

**Traffic standards and guidelines  
2003/2004 survey**

**RSS 22  
Road markings**

**August 2004**



## Survey of traffic standards and guidelines

The Land Transport Safety Authority (LTSA) is the government agency responsible for *promoting safety in land transport at reasonable cost*. Part of its function is to ‘monitor adherence to safety standards within the land transport system’.

To support this objective, the regional engineering sections of the Land Transport Safety Authority undertake a survey programme that assesses the effectiveness of the implementation of various safety standards by road controlling authorities.

The purpose of these surveys is to:

- assist and advise road controlling authorities on the implementation of selected traffic standards and guidelines that affect traffic safety
- measure the uptake of standards and guidelines by road controlling authorities
- provide a national summary of the uptake and compliance with standards and guidelines, and report findings to road controlling authorities and other interested parties
- identify changes to improve standards, guidelines or traffic rules.

The surveys are usually carried out in two parts:

- Part 1 uses a questionnaire to look at the systems and procedures a road controlling authority has in place to deliver on the standard.
- Part 2 uses a field survey to measure, where possible, the actual delivery from the user’s viewpoint. It essentially provides a snapshot of road safety delivery at the date of the survey.

This report presents the national results of the latest of these surveys.

I believe you will find the information of value and will be able to use it to improve road safety in New Zealand.

Please contact the nearest regional office of the LTSA if you would like further information, or assistance with implementing traffic standards or guidelines.



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## List of abbreviations

MOTSAM	<i>Manual of traffic signs and markings: Part II: Markings (TNZ/LTSA, 2004)</i>
CoPTTM	<i>Code of practice for temporary traffic management</i>
M/20	<i>TNZ M/20 Long-life roadmarking materials</i>
M/7	<i>TNZ M/7 Roadmarking paints</i>
P/12	<i>TNZ P/12 Pavement marking</i>
P/20	<i>TNZ P/20 Performance-based specification for roadmarking</i>
P/22	<i>TNZ P/22 Specification for reflectorised pavement marking</i>
RSS 13	<i>Road safety survey 13: No passing lines (LTSA, 2000)</i>
RTS 5	<i>Road and traffic standards series 5: Guidelines for rural road markings and delineation (TNZ/LTSA, 1992)</i>
TNZ	Transit New Zealand
NZRMF	New Zealand Roadmarkers Federation
RCA	road controlling authority
TLA	territorial local authority

## Executive summary

### Introduction

Surveys were undertaken during 2003/04 to investigate policies and practices for traffic calming devices and road markings in a sample of road controlling authorities (RCAs).

This report describes the procedures and presents the results for the road markings surveys. A companion report (RSS 21 *Traffic calming*) details the results of the surveys on traffic calming devices.

The road marking surveys were undertaken between mid-November 2003 and mid-February 2004. This coincided with the season for remarking work.

### Methodology

#### *Interviews*

The Land Transport Safety Authority (LTSA) interviewed staff in 33 road controlling authorities about their policies and practices. The RCAs received a copy of the questionnaire in advance, to help them prepare their responses.

Alister Harlow, Executive Director of the New Zealand Roadmarkers Federation (NZRF), assisted with the interviews.

#### *Field surveys*

After the interviews, the surveyors, including Alister Harlow, joined with staff from the RCAs to inspect a representative, on-road sample of road markings. A total of 643 lines were surveyed at 221 sites (126 urban, 95 rural) in the 33 RCA regions. The surveyors measured line widths and day and night-time visibility.

The results were assessed against the performance criteria in TNZ P/20 *Performance-based specification for roadmarking*. (The results are detailed in Section 5.1 of this report.) The performance criteria were not contractual requirements, in most cases.

### Interview results

- Rural roads made up more than 70% of the total length of the sealed networks in most of the RCAs surveyed. However, 6 large urban authorities, with urban roads typically comprising more than 80% of their sealed networks, were also in the survey.
- The TNZ/LTSA *Manual of traffic signs and markings: Part II: Markings* (MOTSAM) was used by all the RCAs surveyed as their guideline on what road markings are required. 22 (67%) of the RCAs also used *Road and traffic standards series 5: Guidelines for rural road marking and delineation* (RTS 5), or a local modification of RTS 5.

- The most common catalysts for changes to road marking design or the frequency of road markings were road inspections, reviews or audits (in 14 (42%) of the RCAs) and crash reduction studies (in 11 (33%)).
- All except 2 of the RCAs used TNZ specifications for road marking materials, with paint systems being the most predominant method used.
- The use of reflectorised markings varied:
  - 16 (48%) of the RCAs used reflectorised paint for most of their markings.
  - 3 (9%) used reflectorised paint for markings on specific classes of road.
  - 7 (21%) used reflectorised markings in accordance with MOTSAM<sup>1</sup>.
  - The other 7 (21%) used minimal or no reflectorised markings.

The Traffic Regulations 1976 require reflectorised markings for kea crossings (T Reg 96A(4)(a)) and for the RAIL X markings at level crossings (106(6)(a)).

- Most of the RCAs (27, or 82%) stated that they welcome opportunities for materials trials on their networks. Thermoplastic was identified as the long-life material of choice for 4 large authorities for their urban arterials and high-wear areas. The RCAs indicated that there might be more use of thermoplastic if there was more locally available application equipment.
- All except 3 of the RCAs had some form of database for their road markings, with the most common being RAMM (used by 19 of the RCAs (58%)).
- Most of the RCAs (23, or 70%) had method-based road marking contracts, and all of the RCAs used TNZ specifications.
- Remarking programmes for the method-based contracts were based on time periods ranging from every 6 months to every 18 months. Most of the programmes (74%) were based on annual remarking, or annual plus 6-monthly remarking for high wear markings.
- 3 RCAs were using or trialling remarking periods based on visual needs assessments. One of these RCAs claimed they were getting up to 3 years' life on some markings on low volume roads.
- Nearly half the RCAs (15, or 45%) used blacking out to remove small amounts of unwanted markings. More common was the use of sand or abrasion blasting (used by 19 RCAs, or 58%), although this was sometimes restricted until there was sufficient work to warrant a contract. Similarly, 14 RCAs (42%) used water blasting.
- All RCAs rated their contractor's general performance and traffic management as *acceptable or better*.

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<sup>1</sup> MOTSAM particularly specifies reflectorised materials for some road markings and allows discretion for using reflectorised materials on other markings. The most used markings that are specified to be reflective in MOTSAM are no overtaking (no passing) lines, limit lines, and flush medians.

## Field survey results

- 73% of the 631 line widths that were checked were within the specified tolerance for line widths. 15% were wider than the upper tolerance limit and 12% were narrower than the lower tolerance limit.
- 99% of the 551 lines that were assessed for daytime visibility met the 150 m forward visibility criteria.
- A wide range of night-time visibility performance was indicated by the reflectivity measurements. Readings were taken on both reflectorised and non-reflectorised markings, to enable comparison.

Reflectivity measurements were taken on 808 markings and assessed against the TNZ P/20 intervention or performance-level criteria. This performance measure was not a contractual requirement in most cases.

