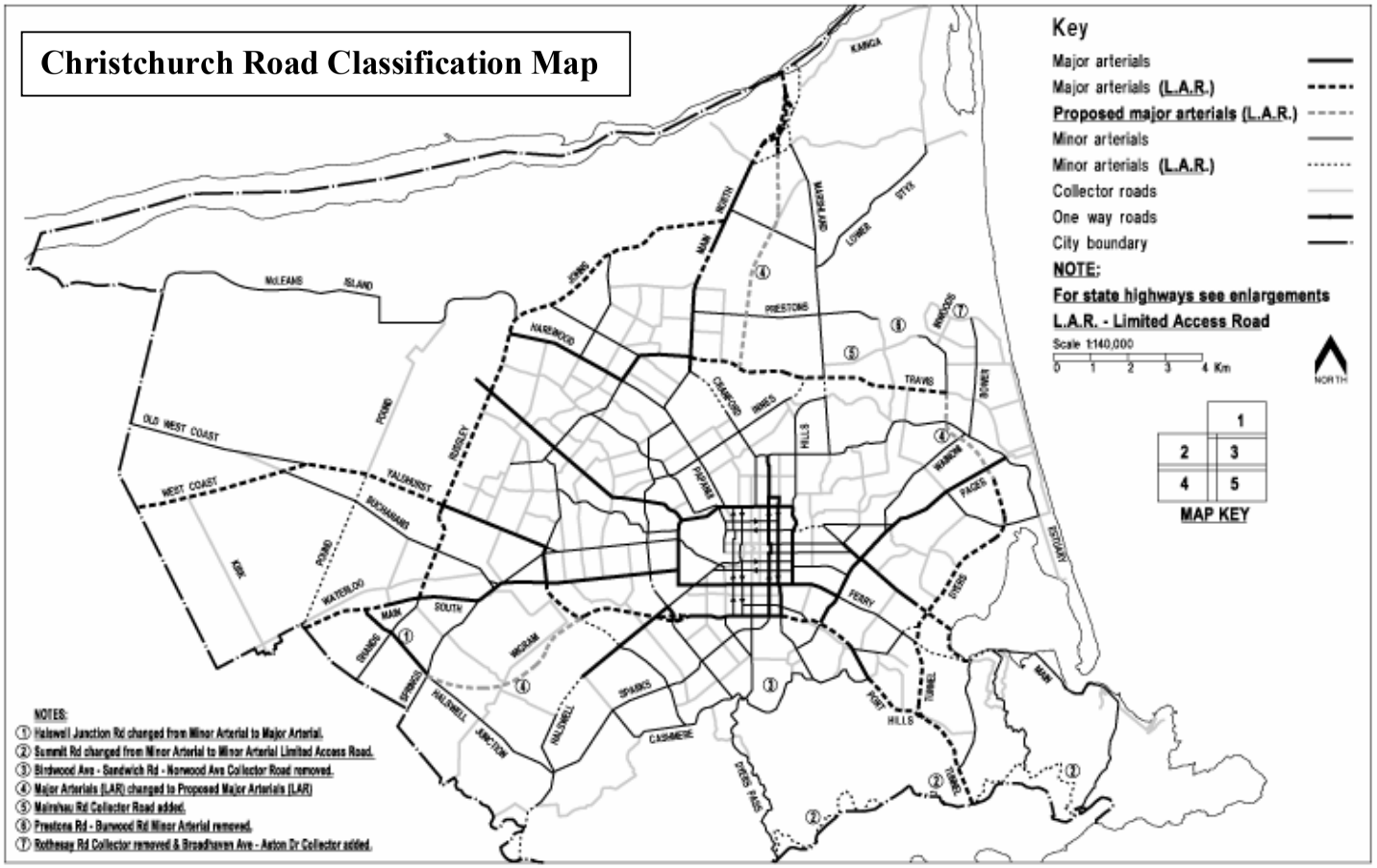
Many of Christchurch's roads do not fit within the already-wide ranges. Some 30% of rural roads have traffic volumes above or below the established ranges for their classes, and 17% of urban roads fall outside their ranges. Amongst urban roads classified as collector and above, 32% have traffic volumes outside the ranges for their classes. Some 65% of major arterial roads need physical road widening to meet the minimum requirements of their class (four lanes, with median).

