REGIONAL PASSING & OVERTAKING PLANS:
A Bridge between High-Level Policy & Localised Solutions

Author: L. J. Cameron, BE, ME, Diploma in Business Admin, CPEng (Transportation), IPEng, MIPENZ, Principal Transport Planner, New Zealand Transport Agency, larry.cameron@nzta.govt.nz.

1. INTRODUCTION

1.1 This paper will discuss the process for developing NZTA's Passing and Overtaking (PO) Plans.

1.2 In 2006, the Board of Transit NZ (now part of New Zealand Transport Agency) approved the PO Policy. The Policy is applied to NZ's rural two-lane SH network, which is about 90% (9,900 km approx) of the total State highway (SH) network (11,000 km approx). The Policy doesn't cover RoNS projects, urban SH sections and rural SH sections currently identified for four-laning.

1.3 The rural two-lane SH network carries about 30% of NZ's total annual road travel, as measured in vehicle kilometres travelled (vkt). Therefore, the Policy has important implications for the New Zealand Land Transport Strategy and Government Policy Statement (GPS) impacts.

1.4 Background research is outlined together with the effect of projected traffic growth on NZ's rural two-lane SHs. The main aspects of the Policy are summarised, such as types of strategy and assessment frameworks. The contribution of the Policy to addressing high-level policy impacts is also discussed.

1.5 Key steps in preparing PO Plans are outlined. Implementation considers the PO Plans' input into strategic studies, as well as other issues such as decision-making processes, prioritisation and funding levels. Examples of PO studies look at the application of PO Plans in the West Coast, South Island and Waikato regions. Future initiatives relating to the Policy are also highlighted.

1.6 Policy frameworks used to evaluate deficiencies within SH sections are appended, namely: tool-kit of options (Appendix A), overtaking sight distance (Appendix B) and PL lengths and spacings (Appendix C). To help understand features recorded, examples of individual SH sheets for each of the four different types of PO strategy are provided (Appendices D-G).

1.7 Part of a work summary sheet shows how work is co-ordinated (Appendix H). Part of a prioritisation sheet shows how deficient SH sections over the next 10 years are identified and ranked (Appendix I).

2. BACKGROUND

2.1 Terminology

2.1.1 Key words (may differ slightly from AUSTROADS definitions):

- Passing - vehicles use specific passing facilities to pass slower vehicles.
- Overtaking (OT) - vehicles cross into the opposing traffic lane to pass slower vehicles.
- Continuation Distance (CD) – sight distance to draw parallel with the overtaken car and either continue with overtaking or drop back if opposing traffic appears.
- Establishment Distance (ED) - sight distance required to overtake a vehicle safely and return to the previous lane when an opposing vehicle is travelling towards the overtaking vehicle throughout the manoeuvre.

- Treatments - are applied directly to the roading infrastructure.
- Measures - act on driver behaviour and/or help to manage demand.

2.2 Projected Traffic Growth

2.2.1 Table 1 shows the traffic volumes by length of rural two-lane state highway. The projected traffic volumes were derived from work undertaken in 2009.

Table 1. Length of Rural Two-Lane State Highway with Estimated 2010 & 2040 Flows

AADT (vpd)	Estimated 2010 (km)	Estimated 2040 (km)
10,000-25,000	400	1,200
4,000-10,000	2,300	3,200
<4,000	7,200	5,500
Total	9,900	9,900
Note: Does not include state highway sections in urban speed zones and rural sections identified for possible four lanes over the next 25-30 years.		

2.2.2 The 10,000-25,000 vehicle per day (vpd) interval is typically above the range for efficient use of passing lanes (PLs) in series on flat and rolling road gradients. However, four-laning may not be cost-effective. Under current estimated lengths, about 650 km from the total 1200 km is likely to require an intermediate step between passing lanes in series and four-laning, such as 2+1 lanes with some routes being 30-80 km long.