The assessment showed the following percentages as being *at or above* the performance measure:

- 45% of all 808 measurements
  - 68% of the 166 measurements taken at sites in areas marked under performance-based contracts
  - 67% of the 493 measurements on lines recorded as being reflectorised, or specified to be reflectorised
  - 76% of the 30 measurements taken on limit lines and 58% of the 86 measurements taken on no passing lines. (MOTSAM specifically requires both these line types to be reflectorised)
  - 88% of the 16 measurements taken on thermoplastic lines
  - 75% of the 102 measurements taken on smooth surfaces (compared with 41% of the 705 measurements taken on chip seal surfaces).
- Very few examples of unexpected or non-standard markings were observed, either at the sites or when driving between the sites.
  - Blacked-out markings at one site were noted to have reflectivity measurements near and above the performance measure. These markings would be very misleading at night and potentially unsafe.

## Best practice

The surveyors consider that best practice includes:

- adopting clear policies on what markings to use on which roads
- maintaining a good database of road markings
- having remarking programmes based on assessed needs
- having formal customer service request systems

- developing good contractual relationships that allow trials, to increase knowledge and ensure continuous improvement of the performance of road marking
- using reflectorised markings to improve the night-time visibility of markings, especially no passing lines and centre lines
- carrying out complete reseals to remove unwanted markings, if removal by blacking out or abrasion blasting could result in unsafe delineation
- supervision of road marking contracts using industry-developed guidelines and quality assurance records.

The degree to which these elements are adopted depends on the road marking budget and the RCA determining that they will obtain value for the likely costs.

### **Recommendations**

- RCAs should continue to work with their road marking contractors to apply best practice and to undertake trials to increase knowledge and ensure continuous improvement in the level of service from road markings.
- The requirements for reflectorised markings should be reviewed. More use of reflectorised markings could improve night-time safety.
- The removal of unwanted markings by blacking out or abrasion blasting should be limited to small amounts of this work and locations where ineffective removal will not create a safety problem. Resealing should be used for large amounts of this work or where safety problems could be created.
- The LTSA should, through its Standards and Guidelines Steering Group, promote the development of guidelines for road marking on private land areas that have public access and road-type use.
- RCAs should assess whether they can achieve better value from remarking programmes based on an assessment of needs, rather than simply carrying out time-based remarking of all existing markings.
- The NZRF should continue to promote best practice and develop guidelines to assist RCAs to get the best value from their road marking programmes.

## 1 Introduction

Between November 2003 and February 2004, the regional offices of the Land Transport Safety Authority (LTSA) conducted surveys of traffic calming devices and road markings in a sample of road controlling authorities (RCAs).

This report describes the procedures and presents the results for the survey of road markings. The road marking surveys coincided with remarking work having recently been undertaken in many areas, because the season for such work had just passed.

Alister Harlow, Executive Director of the New Zealand Roadmarkers Federation (NZRF), assisted with the road marking survey. The involvement of the NZRF stimulated discussion and helped promote good ideas and best practice for road marking. The NZRF provided a MX30 retroreflectometer for undertaking retroreflectivity readings on road markings during the field surveys.

## 2 Purposes of the survey

The purposes of the survey were to:

- identify RCA network characteristics and road marking policies
- establish what standards and guidelines were being used by RCAs for the provision of road markings
- establish what contractual procurement and management procedures were being used by RCAs to manage their road marking
- take a snapshot of the standard of markings at randomly selected sites, and compare them with recognised performance criteria
- identify aspects of the provision and maintenance of road markings that could be improved, and recommend appropriate remedial action.

## 3 Methodology

### 3.1 Sample selection

A sample of 33 RCAs was chosen for the surveys. This included 29 territorial local authorities (TLAs) and four regional offices of Transit New Zealand (TNZ). The sample was weighted towards authorities not included in the 2002/2003 LTSA surveys. Six of the territorial local authorities covered major urban areas. Four covered large provincial townships, with more than a quarter of their sealed roads being urban. The other 19

TLAs covered rural areas with small provincial towns. The surveys of Transit New Zealand regions focused on one professional service contract area per regional office.

Appendix 1 lists the 33 RCAs included in the surveys.

### 3.2 Interview surveys

Interview surveys were conducted with representatives of each of the 33 RCAs. Survey forms were sent in advance, to give the RCAs time to research answers, where necessary. Questions were centred on the standards, guidelines, programmes and practices used for the provision of road markings.

The questionnaire used for the interview surveys is shown in Appendix 2.

### 3.3 Field surveys

Field surveys were conducted for all except one of the 33 RCAs, and staff or representatives from each RCA were encouraged to accompany the surveyors.

The field surveys aimed to determine the extent to which samples of road markings on a RCA's roads complied with:

- *either* the Transit New Zealand/Land Transport Safety Authority *Manual of traffic signs and markings: Part II: Markings* (MOTSAM), *or*
- any policies and procedures adopted by the specific local authority and stated in their response to the questionnaire, *and*
- performance criteria for line width, daytime visibility and night-time visibility.

Sites were selected by driving along a sample of level 1 type roads (traffic volume 500 to 10,000 vpd) and stopping at sites that were typical of the general condition of road marking on the route, and where it would be safe to take the measurements. The sites selected were more often on straight sections of roads than on bends. Sites where there was obvious damage to the road markings or where there was high wear (such as on routes to industrial areas) were avoided.

In the regions of each of the major urban authorities, about six urban sites were selected. In the regions of each of the other authorities, about four urban and four rural sites were selected.

Generally, line widths, daytime visibility assessments and reflectivity readings were taken on all lines at each site. At least *three* reflectivity readings were taken along a few metres of each line. Five or seven readings were taken if there was inconsistency in the readings. If the surface type varied at a site, readings were taken separately on each surface type, or just on one surface type.

The performance measurements were used to give a snapshot of the markings at the time of the survey. They were not used to measure or compare contractors' performances. The performance measures were not contractual criteria, in most cases.

## 4 Results of the interview surveys

### 4.1 Road networks

#### ***Length and surface types***

Twenty seven of the 33 RCAs completed question 1, detailing the lengths of urban and rural sealed roads and the type of sealed surface.

- 4 were large urban authorities and their responses showed that more than 80% of the length of their sealed roads was *urban*.
- Responses from the other 23 RCAs showed that 70% or more of the length of each of their networks was *rural*.
- In addition, the responses from the 27 RCAs showed the following:
  - 78% of the urban sealed roads have chip seal, 19% smooth asphalt type surfacing, and 2% ‘other surfaces’ (such as concrete or brick paved areas).
  - All except about 1% of the total length of rural sealed roads have chip seal surfacing.

#### ***Special conditions affecting road marking***

The most common conditions affecting road markings were:

- gritting for ice – 16 (48%) of the RCAs
- snow – 4 (12%)
- seal bleeding (weather or heavy traffic) – 9 (27%).

Other conditions recorded included stock effluent, rock falls, forestry traffic and heavy vehicle use. One of the respondents noted that some research suggests marking too soon after CMA application reduces the life of the markings.

#### ***Delegated authority***

- None of the authorities surveyed had delegated authority for road markings on any significant sections of another authority’s road network.
- 7 (21%) RCAs noted they had authority for marking on boundary roads, or marking parking and no stopping restrictions on state highways.

Typically, limit lines and other intersection markings on local roads at state highway intersections are marked by the state highway road marking contractor.

## 4.2 Road marking standards

### General

- All of the RCAs surveyed used MOTSAM to determine what road marking was required.
- 22 (67%) RCAs also used *Road and traffic standards series 5: Guidelines for rural road marking and delineation* (RTS 5), or a local modification of it.