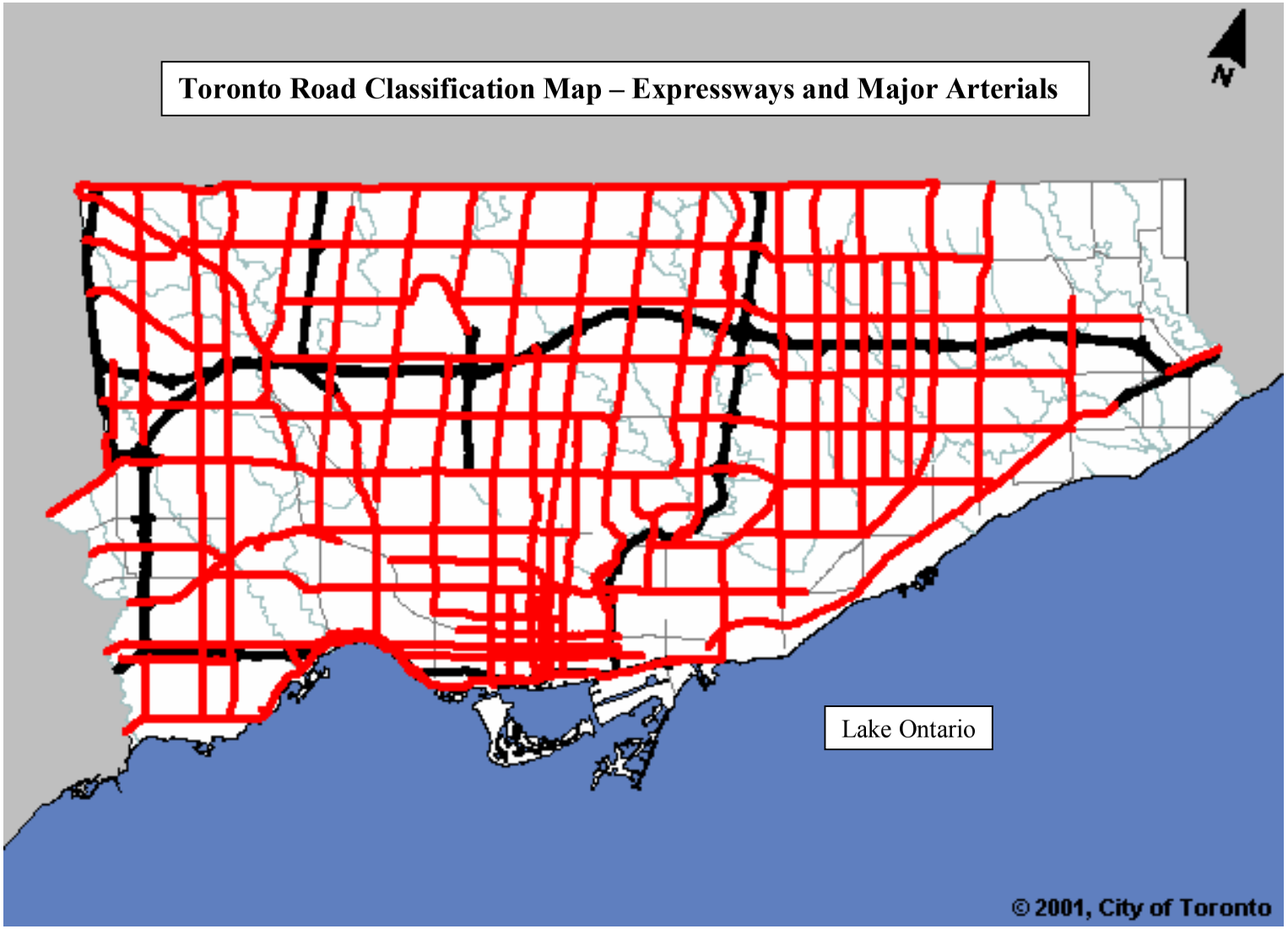
Christchurch's road classification system is probably indicative of the state of road classification in New Zealand. We have an obligation to do better if we are to fulfil our mandates of providing safe and efficient transportation networks for the people of New Zealand. Are we up to the challenge?

Data for this paper come from Christchurch City Council's (CCC) Road Assessment and Maintenance Management (RAMM) system. The provision by CCC staff of RAMM data, and assistance in interpreting it and the City Plan, is gratefully acknowledged. Data for Toronto comes from a paper entitled *"Development of a New Road Classification System"* [1]. The assistance of Malcolm Douglass (Douglass Consulting Services Ltd), David Turner (MWH NZ Ltd) and two IPENZ reviewers in preparing this paper was also greatly appreciated. The conclusions reached, however, are the author's alone and do not necessarily reflect the views of these individuals or MWH New Zealand Ltd.

[1] *Development of a New Road Classification System:* Macbeth, Andrew G, Institution of Transportation Engineers, Proceedings of Annual Meeting, Nashville, Tennessee – August 2000.