2.2.3 Of the remaining 550 km, about 150 km would be located on either mountainous gradients requiring close spaced PLs/climbing lanes. Slightly under 400 km lies between 10,000-14,000 vpd range. For this 400 km approximate length, it would seem appropriate to consider PLs in conjunction with monitoring demand. Only about 15 km of the rural two-lane SH network has isolated short lengths of 5 km or less with no treatment to be provided.

2.2.4 By 2040, as well as about 800 km of SH having increased traffic volumes between 10,000-25,000 vpd range, about 1,700 km will move into the 4000-10,000 vpd range, providing a nett 900 km increase for SHs carrying 4,000-10,000 vpd. The 4,000-10,000 vpd range is usually suitable for PLs in series and therefore more PLs would be required.

2.2.5 In 30 years time, about 5,500 km of New Zealand's two-lane SHs will carry under 4,000 vpd, with most of this length suitable for overtaking. Where SH sections have exceptionally good overtaking sight distance, the upper limit for relying solely on overtaking sight distance might be extended to about 7,000 vpd.

2.2.6 These strategies may overlap or the AADT may only slightly exceed the strategy's threshold values. Therefore, some professional judgement needs to be applied when choosing the SH section strategy.

2.3 Research

2.3.1 NZ research has shown that PLs generated a nett 14% reduction in the number of head-on, overtaking and rear-end crashes (Koorey, 1999). This report also highlighted an increase in loss of control type crashes for 0-2 km upstream and 0-4 km downstream of the PL. When the Passing and Overtaking Policy was being developed, it took this research into account by requiring supporting roadside/edge line treatments to be considered for these locations, if appropriate.

2.3.2 As part of developing the Policy, a background technical report was prepared by NZTA with an extensive literature review of both NZ and overseas practice (NZTA, 2006). Within this report, a range choice of low-volume (<4,000 vpd) and moderate (4,000-25,000 vpd) volume passing treatments were assessed against operational efficiency, safety, costs and capacity flows. This report also identified a number of knowledge gaps, which has been the basis for on-going research relating to passing and overtaking issues.

2.3.3 Wanty, 2007 investigated a methodology for measuring percentage following and speed over NZ's State highway network. While this approach has proved to be very data intensive, there have been one-off situations where the methodology has been applied to specific issues.

2.3.4 A mixture of overseas research has been used to develop a layout table of overtaking lengths relative to speed environment and AADT (Appendix B). This research included:

- Overtaking lengths relative to speed environment (AUSTROADS, 2003),
- The frequency of CD and ED overtaking lengths relative to AADT, as well as the proportion of available sight distance (i.e. 300 m or more) (Bergh & Carlsson, 1995)
- The proportion of longer gaps (i.e. 25 seconds headway or more) in opposing traffic (Werner & Morrall 1984).

2.3.5 Cenek and Lester, 2008 undertook research that confirmed the Passing & Overtaking Policy's long-term framework for passing and overtaking treatments (Appendix C).

2.3.6 Under the current EEM procedures, a computer simulation is required to evaluate slow vehicle bays (SVBs). This approach is not practical for an initial investigation to determine the viability of a SVB project. Within Beca Infrastructure, 2008 & 2009, a report and Excel marco-based evaluation tool were respectively prepared. It has been left to each NZTA Regional Programme Manager to decide if they accept the evaluation tool results in lieu of a more detailed computer analysis.

2.3.7 A preliminary investigation into the viability of ITS to increase passing lane merge capacity has been undertaken (Beca Infrastructure, June 2010). This report will eventually be superceded by a larger NZTA research project currently out to tender. This larger project is mentioned later within this paper under Section Future Directions.

2.3.8 Beca Infrastructure, December 2010 has investigated the Passing Lane Length Factors Table A7.11 within Appendix A7 of the EEM. A subsequent revision will help to ensure that the increased performance of longer PLs is taken into account as AADTs increase. This research will also help to evaluate the relative benefits of length extensions to existing PLs that are below the nominal Policy length (Appendix C).