### Centre lines and edge lines

Responses to the questions on the *criteria for marking centre lines and edge lines* were incomplete. Typically the replies noted the inter-relatedness of the criteria for traffic volumes, road classification and road width. However, there was no obvious commonality or definitive criteria discernible from the responses.

- The proportion of the local authority networks marked with *centre lines only* varied from 4% to 50%; and the proportion marked with *edge and centre lines* varied from 3% to 42%.
- Only a few authorities provided data on the road lengths marked with *edge lines only* and these indicated that less than 10% of their networks were marked with edge lines only.
- All 4 TNZ areas surveyed had both centre and edge lines (or kerbs) on the full network.

The responses indicated that a variety of *line widths* are used by the RCAs for both centre and edge lines. The following widths are used:

- 75 mm centre line – 3 (9%) RCAs
- 100 mm centre line – 29 (88%) RCAs
- 75 mm edge lines – 12 (36%) RCAs
- 100 mm edge lines – 23 (70%) RCAs
- 150 mm or 200 mm spot treatments for edge and/or centre lines – 8 (24%) RCAs
- 2 (6%) of the RCAs simply quoted MOTSAM for line widths.
- 1 (3%) of the RCAs indicated that they use a variety of line widths, but did not specify what widths.

Some RCAs use more than one width for edge and/or centre lines, so the numbers above do not add up to the 33 RCAs surveyed.

MOTSAM was referred to as the guideline. Section 2.01.02 of MOTSAM specifies that standard urban and rural road centre lines should be 100 mm wide. Section 2.03.02 specifies 75 mm-wide edge lines for two-lane rural roads with an AADT < 2500; and 100 mm-wide edge lines for two-lane rural roads with an AADT > 2500, and for two-lane urban roads.

### ***Other road markings***

Question 7 of the questionnaire was intended to identify specific situations or road markings where RCAs might use local standards or variations from MOTSAM. Various road markings were listed in the question. Unfortunately, the question was ambiguous and some authorities only responded if they used a variation from MOTSAM for the listed road marking, and others if they used the listed marking either in accordance with MOTSAM or to a different standard. Responses, therefore, do not add up to the 33 RCAs surveyed. Analysis of the responses shows the following trends:

#### ***Flush medians***

- 21 (64%) of the RCAs indicated that they have flush medians and mark them in accordance with MOTSAM. 3 (9%) of these have no gap in the median at minor side road intersections. (Diagrams in MOTSAM show flush medians with a gap and continuity lines across intersections. However, MOTSAM does note that they may be marked straight through minor side roads that have very low turning flows.)

#### ***Painting of kerbs on traffic islands***

- 20 (61%) of the RCAs paint kerb faces on the noses of traffic islands and another 3 (9%) no longer paint them, but have done so in the past. (MOTSAM notes that kerb faces may be marked with reflective white material.)
- Of the 20 RCAs that paint the kerb faces:
  - 6 painted just the nose end of traffic islands
  - 2 painted the full islands (generally, to give an overall tidy appearance in urban areas)
  - 12 did not state whether they painted only the nose or the full island.

Comments noted during the surveys identified:

- maintenance issues to do with keeping paint markings in good condition on the concrete kerb surfaces
- that RG 17 'Keep left' signs on traffic islands are the signs most often replaced because of damage.

#### ***Right turn bays***

- 23 (70%) of the RCAs stated that they have painted right turn bays, marked in accordance with MOTSAM. Generally the full chevron marking is used, but 7 of these RCAs had also used the MOTSAM urban alternative when space was limited.

One authority commented that the installation of cycle lanes was reducing the space for right turn bays.

#### ***Private land (service stations, shopping car parks, etc)***

- 24 (73%) of the RCAs stated that the marking at public access intersections to private land (eg, service stations, supermarket car parks) is controlled through District Plan or resource consent procedures. The other 9 (27%) RCAs either did not answer, or answered 'No' or 'Not applicable' to this question. Generally, the

developer was responsible for any markings on the private land, and the road controlling authority for markings on the road.

- Similarly, 24 (73%) of the RCAs stated that they had engineering input, through the District Plan or resource consent process, into what markings might be used on private land that has public access, but the developer or land owner was responsible for the markings. Again, the other 9 (27%) either did not answer or answered 'No' or 'Not applicable' to this question.
- Control of markings on public access private land was mainly an issue in the larger urban authorities, with inconsistency in the standards being applied noted as the main problem. One authority suggested the LTSA should assist in developing national standards for parking areas. The interviews showed some support for this, but the level of support was not recorded.

#### ***Pedestrian crossings***

- 7 (21%) of the RCAs stated that they mark limit lines at pedestrian crossings.
  - 2 of these mark *all* crossings with limit lines.
  - 3 mark *some* of their crossings.
  - 1 had tried them at one crossing but found they were not useful.
  - The other RCA was implementing an upgrading to mark limit lines and centre lines at all crossings.

#### ***Lane arrows for tourists***

- 7 RCAs (21%) stated that they use lane arrows to help direct tourists to drive on the left.
- A further 3 stated that they were considering using them on some tourist routes.

Two formats for their use were evident: placing the arrows in pairs (one in each lane), or having the arrows staggered. It was considered the arrows in pairs had greater impact and gave a clearer message to tourists to drive on the left. The staggered layout was developed to overcome legal issues near access points where the arrows in pairs may be interpreted as meaning drivers could not turn into the access, as they would be failing to comply with the lane markings.

#### ***'Keep clear' zones***

- 11 (33%) of the RCAs use hatch markings to indicate 'Keep clear' zones.
- 3 (9%) use *either* hatched markings *or* the words 'Keep clear'.
- 1 (3%) uses just the words.

#### ***Alberta markings at multilane roundabouts***

- 28 (85%) RCAs did not have multilane roundabouts.
- 5 (15%) RCAs had multilane roundabouts and all of these used Alberta type markings.

### 4.3 Reviewing road marking

Processes that caused changes in road marking design or the frequency of road marking were:

- road inspections, reviews or audits – 14 (42%) of the RCAs
- crash reduction studies – 11 (33%) of the RCAs
- public complaints/requests, political pressure (to change frequency) and weather problems – 1 or 2 RCAs.

RCAs were asked whether they had reviewed their no passing line markings as a result of *Road safety survey 13: No passing lines* (RSS 13) (LTSA, 2000). Responses were:

- ‘No’ – 22 (67%). 2 of these RCAs noted that they had reviewed no passing lines as part of other inspections, but not as a result of RSS 13.
- ‘Yes’ – 11 (33%), including 1 RCA that was also investigating using no passing lines on horizontal curves.

### 4.4 Road marking materials

- 31 (94%) of the RCAs used either the specifications for road marking materials in TNZ M/7 *Roadmarking paints* and/or those in TNZ M/20 *Long-life roadmarking materials*.
- 2 (6%) of the RCAs stated that they specified ULTRAX, a polymer-modified alkyd paint.