Appendix 1 - Maps




Toronto Road Classification Map – Expressways and Major Arterials
N
Lake Ontario
© 2001, City of Toronto

Appendix 2: Road Classification Criteria

Christchurch City Council – City Plan
(a "proposed district plan" as at August 2001)

Appendix 2 – Roading hierarchy standards

Road classification (refer to Appendix 3)	Typical total daily traffic flows (VPD)	Road widths **(m)** Minimum	Road widths **(m)** Maximum	Roadway widths **(m)** Minimum	Roadway widths **(m)** Maximum	Minimum lanes	**Number of** Footpath**s**	Median	Amenity strip	Parking	Cycle facilities	Access controls
Major arterial – Urban	>12,000	30	40	24	34	4	2	Yes	Yes	Yes	Yes	Yes
Major arterial – Rural	>10,000	40	50	30	34	4	No	Yes	Yes	Yes	Yes	Yes
Minor arterial – Urban	3,000 to 15,000	20	30	14	22	2	2	*	Yes	Yes	Yes	Yes
Minor arterial – Rural	2,000 to 12,000	20	30	12	22	2	No	*	No	Yes	Yes	(1)
Collector – Urban	1,000 to 6,000	18	20	12	14	2	2	No	Yes	Yes	*	*
Collector – Rural	100 to 2,500	18	20	9	14	2	No	No	No	Yes	*	No
Local – Business	–	18	20	12	14	2	1	No	Yes	Yes	*	No
Local – Urban	>250	14	20	9	14	2	2	No	Yes	Yes	*	No
Local – Urban	<250	12	18	**~~8~~ 7.5**	12	2	1	No	Yes	Yes	*	No
Local – Rural	<250	16	20	7	14	2	No	No	Yes	Yes	*	No

Clarification of standards

1. Where the road width and/or standard of construction requires road widening, the Council may initiate purchase or designation procedures as required.
2. "Yes" means that the provision of those facilities shall be incorporated into the design and construction of the road.
3. * means that the provision of those facilities is allowed for in the standards for road design and construction and/or shall be considered as conditions of consent on subdivision roading under Clause 5.2 of these rules.
4. Amenity strips shall only be required on rural roads where these adjoin a Living Zone.
5. (1) indicates that adequate spacing will be required between high traffic generators.
6. For the purposes of calculating "Typical total daily traffic flows (VPD)" on local roads, the minimum vacant allotment size for the respective zone shall determine the number of household units, which in turn will be deemed to generate 10 vehicle movements per day.
7. Local hillside roads (on any part of a zone on the slopes of the Port Hills) may only require one footpath.
8. Some localised road widening may be required at intersections to increase capacity.
9. **The minimum diameter for a cul-de-sac turning head is:**
   Residential 25 metres
   Business 30 metres

Table 1: Road Classification Criteria TORONTO ROAD CLASSIFICATION SYSTEM January 2000

Characteristic	Locals	Collectors	Minor Arterials	Major Arterials	Expressways
Traffic movement versus property access	Property access primary function	Traffic movement and property access of equal importance	Traffic movement primary consideration; some property access control	Traffic movement primary consideration; subject to property access control	Traffic movement primary consideration; no property access
Typical daily motor vehicle traffic volume (both directions)	< 2,500	2,500 – 8000	8,000 – 20,000	> 20,000	> 40,000
Minimum number of peak period lanes (excluding bicycle lanes)	One (one-way streets) or two	One (one-way streets) or two	Two	Four	Four
Desirable connections	Locals, collectors	Locals, collectors, arterials	Collectors, arterials	Collectors, arterials, expressways	Major arterials, expressways
Flow characteristics	Interrupted flow	Interrupted flow	Uninterrupted except at signals and crosswalks	Uninterrupted except at signals and crosswalks	Free-flow (grade separated)
Legal speed limit, km/h	40 – 50	40 – 50	40 – 60	50 – 60[1]	80 – 100
Accommodation of pedestrians	Sidewalks on one or both sides	Sidewalks on both sides	Sidewalks on both sides	Sidewalks on both sides	Pedestrians prohibited
Accommodation of cyclists	Special facilities as required		Wide curb lane or special facilities desirable		Cyclists prohibited
Surface transit	Generally not provided	Permitted	Preferred	Preferred	Express buses only
Surface transit daily passengers	Not applicable	< 1,500	1,500 – 5,000	> 5,000	Not applicable
Heavy truck restrictions (e.g. seasonal or night time)	Restrictions preferred	Restrictions permitted	Generally no restrictions	Generally no restrictions	No restrictions
Typical spacing between traffic control devices[2], m	0 – 150	215 – 400	215 – 400	215 – 400	Not applicable
Typical right-of-way width, m	15 – 22	20 – 27	20[3] – 30[4]	20[3] – 45[4]	> 45[4]

Notes: Private roads and lanes (public or private) are not part of this classification system.

1. A number of major arterial roads have speed limits which fall outside this range, as noted in the report under the heading "Speed Limits".
2. Traffic control devices means traffic control signals, pedestrian crossovers and 'Stop' signs.
3. 20 m rights-of-way exist on many downtown or older arterial roads. New arterial roads should have wider rights-of-way.
4. Wider rights-of-way (within the ranges given) are sometimes required to accommodate other facilities such as utilities, noise mitigation installations, bicycle facilities, and landscaping. For new streets, wider rights-of-way (upper end of ranges given) should be considered to accommodate such facilities.

This table to be used in conjunction with the report "Road Classification System – A Consolidated Report" adopted by Toronto City Council June 2000.
(See also http://www.city.toronto.on.ca/transportation/road_class.htm)