2.3.9 Wanty, 2011 undertook a statistical analysis on intersection crashes close to passing lanes. A suggested table of separation distances for access driveways and District road intersections has since been provided with respect to existing or proposed passing lanes. The suggested table, which is a late appendage within the report, should also be useful for the processing of access driveway and LUD applications, with a view to safeguarding existing and future passing lane sites.

3. POLICY ISSUES

3.1 Types of Strategy

3.1.1 The Policy applies one of four different types of strategy to each SH section, depending on the expected traffic flows and steepness of the road gradient:

- Overtaking – relies on sight distance with some overtaking sight distance improvements,
- Mainly overtaking – as for overtaking but in some situations, low-cost passing treatments may be required to bridge any deficiencies in sight distance,
- Mixed passing & overtaking - passing lanes in series with 5 km spacings but longer 10 km spacings, if some limited overtaking is still viable during peak periods,
- Passing only – 2+1 lanes on flat/rolling gradients and close spaced PLs or climbing lanes on mountainous gradients.

3.2 Types of Treatment/Measure

3.2.1 For each SH section strategy, appropriate overtaking, passing and supporting treatments/measures have been identified (Appendix A). Depending on the SH section strategy, some preferred general options for each supporting treatment and measure have been highlighted. Other options can be considered if more appropriate for the specific location.

3.3 Layout Frameworks

3.3.1 Policy frameworks have been developed to ensure consistency and to help assess the best type of road section strategy. They have an overlap as sometimes the transition from one strategy to another is not clearly defined. These frameworks are:

- Tool-kit of options (Appendix A),
- Length & frequency of overtaking sight distance (Appendix B),
- Long-term framework for overtaking and passing treatments (Appendix C).

3.4 High-Level Policy Objectives and Impacts

3.4.1 Both the Passing & Overtaking Policy and Passing & Overtaking Plans contribute to a number of high-level policy objectives and impacts. These objectives and impacts lead towards desirable outcomes that government are seeking to achieve within the transport sector. Notable result areas are:

Reduction in journey time delays

- As mentioned previously, the two-lane rural SH network carries about 30% of NZ's total annual road travel, as measured in vehicle kilometres travelled (vkt). Therefore, the Policy has a marked influence in reducing journey time delays, particularly at higher traffic volumes.
- NZTA is currently investigating the use of 2+1 lanes on state highways carrying 10,000-25,000 vpd, as an intermediate step between passing lanes and four-lanes.
- At lower traffic volumes below 10,000 vpd, PO Plans help to identify treatments, such as PLs in series, slow vehicle bays and shoulder widening, particularly for long sections with steep/undulating gradients and restricted sight distances.

Reduction in death and serious injury

- Both PO Plans and KiwiRAP target a reduction in head-on, intersection and loss of control type crashes. PO Plans also help to identify opportunities for being part of regional initiatives for education and enforcement measures.
- Development of 2+1 lanes, currently under investigation, will also consider a wire rope central barrier. The wire rope barrier will help to reduce the number of head-on crashes over the 10,000-25,000 vpd range where the likelihood of opposing traffic is high.
- NZ research (Koorey et al, 1999) shows that PLs provide a nett reduction in crash severity including fatal and serious injuries.

More efficient freight supply chains

- The majority of inter-regional road freight movements involve rural two-lane SHs for at least part of their trip. In the future, heavy commercial vehicles, which are typically slower moving vehicles, are likely to represent a higher proportion of the total traffic stream on rural two-lane State highways.
- PO Plans help to identify routes carrying high proportions of freight vehicles, where education and enforcement measures may be appropriate as part of wider regional initiatives. These wider initiatives involve regional representation from various NZTA groups, Road Controlling Authorities, NZ Police and other key stakeholders.
- If there are specific freight or long-haul passenger issues, industry representatives are engaged early within the preparation of PO Plans.