**Reflectorised markings** were specified by authorities:

- for all markings, or all except no stopping and parking – 14 RCAs (42%)
- for all longitudinal markings, but not limit lines or arrows – 1 RCA (3%)
- for as many markings as possible – 1 RCA (3%)
- for rural centre and edge lines and pedestrian crossings – 1 RCA (3%)
- for limit lines plus arterial or strategic roads – 1 RCA (3%)
- for high volume arterials or collectors – 1 RCA (3%)
- as MOTSAM<sup>2</sup> specifies – 7 (21%) of the RCAs, including 1 RCA that also specified reflectorised markings for some collectors
- for limit lines, no passing lines and pedestrian crossings – 2 RCAs (6%)
- for give way lines, stop lines, one-lane bridges and no passing lines – 1 RCA (3%)
- for controlled intersections – 1 RCA (3%).

<sup>2</sup> MOTSAM particularly specifies reflectorised materials for some road markings, and allows discretion for using reflectorised materials on other markings. The most used markings that are specified to be reflective in MOTSAM are no overtaking (no passing) lines, limit lines, and flush medians.

Three RCAs (9%) do not use, or do not specify, reflective materials.

The Traffic Regulations 1976 require reflectorised markings for kea crossings (T Reg 96A(4)(a)) and for the RAIL X markings at level crossings (106(6)(a)).

#### **4.5 Wet/night visibility assessment**

- 13 (39%) of the RCAs reported undertaking night-time inspections, but not specific wet/night assessments.
- 19 (58%) reported that they do not undertake wet/night assessments.
- 1 of the TNZ regions noted that their consultant and contractor undertake reflectivity tests for dry night visibility.

#### **4.6 Skid resistance assessment**

- 30 (91%) of the RCAs said they do not undertake skid resistance tests of their road markings.
- 3 (9%) reported undertaking skid resistance tests for road markings. 1 had undertaken British Pendulum tests near the start of the contract term and had not repeated them because they demonstrated compliance considerably exceeding the requirements. Another noted they were part of P/20, and the third did not give any details of the tests they carried out or when they were undertaken.

#### **4.7 Road marking materials and trial opportunities**

Paint systems are the most predominant material used for road markings.

- 16 (48%) of the RCAs said they specify materials complying with the M/7 specification and have markings made using standard alkyd paint.
- 14 (42%) of the RCAs specify waterborne materials, with 5 of these providing for the use of alkyd materials when the application conditions are not suitable for the waterborne.
- 2 (6%) of the RCAs use a polymer-modified alkyd paint.
- 1 (3%) of the RCAs did not specify the materials, as this is their contractor's selection under their performance-based contract.

Responses to the question about long-life products being used showed the following:

- Thermoplastic is the long-life material of choice for urban arterials and areas of high wear in North Shore, Auckland, Manukau and Wellington.
- A further 6 RCAs had trialled thermoplastic for pedestrian crossing, limit line or profiled edge line markings, as a safety enhancement.

RCAs indicated there might have been more use of thermoplastic if there was more local-based application equipment.

- Cold-applied plastic is being trialled by 3 RCAs (Far North District, Whangarei District and Hamilton City) on limit lines in high-wear areas.

A wide variety of marking systems are being used in the TNZ performance-based contracts.

Most of the RCAs (27, or 82%) stated they would welcome opportunities for materials trials on their networks.

#### 4.8 Subdivision road markings

- 15 (45%) of the RCAs stated that control of road markings for new subdivisions was through the District Plan and the resource consent process.
- 8 (24%) of the RCAs stated that control was through their specifications or codes of practice.
- 9 (27%) said subdivision road marking was not applicable because they had few new subdivisions, or those they had did not require any road marking.
- 1 (3%) said that control was undertaken on a case-by-case basis.
- 6 (18%) of the RCAs indicated that they had problems with developers installing non-standard markings. The problems noted included poor advice from consultants, resulting in wrong markings at islands; cheap paint being used on roads to be taken over by the RCA; and there were a few instances of developers not following the council's development manual.
- One of the large urban authorities noted problems resulting from the number of council departments that could be involved in subdivisions, and the difficulty training all staff involved to check everything thoroughly. Another noted that they had a specific engineering team responsible for managing the development of subdivisions.

#### 4.9 Road marking database

Six authorities reported having more than one type of database (eg, RAMM and spreadsheet or contractors' database). The types of database identified were:

- RAMM – 19 (58%) of the RCAs
- Excel spreadsheet or electronic database – 10 (30%) of the RCAs, including 1 using a total inventory system (MAXIMO)
- contractors' database – 5 (15%) of the RCAs
- no formal database – 3 (9%) of the RCAs (including 1 that was developing a database).

Maintenance and updating of the databases was mainly based on contractor's claims for payment, which typically involved Excel spreadsheets. For RCAs using consultants, responsibility for maintenance of the databases rested with the professional services consultants. Eleven (33%) RCAs updated their databases from cyclic surveys of the

network. Other systems for recording road markings included aerial photographs, GIS data and annual videotaping.

#### **4.10 Public enquiries and concerns**

- 27 (82%) of the RCAs had formal customer service request systems or procedures in place for receiving and handling public enquiries or concerns.
- 3 (9%) of the RCAs noted that they received very few complaints or concerns.
- 3 (9%) of the RCAs said that any concerns were investigated by engineering staff.

About half the RCAs directly issued instructions to contractors for any remedial works required. The other half used their consultants or design services sections to instruct contractors to undertake remedial works.

#### **4.11 Management of road marking programme**

RCAs indicated that management of the road marking programme was undertaken by:

- a professional services consultant – 14 (42 %) of the RCAs, including 1 that responded: ‘Asset manager plus professional services consultant’
- a council engineer or asset manager – 12 (36%) of the RCAs
- a council business unit or in-house consultant – 7 (21%) of the RCAs.

#### **4.12 Contract terms, specifications and quality control**

##### ***Contract terms and age***

- Contract terms were:
  - 3 + 1 + 1 years – 12 (36%) of the RCAs
  - 2 + 1 + 1 + 1 years – 5 (15%)
  - 3 years – 4 (12%).
- 1 TNZ contract was a 10-year performance specification maintenance contract (PSMC), and another a 5-year hybrid contract.
- Other contract terms ranged from 1 to 3 years, with various fixed-term renewal periods – 10 (30%) of the RCAs.

At the time of the survey, contracts had been let for:

- more than 6 months – 27 (82%) of the RCAs
- 3 to 6 months – 3 (9%)
- less than 3 months – 4 (12%).

One RCA had more than one road marking contract.

### **Changes to the management contracts**

- 17 (52%) of the RCAs had not recently investigated or changed their management of road marking contracts.
- 16 (48%) had recently investigated or were investigating a change, and of these:
  - 4 (12%) of the RCAs had recently changed
  - 2 (6%) had investigated but did not change
  - 10 (30%) were still investigating changes.

### **Method- or performance-based contracts**

- 23 (70%) of the RCAs had method-based contracts.
- 10 (30%) had performance-based contracts.

Typically, the *method-based contracts* required materials application rates in accordance with TNZ P/12 *Specification for pavement marking* (150 microns dry film thickness, 275 grams/m<sup>2</sup> minimum bead drop-on rate). Five RCAs noted that they require 220 micron dry film thickness.

Performance criteria for seven of the *performance-based contracts* were based on TNZ P/20 *Performance-based specification for roadmarking* (colour, daytime visibility, night-time visibility, skid resistance). The other performance-based contracts included criteria such as 80% retained after 6 months, condition rating based on forward visibility (safety oriented), level of service, and no environment or health and safety incidences.