Better use of existing transport capacity

- As mentioned previously, NZ's rural two-lane SH network is about 90% (9,900 km approx) of the total SH network (11,000 km approx). Along with other strategic assets, management of the State Highway network forms part of the National Infrastructure Plan.
- PO Plans suggest PL and 2+1 lane layouts, which help to retrofit extra capacity and hence improve level of service to the existing network.
- Where available, the overtaking and mainly overtaking strategies make use of existing sight distance to help defer expenditure on PLs.

Value for Money

- The Policy enables incremental development in small capacity steps that closely match demand. Therefore, inputs are staged to achieve the best economy of inputs but still provide an adequate level of service.
- During 2006/07 to 2008/09, thirty passing lanes were constructed with an overall combined BCR of 4.7. Project efficiency generally falls into three BCR categories of i) less than 2 ii) 2 to 4 and iii) greater than 4. Therefore, passing lane projects are highly efficient at maximising the value of resources used.
- The PO Policy helps to make a significant contribution to the four above-mentioned outcomes of: reduction in journey time delays, reduction in death and serious injury, more efficient freight supply chains and better use of existing transport capacity. Therefore, the mix of treatments and measures implemented within PO Plans is effective in helping to address a number of immediate impacts sought in the GPS.

4. PASSING & OVERTAKING PLANS

4.1 PO Plans are an important tool to help identify an appropriate strategy by each SH section. The use of the SH video has made it possible to provide visual inspection and professional judgement. Key steps in the PO Plan process are:

- Division into SH sections,
- Inventory,
- Deficiency analysis & identify work Items,
- Reconfirm SH section strategy,
- Regional crash database (prepared in conjunction with the PO Plan),
- Work summary sheet,
- Prioritisation sheet.

4.1 Division into SH Sections

4.1.1 Using a road atlas, each SH is roughly divided into sections between townships or other prominent features. RAMM data is used to categorise these SH sections into flat, rolling and mountainous road gradient.

4.1.2 SHs are broken up into smaller sections with similar road gradients and level of traffic volumes. These smaller SH sections help to ensure that the SH section is more appropriate for local conditions and that the whole SH section is consistent with one type of strategy.

4.1.3 An appropriate interim (10 year) strategy is applied, which leads to a long-term (30 year) strategy. For example, a SH section may require 1.5 km PLs @ 5 km spacings over the next 10 years with infilling to provide 2+1 lanes after year 20.

4.1.4 The following guidance about dividing SH sections is usually applied:

General

- If the section has at least one third of more difficult terrain, the steeper road gradient is considered to dominate the overall section e.g. sections with 40% rolling gradient and 60% flat gradient are considered to have an overall rolling gradient.
- For transition points with an AADT of 5,000 vpd or less, if the AADT is exceeded by less than 250 vpd, the AADT should be rounded down to the nearest 1,000 vpd e.g. 5,250 vpd becomes 5,000 vpd.
- For transition points with an AADT of 7,000 vpd or more, if the AADT is exceeded by less than 500 vpd, the AADT should be rounded down to the nearest 1,000 vpd e.g. 10,500 vpd becomes 10,000 vpd.

Overtaking/mainly overtaking strategies

- For overtaking or mainly overtaking strategies, SH section lengths up to 50 km are desirable, with some occasional sections being 50-100 km long.

Mixed passing & overtaking strategies

- SH sections requiring a PL layout should be at least twice as long as the PL spacings for their long-term strategy i.e. 10 km or more if 5 km spacings and 20 km or more if 10 km spacings.
- If the SH section length, is less than double the long-term PL spacings, consideration should given to merging with the adjoining SH section's strategy.
- Where adjoining under-length SH sections have the same section strategy, it may be appropriate to combine the sections to achieve a desirable length.

Passing only strategies

- It is assumed that for 2+1 lanes to be viable, at least 10 km is required.

4.2 Inventory

4.2.1 The SH video was used to identify features and to check the division of SH sections. Each SH section has an individual spreadsheet with its own interim (10 year) and long-term (30 year) PO strategy. Parts of individual SH sheets are provided as examples of SH sections with overtaking, mainly overtaking, mixed passing & overtaking and passing only strategies (Appendices D-G respectively). Where the interim and long-term strategies are different, the features for both strategies are recorded.

4.2.2 The following guidance about inventory information is usually applied:

General

- All rural centres/settlements with urban speed zones (i.e. 70 km/hr or less) were noted. Sections that are more than 1 km long could affect the downstream influence for either the PL or overtaking zone layout for the section.
- On longer more remote sections, bridges or possibly an intersecting road are also included to help the reader locate themselves within the section.

Overtaking/mainly overtaking strategies

- The estimated HCV speed is visually assessed and its location is recorded as one of four categories i.e. 25-50, 50-70, 80-90 and 90-100 km/hr HCV speed. The visual assessment methodology has been calibrated using field measurements for HCV speeds over a range of road gradients.
- Available sight distance for 300 m or more is recorded and included the appropriate CD and ED relative to the HCV speed (for sections on flat/rolling gradient carrying 7,000 vpd or less and on mountainous gradient carrying 4,000 vpd or less as either an interim (10 year) strategy or long-term (30 year) strategy).
- Two close spaced CDs are assumed to have the same effect as an ED.
- Existing isolated PLs, SVBs and marked sealed shoulders which sometimes occur on low volume SHs are recorded. These passing treatments are noted, as they may be extended or upgraded at a later date.

Mixed passing & overtaking strategies

- Existing PLs, SVBs and marked sealed shoulders.

- Nearby intersections from 300 m approx upstream of the start of the diverge taper to about 300 m approx downstream of the end of the merge taper, together with the existing treatment for left and right turns.
- Access driveways within or near to existing PL merges and diverges.
- Speed advisory curves occurring near the end of a PL.

Passing only strategies

- All bridges, intersecting roads and speed advisory curves were also included, as these features tended to be constraints for locating 2+1 lanes.
- No-exit roads and important intersecting roads are noted as not suitable for leg closures.

4.3 Deficiency Analysis & Work Items

4.3.1 For each SH section, a layout framework is applied first to the long-term strategy. Where the interim and long-term strategies are different, different frameworks are used.

4.3.2 The following guidance about deficiency analysis is usually applied:

General

- Any proposed SH Plan projects are considered as part of the interim strategy.
- Any possible regional PL projects are considered as part of the long-term strategy

Overtaking/mainly overtaking strategies

- The length and frequency of overtaking sight distance (Appendix B) is used to determine the highest projected AADT for the existing layout of overtaking zones.
- In some cases, the projected AADT may be either higher or lower than the long-term AADT value.
- If CD and ED spacings are adequate for the long-term strategy then the interim strategy would be adequate also. The interim strategy should be checked if a long-term strategy is not feasible.
- CDs and EDs that are 90% and 95% of desirable length are still used but are noted respectively as marginal and close enough.
- For mixed HCV speed environments, the CD and ED lengths are appropriate for the HCV speed environment that they are located within. Downstream spacings are adjusted with the remaining portion of the spacing either halved or doubled to match the upcoming HCV speed environment e.g. for 10 km spacings on flat gradients equates to 4x(0.5x6)= 7 km spacing for say mixed flat/mountainous gradient.
- For SH sections with either less than projected 4,000 vpd (rolling and mountainous) or 5,000 vpd (flat), isolated PLs, SVBs and shoulder widenings with less than 60% of the Policy length are probably economical to extend. Refer to Appendix C for Policy lengths relative to projected AADT and road gradient.
- PLs with 60-80% of Policy length are not extended until the section AADT lies above 4,000 vpd (mountainous) or 7,000 vpd (flat/rolling).