### **Specifications**

- 26 (79%) of the RCAs indicated that they use the TNZ P/12 specification. (Most use the current 2000 version, but some use the 1995 or 1998 versions.)
- 2 RCAs (6%) said they use TNZ P/22 *Reflectorised pavement marking*.
- 5 RCAs (15%) said they use TNZ P/20.

### **Contract relationship**

- 20 (61%) of the RCAs considered they had a *service agreement* type relationship with their contractor.
- 12 (36%) said they had a *partnering type* relationship.
- 1 (3%) RCA was unclear, as the terminology in their contract was vague.

One authority commented that partnering, with its three-way partnership between the council, consultant and contractor, provided more flexibility and innovation.

### **Quality assurance requirements**

- 25 (76%) of the RCAs indicated that their quality assurance requirements were based on TNZ P/12, P/22 or P/20 specifications (specifically, ISO 9000: 2000).

- 5 (15%) used Transit New Zealand quality assurance requirements (TQS2 or TQS3).
- 2 (5%) use NZRF quality assurance requirements.
- 2 (5%) did not state their requirements

### ***Remarking programmes***

The 23 RCAs with method-based contracts used the following types of remarking programme:

- Annual remarking – 9 (39% of the 23 RCAs)
- Annual remarking, with 6-monthly for high-wear markings – 8 (35% of the 23 RCAs)
- 18-monthly remarking, with 6-monthly for high-wear areas – 1 (4% of the 23 RCAs)
- 9-monthly remarking – 1 (4% of the 23 RCAs)
- 6-monthly remarking – 1 (4% of the 23 RCAs)
- Needs-based remarking – 3 (13% of the 23 RCAs). 1 of these RCAs was trialling needs-based assessments to set the remarking programme. Another noted they were getting up to 3 years life on some markings on low volume roads.

The percentages shown above are based on the 23 RCAs with method-based contracts. Remarking programmes, and the period between remarking, are not applicable for the 10 (30%) of the RCAs surveyed that have performance-based contracts, as remarking is based on performance criteria.

## **4.13 Testing and other contract management procedures**

### ***Materials and application rate tests***

Responses to questions 35 and 36, about what materials and application rate tests were undertaken and who did them, clearly showed that the RCAs relied very much on the contractors' quality assurance systems, and carried out very little independent testing. The responses indicated the following:

- No testing – 16 (48%) of the RCAs
- Quality assurance systems – 11 (33%) of the RCAs
- Plate or application rate tests – 6 (18%) of the RCAs
- Visual assessment – 4 (12%) of the RCAs
- Retroreflectivity tests – 1 (3%) of the RCAs.

Most authorities did not review the contractor's quality assurance records to verify the materials being applied and their application rates. In general, the RCAs relied on the life of the markings to assess contractors' performance.

**Road marking after reseals**

Most RCAs indicated that the installation of road marking after reseals was part of the reseal contract. Responses were:

- Subcontract or requirement under the reseal contract – 20 (61%) of the RCAs
- Road marker nominated to undertake remarking after reseals – 9 (27%) of the RCAs
- Part of overall maintenance contract – 4 (12%) of the RCAs.

**Maintenance activities other than remarking**

Maintenance activities (other than remarking) undertaken for road markings were:

- sweeping, vegetation control and removal of moss (as activities that would get undertaken if required before remarking) – 18 (55%) of the RCAs.

Fifteen (45%) of the RCAs undertake no additional maintenance for road marking.

**Removing unwanted markings**

A variety of methods were used by the RCAs for removing unwanted markings. Many used more than one method. The methods were:

- Sand or abrasion blasting (generally used when there is sufficient work to warrant a contract. Reasonably effective, but can damage surface) – 19 (58%) of the RCAs
- Blacking out (used for small amounts and not always very effective) – 15 (45%)
- Water blasting (similar comments to sand/abrasion blasting) – 14 (42%)
- Bitumen emulsion/grit – 2 (6%).

It was acknowledged that resurfacing is a more effective way to remove unwanted markings.

The field surveyors noted some confusing and some unsafe results from the removal of markings. Examples are shown in the photographs that follow.



Confusing 'blacked out' right turn arrow.



Unsafe delineation from 'blacked out' unwanted centre and edge lines. Glass bead was clearly evident on the blacked out markings. Tests showed these lines had higher reflectivity than the new white lines and would therefore be more visible at night (reflectivity readings of 111 and 64 on the blacked out lines, compared with 58 to 80 on the new white lines).

#### 4.14 Traffic management requirements

The RCAs used the following traffic management requirements in road marking contracts:

- TNZ *Code of practice for temporary traffic management* (CoPTTM) – 13 (39%) of the RCAs
- CoPTTM with local amendments – 6 (18%)
- TNZ G/1 *Temporary traffic control* – 13 (39%) of the RCAs. 5 of these advised that they are changing, or will change, to CoPTTM.
- Council specification (specifies TNZ *Working on the road* handbook) – 1 of the RCAs (3%).

#### 4.15 Rating of contractors' performance and traffic management

RCAs were asked to rate their contractors' general performance and traffic management, on a 5-point scale. Some RCAs gave intermediate point ratings. The responses were as follows:

##### **General performance**

- Excellent – 4 (13%) of the RCAs
- Good to Excellent – 2 (6%)
- Good – 12 (39%)
- Acceptable to Good – 5 (16%)
- Poor or Very poor – 0 (0%).

##### **Traffic management**

- Excellent – 2 (6%) of the RCAs
- Good to Excellent – 0 (0%)
- Good – 18 (56%)
- Acceptable to Good – 4 (13%)
- Poor or Very poor – 0 (0%).

Two RCAs considered it too soon to rate their contractors' general performance and one their contractor's traffic management.

All RCAs rated their contractor's performance as *acceptable or better*.

## 5 Results of the field surveys

### 5.1 Survey sample

In total, 643 lines were surveyed, at 211 sites (126 urban, 95 rural) in the 33 RCAs. The surveyors measured line widths and day and night-time visibility.

For the purposes of this survey, assessments were made against the criteria in TNZ P/20 *Performance-based specification for roadmarking*. These performance criteria were not contractual requirements in most cases.

- Line width tolerances were taken as +10%, -5%.
- The daytime visibility criteria used was that the markings should be readily visible for a forward distance of 150 m or, if less than 150 m, as far forward as possible until obstructed by the geometry.
- Night-time visibility was assessed from retroreflectivity measurements. TNZ P/20 specifies that retroreflectivity should exceed  $100 \text{ mcd} \cdot \text{m}^{-2} \cdot \text{luxe}^{-1}$ , measured with a Mirolux 12 reflectometer. This is equivalent to  $72 \text{ mcd} \cdot \text{m}^{-2} \cdot \text{luxe}^{-1}$  using 30 metre geometry readings with the MX30 retroreflectometer. In accordance with industry practice, 70% of this value was used for yellow no passing lines (ie,  $50 \text{ mcd} \cdot \text{m}^{-2} \cdot \text{luxe}^{-1}$  for the 30 metre geometry MX30 readings). The field measurements taken were all 30 metre geometry readings using an MX30 retroreflectometer. The readings were not converted to equivalent Mirolux 12 readings, but were compared against the above 30 metre MX30 equivalent readings.

Overall results, by RCA, are shown in Appendix 1.

The total numbers of sites, lines measured and retroreflectivity measurements for the survey were:

- 221 sites – 126 urban and 95 rural
- 643 lines
  - 239 centre lines (172 on straights, 26 on bends and 41 flush medians)
  - 251 edge lines (218 on straights, 17 on the inside of bends, 16 on the outside of bends)
  - 57 no passing (no overtaking) lines
  - 96 other lines, including 29 limit lines and a variety of miscellaneous line types, such as parking or bus stop markings
- 613 line widths, measured and compared with stated standards or expected width
- Daytime visibility assessed for 557 lines
- 808 reflectivity measurements (each being the average of three to seven MX30 readings on a line). These exceed the number of lines because reflectivity readings were taken in two directions on some centre and no passing lines.

## 5.2 Line widths

- 73% of the 613 line widths measured were within the tolerance of  $-5\%$  to  $+10\%$  of the expected or standard width for that line type.
- 15% (95 lines) were wider than the 10% upper tolerance limit.
- 12% (73 lines) were narrower than the  $-5\%$  lower tolerance limit.

## 5.3 Daytime visibility

- 99% (551 lines) of the 557 lines were assessed as meeting the 150 m forward visibility criteria.

## 5.4 Night-time visibility

The following table shows the number, and percentage, of various line types that had reflectivity measurements below the performance measure, 100% to 200% of the performance measure, or over 200% of the performance measure. Measurements were taken on all lines to enable a measured assessment of the night-time visibility, even though many of the lines were not reflectorised and night-time visibility requirements were not specified in the road marking contract.

The field measurements taken were all 30 metre geometry readings using an MX30 retroreflector. The readings were not converted to equivalent common base or Mirolux 12 readings. They were compared against a performance measure of  $72 \text{ mcd} \cdot \text{m}^{-2} \cdot \text{lux}^{-1}$  ( $50 \text{ mcd} \cdot \text{m}^{-2} \cdot \text{lux}^{-1}$  for yellow no passing lines) for the 30 metre MX30 readings, which is equivalent to the TNZ P/20 specification of  $100 \text{ mcd} \cdot \text{m}^{-2} \cdot \text{lux}^{-1}$  measured with a Mirolux 12 reflectometer. This performance measure was not a contractual requirement in most cases.

The table shows the following:

- 45% of all the measurements were at or above the TNZ P/20 performance measure. More of the urban lines had measurements at or above the performance measure than rural lines (49% compared with 40%).
- For sites in areas where the TNZ P/20 performance measures were contractual requirements, 68% of the 166 measurements were at or above the performance measure. These sites were from Auckland City, Southland District and the four TNZ regions.
- 67% of the 493 measurements on lines recorded or specified as reflectorised were at or above the performance measure.
- Only 16 measurements were on thermoplastic lines and 14 (or 88%) of these exceeded the performance measure. One site had two measurements below the performance measure but it was noted that the thermoplastic paint was very worn and the readings may have been from previous paint markings.
- 58% of the 86 measurements on no passing lines were at or above the performance measure. MOTSAM specifically requires no passing lines to be reflectorised.

- 76% of the 30 measurements on limit lines were at or above the performance measure. MOTSAM specifically requires limit lines to be reflectorised.
- More of the measurements on lines on smooth surfaces were at or above the performance measure than measurements on lines on chip seal surfaces (75% of 102 measurements, compared with 41% of 705 measurements). Nearly 50% of the measurements on smooth surfaces were over 200% of the performance measure.

30 metre geometry MX30 measurements							
Line type	Total	Below performance measure		100% to 200% of performance measure		Over 200% of performance measure	
		No.	%	No.	%	No.	%
All (urban and rural)	808	443	55%	197	24%	168	21%
All urban	436	221	51%	109	25%	106	24%
All rural	372	222	60%	88	23%	62	17%
Sites in areas with TNZ P/20 specification	166	53	32%	45	27%	68	41%
Reflectorised – all	493	163	33%	172	35%	158	32%
All thermoplastic lines	16	2	12%	11	69%	3	19%
No passing – all	86	36	42%	31	36%	19	22%
No passing – urban	30	12	40%	9	30%	9	30%
No passing – rural	56	24	43%	22	39%	10	18%
Limit lines – all	30	7	23%	7	23%	16	53%
All lines on smooth surface	102	26	25%	26	25%	50	49%
All lines on chip seal surface	705	417	59%	170	24%	118	17%

### **Directional issue**

The field surveys demonstrated variations in the reflectivity of the lines according to the direction the markings were applied. Road markings should be applied in the direction of travel for the lane to which the marking applies. This is because the paint and reflective beads have better coverage on the face of the aggregate in the direction of travel than on the opposite face. Dual gun systems can overcome the directional issue for applying the paint and the reflective beads.

Measurements were taken in both directions on 122 of the reflective lines surveyed. Most of these were centre lines (84) or no passing lines (27). The measurements were assessed to demonstrate this issue and are not intended to imply that the markings were

incorrectly applied. In many cases, the higher reflectivity readings were in the direction of travel for the lane to which the marking applied.

Analysis of the measurements for these lines shows the following:

- The largest difference between directional measurements on any one line was 119 mcd.
- 16 lines (13%) had measurements above the performance measure in one direction but below in the other.
- 7 lines (6%) had measurements that were lower in one direction than the other by 50% or more.
- 36 lines (30%) had measurements that were lower in one direction than the other by between 25% and 50%.
- 48 lines (39%) had measurements that were lower in one direction than the other by between 10% and 25%.
- 31 lines (25%) had measurements with less than 10% difference between one direction and the other.

## **5.5 Observations**

In addition to the specific site inspections, the surveyors made general observations of road markings on the routes driven between the sites.

Their observations included the following:

- The daytime appearance of markings was generally good and there were very few examples of unexpected, non-standard or misleading markings.
- Some blacking out of markings was not effective. Old markings showing through can be misleading and potentially unsafe.
- No problems with the reinstatement of markings after reseals were observed. However, there were rural routes with quite significant lengths of centre or edge lines missing due to dig-out repairs.
- Remarkings using non-reflectorised paint over thermoplastic resulted in a lower reflectivity or level of service. The reflectivity was reduced even though the line may have appeared whiter in the daytime.
- There was some variation in the marking of edge line tapers at urban intersections. Some RCAs had a simple, straight edge line taper from the kerb; others continued the edge line around the kerb radius at the intersection. The latter appeared unnecessary and could add costs to the remarking.

## 6 Discussion

### 6.1 General

- The survey showed that the overall daytime performance and standard of road markings was good. Some RCAs had increased the level of performance of their road markings through knowledge, trials and good contractual relationships.
- The wide range of MX30 reflectivity measurements from the field surveys indicates a wide range of night-time visibility performance.
- The interview surveys showed that there is some demand for a guideline on markings for private land areas with public access (car parks etc), to achieve nationwide consistency for these areas. The interview surveys also showed that there is variation in the use and format of lane arrows for tourists.
- There is a strong reliance by RCAs on the expertise and integrity of their road marking contractors. In general, the authorities relied on visual assessments and the amount of remarking needed to assess contractors' performance. The low levels of supervision and checking on road marking may reflect the relatively low expenditure on road marking, compared to other road network budget items.
- All authorities rated their contractors' general performance and their traffic management as acceptable or better. More than half rated their contractors' performance as good or better.
- Most RCAs are using method-based contracts. Only three (apart from the TNZ regions) have TNZ P/20-type performance-based contracts. The TNZ specifications are the guidelines adopted by most RCAs and should be retained, even if they are not in current use by TNZ.
- Trials have shown waterborne paint to be cost effective over the full life cycle. However, survey respondents pointed out that it is subject to climatic conditions during its application.
- The most common factors affecting road markings were gritting for ice, snow, and seal bleeding problems.
- Removal of unwanted markings is a safety issue. It is typically undertaken by blacking out the markings or removing them by abrasion blasting (sand or water blasting). Most authorities stated that relatively small amounts of this work are undertaken. Surveyors observed examples of old markings having been ineffectively removed. The results ranged from confusing indications to misleading and potentially unsafe delineation. Resurfacing is the most effective way to remove unwanted markings.
- Good, clear road markings can enhance road safety. A high level of direct supervision of road marking work is not necessary, as visual inspections can provide a lot of information and quality assurance records can be checked.