Mixed passing & overtaking or passing only strategies

- The long-term framework for passing and overtaking treatments (Appendix B) is used to determine either the length and spacing of PLs or 2+1 lanes based on projected AADT and road gradient.
- Existing PLs that are 80-100% of the Policy length should still be adequate. Otherwise, extend the PL length.
- Same as for overtaking and mainly overtaking strategies. For SH sections with less than projected 7,000 vpd (flat/rolling), only PLs with less than 60% of the Policy length are probably economical to extend.
- Same as for overtaking and mainly overtaking strategies. For PLs with 60-80% of Policy length are not extended until the section AADT lies above 4000 vpd (mountainous) or 7,000 vpd (flat/rolling).

4.4 Reconfirm SH Section Strategy

4.4.1 The deficiency analysis is usually undertaken by a second more experienced person. This change in personnel allows the opportunity to review the HCV speed environment. Consequently, there may be some changes that alter the SH sections. After either the inventory and/or deficiency analysis and before identifying work items, the SH sections may sometimes be rearranged where:

- Part of a SH section is able to accommodate a different strategy with less infrastructure.
- Flat and/or rolling terrain was added for each end of a mountainous section so that any existing/recommended passing treatments can be included within the SH section.
- Long-term strategies may be the same but interim strategies differ or vice versa for some parts of the SH section.

4.5 Regional Crash Databases

4.5.1 Rural two-lane SH crashes have been grouped under common crash types. For both mixed passing & overtaking and passing only strategies, supporting treatments should be provided at either crash prone locations or high risk locations to mitigate any adverse safety effects from installing PLs. The travel time savings are provided by the PLs not the supporting treatments. Therefore, the emphasis is on intersection and cornering type crashes.

4.5.2 For both overtaking and mainly overtaking strategies, supporting treatments are provided, if crash prone locations are close to overtaking zones or isolated PLs. These treatments will help to provide both travel time and crash reduction savings.

4.5.3 Therefore, the emphasis is on providing either a localised marked sealed shoulder or adequate seal width on selected straights to mitigate overtaking, head-on and loss of control on straights type crashes. Also, a low-cost treatment, such as increased skid resistance, should be considered as a curve treatment, where cornering crashes are occurring up to 2 km downstream of overtaking zones.

Head-on straight (BA), overtaking (A) and rear-end (F) type crashes

4.5.4 These types of crash clusters are suitable for improvements to overtaking zones and passing facilities. Crash prone overtaking/passing-related locations are also used to help prioritise individual SH sections.

Head-on at corners (BB-BO) and loss of control cornering (D) type crashes

4.5.5 Crash clusters for these types of crashes are considered for roadside/edge line treatments e.g. speed advisory signs/chevron markings, shoulder widening and guardrails. These treatments are applied at a progressively reducing severity for about 4 km downstream of an existing/proposed passing facility. A 2 km downstream length could be considered for existing/proposed overtaking zones.

Intersection-related crashes (crossing (H, J) and turning (G, K, L))

4.5.6 These types of crash clusters are considered for intersection treatments, particularly if either within 300 m or located within existing/proposed passing facilities. Usually either right turn bays, deceleration lanes or shoulder widening are required. For cross roads, a leg closure may be more appropriate.

Overtaking (A), head-on (BA), loss of control (C) on straights type crashes

4.5.7 For overtaking and mainly overtaking section strategies, these types of crash clusters may require either a localised shoulder widening (if the seal width is adequate) or seal widening (if the seal width is not adequate).

4.5.8 From the State Highway Performance Indicators and Targets 2000/01 (NZTA, 2002), the seal width is deficient as follows:

- R4 (7/7.5/8 m target width) <1,000 vpd – deficient if less than 6.5 m,
- R3 (8.5/9.0 m target width) 1,000-4,000 vpd – deficient if less than 7.7 m,
- R2 (10 m target width) >4,000-10,000 vpd – deficient if less than 9 m.