## 6.2 Best practice

A variety of policies, management procedures and specifications are being used for road marking. The field surveys measured performance criteria that were not contractual criteria in many cases. Road marking is not a 'one size fits all' process. It is difficult, therefore, to identify specific policies and practices as constituting 'best practice'. The surveyors, however, consider that elements of best practice include:

- adopting clear policies on what markings to use on which roads, including, as necessary, clarification of any discretionary or optional issues included in any national guidelines that are adopted
- maintaining a good database of road markings
- having procedures to remark the markings that should be on the network (this does not necessarily mean remarking all existing markings)
- having remarking programmes based on assessed needs
- having formal customer service request systems
- developing good, working contractual relationships that allow trials, to increase knowledge and ensure continuous improvement of the performance of road marking
- using reflectorised markings to improve night-time visibility, especially for no passing lines and centre lines
- completing reseals to remove unwanted markings if removal by blacking out or abrasion blasting could result in unsafe delineation
- supervision of road marking contracts using industry-developed guidelines and drawing on quality assurance records.

The degree to which these elements are adopted depends on the road marking budget and the RCA determining that they will obtain value for the likely costs.

## 7 Recommendations

- RCAs should continue to work with their road marking contractors to apply best practice and to undertake trials to increase knowledge and ensure continuous improvement in the level of service from road markings.
- The requirements for reflectorised markings should be reviewed. More use of reflectorised markings could improve night-time safety.
- The removal of unwanted markings by blacking out or abrasion blasting should be limited to small amounts of this work and locations where ineffective removal will not create a safety problem. Resealing should be used for large amounts of this work or where safety problems could be created.
- The LTSA should, through its Standards and Guidelines Steering Group, promote the development of guidelines for road marking on private land areas that have public access and road-type use.
- RCAs should assess whether they can achieve better value from remarking programmes based on an assessment of needs, rather than simply carrying out time-based remarking of all existing markings.
- The NZRF should continue to promote best practice and develop guidelines to assist RCAs to get the best value from their road marking programmes.

## Appendix 1: Summary of field surveys, by RCA

RCA	No. of sites (U = urban R = rural)	No. of lines	Width		Day visibility		Night visibility			
			No. within tolerance	No. not within tolerance	No. meeting criteria	No. not meeting criteria	Min. MX30 measurement	Max. MX30 measurement	No. over performance measure	No. below performance measure
Far North District	3U, 5R	26	15	9	25	0	9	325	17	17
Whangarei District	5U, 2R	23	13	8	23	0	18	342	10	16
North Shore District	5U, 0R	13	9	4	12	0	27	393	14	5
Auckland City	5U, 0R	16	9	7	16	0	19	262	11	6
Manukau District	5U, 2R	16	11	2	9	0	22	269	21	3
Hauaraki District	4U, 4R	25	18	6	22	0	20	209	21	14
Hamilton City	6U, 0R	21	18	1	12	3	27	317	20	6
Otorohanga District	3U, 4R	16	12	2	8	0	25	178	2	15
Waitomo District	4U, 3R	19	11	1	6	0	25	362	11	10
Rotorua District	4U, 4R	23	19	4	19	0	25	237	14	19
TNZ Hamilton	4U, 4R	27	15	12	18	0	34	368	29	4
Gisborne District	3U, 2R	22	12	10	22	0	14	299	18	12
Wairoa District	4U, 3R	18	5	13	18	0	19	292	19	7
Stratford District	2U, 2R	12	6	6	11	0	37	74	3	11
Ruapehu District	3U, 3R	16	9	7	14	0	27	67	0	20
Manawatu District	3U, 3R	16	11	5	14	0	13	217	5	15
Wellington City	7U, 0R	19	13	5	14	0	25	223	5	14
Masterton District	4U, 3R	22	18	4	20	0	21	110	3	20
Carterton District	4U, 4R	16	15	1	14	0	24	116	5	14
Kaikoura District	0U, 0R	0	<i>No field surveys in Kaikoura</i>							
TNZ Wanganui	2U, 5R	29	15	14	25	0	23	242	26	14
TNZ Wellington	2U, 3R	15	13	1	12	0	19	306	6	11
Hurunui District	2U, 4R	18	15	2	18	0	16	141	4	15
Waimakariri District	3U, 3R	21	16	5	21	0	15	232	12	16
Christchurch City	9U, 0R	21	14	7	21	0	32	251	9	17
Banks Penin. District	2U, 3R	9	9	0	9	0	16	53	0	10
Selwyn District	3U, 5R	21	18	3	19	0	16	66	0	29
Ashburton District	4U, 4R	23	19	4	23	0	27	249	6	20
Timaru City	4U, 4R	25	23	0	22	0	8	473	17	16
Waitaki District	6U, 3R	21	18	1	16	0	14	105	3	23
Clutha District	4U, 4R	23	16	7	20	2	21	178	12	16
Southland District	3U, 4R	22	9	11	20	0	24	245	16	15
TNZ Dunedin	4U, 5R	29	21	6	29	0	41	292	28	10
<b>Totals</b>	<b>126U, 95R</b>	<b>643</b>	<b>445</b>	<b>168</b>	<b>552</b>	<b>5</b>	<b>8</b>	<b>473</b>	<b>367</b>	<b>440</b>

**Note**

For the purposes of this survey, assessments were made against the criteria in TNZ P/20 *Performance-based specification for roadmarking*. These performance criteria were not contractual requirements in most cases.

- Line width tolerances were taken as +10%, -5%.
- The daytime visibility criteria used was that the markings should be readily visible for a forward distance of 150 m or, if less than 150m, for as far forward as possible until obstructed by the geometry.
- Night-time visibility was assessed from retroreflectivity measurements. TNZ P/20 specifies that retroreflectivity should exceed  $100 \text{ mcd} \cdot \text{m}^{-2} \cdot \text{lux}^{-1}$ , measured with a Mirolux 12 reflectometer. This is equivalent to  $72 \text{ mcd} \cdot \text{m}^{-2} \cdot \text{lux}^{-1}$  using an MX30 retroreflectometer. The value for yellow no passing lines was set at 70% of this (ie,  $50 \text{ mcd} \cdot \text{m}^{-2} \cdot \text{lux}^{-1}$  for MX30 readings).

## Appendix 2: Survey of road markings – Questionnaire

Road controlling authority: \_\_\_\_\_

Person(s) replying to questionnaire: \_\_\_\_\_

Position in organisation: \_\_\_\_\_

Contact phone number: \_\_\_\_\_

Contact email: \_\_\_\_\_

Interviewer: \_\_\_\_\_ Date: \_\_\_\_\_

Road network and road marking policies	Prompts
<p>1. What length of sealed road do you have?</p> <p><b>Urban</b> chip seal ..... km smooth surface ..... km  other ..... km</p> <p><b>Rural</b> chip seal ..... km smooth surface ..... km  other ..... km</p>	<p>‘Smooth surface’ covers asphalt, slurry, friction course etc. ‘Other’ covers paving etc.</p>
<p>2. Do you have any special conditions that may affect your road markings and, if so, how do you manage these special conditions?</p>	<p>Snow, gritting.</p>
<p>3. Do you have delegated authority for road markings on any other RCA roads or section(s) of state highway or another RCA’s roads?  <b>Yes / No</b></p> <p>If ‘Yes’, please define which sections/roads:</p>	<p>Define SH and RP range or area.</p>
<p>4. What standards do you use to determine what road marking is required?</p> <p>MOTSAM <b>Yes / No</b>                      RTS 5 <b>Yes / No</b></p> <p>Other .....</p>	
<p>5. What lengths or proportion of your network have the following markings and what criteria do you use to determine where to use these markings?</p> <p style="text-align: center;"><i>km or % criteria</i></p> <p>centre line only    ....                      ...                      .....</p> <p>edge line only       ....                      ...                      .....</p> <p>edge and centre line ....                      ...                      .....</p>	<p>Criteria could include traffic volume, road type and may vary depending on edge marker delineation.</p>

6. What is your policy on line width for: edge lines ..... centre lines ..... other? .....			Traffic volume.  Road type.
7. Complete the table below to show if you use any local standards or variations from MOTSAM for the road markings listed:			
<b>Road marking</b>	<b>Yes / No</b>	<b>Comment</b> (Briefly describe standard and/or situation it is used in and any evaluations undertaken)	Attach copies of local standards or variations if necessary.
Flush medians			Continuous across intersections.
Painting of kerbs on traffic islands			What is your policy?
Urban right-turn bays			MOTSAM full with chevron diverge (Fig. 3.26) or shorter with continuity line diverge (Fig 3.27).
Intersections with public access to private land			Who controls markings at accesses to service stations, supermarket car parks etc?
Public access private land			Car parks.
Centre lines and limit lines at pedestrian crossings			
Arrows for tourists			Directional arrows on road at exits from rest areas etc.
KEEP CLEAR wording c.f. cross-hatched clear zone			

Alberta markings at roundabouts		
Other (describe)		List any other markings not included above.
8. What procedures or investigations have you used to influence or change your road marking design and/or frequency of marking ?		Crash studies, project or existing road safety audits.
9. Have you reviewed your no passing lane markings as a result of the LTSA survey in 2000 or as a result of reading RSS 13? <b>Yes / No</b>		
10. What specifications do you use for road marking materials? TNZ M/7 <b>Yes / No</b> TNZ M20 <b>Yes / No</b> Other .....		
11. Which markings and on which roads do you specify the use of reflectorised materials for?		Centre lines, edge lines, limit lines, arrows, other.
12. Do you assess wet night visibility of your road markings? <b>Yes / No</b> If 'Yes', what programme do you have for this?		
13. Do you carry out tests to determine the skid resistance of your markings? <b>Yes / No</b> If 'Yes', what programme do you have for this?		
14. What policies do you have to select different material types (eg, chlorinated rubber modified alkyd, waterborne, thermoplastic)?		
15. List the product type and amount of any long-life markings you have on your network:		Thermoplastic, cold applied plastic. Km, m, sq m.
16. Are there opportunities for materials trials on your network? <b>Yes / No</b>		Profiled edge lines, other.
17. Describe any trials and evaluations that have been or are being undertaken:		Profiled edge lines.

<p>18. How do you control the standards and specifications for road markings in new subdivisions?</p> <p>Describe any problems you have had with developers installing non-standard markings, and how you have rectified these.</p>	
<p>19. What form of inventory or database of road markings do you maintain?</p>	<p>Industry concerns. RAMM is not adequate and issue under consideration.</p>
<p>20. What procedures do you have to update your inventory or database of road markings?</p>	
<p>21. What process do you have for handling public enquiries/complaints/requests?</p>	
<p>22. How are these actioned or authorised for action by your contractor?</p>	

<p><b>Contract management procedures</b></p>	
<p>23. Who manages your road marking contract programme?</p>	<p>Asset manager, professional service consultant, TNZ consultant manager</p>
<p>24. What QA or quality control requirements are included in your contract?</p>	
<p>25. What is the contract term?</p>	



35. What tests do you do to check the standard of materials and application rates?	
36. Who carries out these tests, and at what intervals?	
37. What procedures do you have to control the installation of road markings after resealing?	
38. What maintenance, other than remarking, do you undertake for road markings (eg, sweeping, vegetation control)?	
39. What procedures or specifications do you have for removing unwanted markings? How well do they work?	
40. How well does your contractor perform? (Assess on a scale of 1 to 5.)	Scale: 1 = very poor 3 = acceptable 5 = excellent
41. What guidelines do you require your contractor to conform to, in managing traffic control?	
42. How well does your contractor manage traffic control? (Assess on a scale of 1 to 5.)	Scale: 1 = very poor 3 = acceptable 5 = excellent
<b>General</b>	
43. Any general comments or suggestions on how the LTSA could assist you with any problems that cause you concern with respect to road markings?	

## Road safety survey series

RSS 1	<i>Traffic signal light output</i>	1995/96
RSS 2	<i>Street lighting</i>	1995/96
RSS 3	<i>Treatment of slip lanes at traffic signals</i>	1995/96
RSS 4	<i>Stop and give way controls at intersections</i>	1996/97
RSS 5	<i>Advisory speed signs</i>	1996/97
RSS 6	<i>Pedestrian crossings</i>	1996/97
RSS 7	<i>Temporary speed limits</i>	1998
RSS 8	<i>Traffic control at road works</i>	1998
RSS 9	<i>Safety management systems</i>	1998
RSS 10	<i>Skid resistance</i>	1999
RSS 11	<i>Pedestrian platforms</i>	1999
RSS 12	<i>Floodlighting pedestrian crossings</i>	1999
RSS 13	<i>No passing lines</i>	2000
RSS 14	<i>Roundabouts</i>	2000
RSS 15	<i>Roadside hazard management</i>	2001
RSS 16	<i>Road hierarchies</i>	2001
RSS 17	<i>School crossing facilities</i>	2002
RSS 18	<i>Data collection</i>	2002
RSS 19	<i>Traffic signs</i>	2003
RSS 20	<i>Vehicle entrances, stock crossing facilities and amenity carriageway surfacings</i>	2004
RSS 21	<i>Traffic calming</i>	2004
RSS 22	<i>Road markings</i>	2004

These reports are available on the LTSA website at [www.ltsa.govt.nz](http://www.ltsa.govt.nz).

They may also be purchased from the LTSA regional office in Auckland (Private Bag 92-515), Hamilton (Private Bag 3081), Napier (PO Box 972), Palmerston North (PO Box 1947), Wellington (PO Box 27-249), Christchurch (PO Box 13-364) or Dunedin (PO Box 5245) at a cost of \$10 each including GST.