4.5.9 Within the crash data, you will still need to distinguish between head-on crashes at one-way bridge sites, which may be due to the bridge and its approaches rather than passing/overtaking demand.

Accessway (Non-intersection G, H, J, K, L) pedestrian & cyclist crashes (N,P, vehicle S)

4.5.10 Generally, there is a low occurrence of these types of crashes. The width of sealed shoulder may be a factor in these types of crashes. The low incidence of access driveway crashes suggests that local knowledge is a factor in avoiding crashes.

4.5.11 The exposure rate for pedestrians and cyclists is low. Therefore, single fatal and serious crashes are considered. Typically these types of crashes can indicate conditions where either high volumes of cyclists can occur on SH sections (e.g. SH 1 Picton to Blenheim) or there is a short distance between two urban centres (e.g. SH 3 Longburn to Palmerston North).

4.6 Work Summary Sheet

4.6.1 The summary sheets outline the interim (10 year) and long term (30 year) programme of work/activities for overtaking and passing treatments plus supporting treatments/measures for each SH section. Part of a work summary sheet is provided as an example (Appendix H). Information on the work summary sheets are collated from layouts provided in each SH section spreadsheet.

4.6.2 Supporting treatments are selected from the Tool-kit of Options. The crash data base is also checked to identify any nearby crash cluster sites/routes. If there is a crash cluster, an appropriate supporting treatment should be provided.

4.6.3 The following guidance on work summary sheets is usually applied:

General

- On the individual SH section sheets, rectangles with dashed lines are used to indicate work to be undertaken. Similarly, rectangles with solid line are used to indicate existing features that are part of a strategy
- Within each rectangle, "I" for interim and "LT" for long-term is used to indicate the status of the work or existing feature.

Overtaking or mainly overtaking strategies

- For slight deficiencies in the CD and ED spacings, the suggested passing treatments are usually deferred to the long-term strategy with crash monitoring. Early implementation is provided if there is an adverse crash history.
- Supporting vegetation clearance is commonly used to address deficiencies in sight distance or to link two shorter lengths of clear sight distance.
- Supporting realignment projects, scheduled as part of other work, can provide new opportunities for either overtaking sight distance or isolated PLs.
- Supporting seal widening, scheduled as part of other work, may be required depending on seal width strategy relative to AADT. This treatment may be required if the layout of overtaking zones seems adequate but the CD or ED is still a crash prone location.
- Supporting localised marked sealed shoulders may be required if the seal width is adequate and there is an adequate layout of overtaking zones but there are still crash clusters sites occurring along some CDs and EDs.

Mixed passing & overtaking strategies

- Under-length PLs are usually extended first as part of the interim strategy with infilling of new PLs to follow. New PLs may be either on the SH Plan (proposed PLs) or at new sites that need to be confirmed (possible PLs).
- If the projected AADT indicates a passing strategy but the SH section has been retained as a mixed passing and overtaking strategy, passing strategy supporting measures would still be applied.
- New realignments can provide new opportunities for either overtaking sight distance or PLs in series. If the realignment is long enough, it may remove crash cluster routes of sub-standard curves.
- If appropriate, nearby supporting intersection and curve treatments are usually considered as part of the PL investigated. Usually, only crash cluster sites that are near to existing/planned PLs would be upgraded.
- Curve treatments, preferably as part of other scheduled work, should be co-ordinated with any new PL. However any curve treatment would be with decreasing emphasis for up to 2 km upstream and up to 4 km downstream. Crash prone locations can be identified from the regional crash database.
- If close to PLs, intersections would be considered to determine if their turning provision is adequate, particularly if the intersection has an adverse crash history.

- Resource planning measures typically include the safeguarding of existing and future PL sites, some localised submissions and designation issues. Encouraging the use of alternative networks is best done in conjunction with intersection leg closures.
- For sections with currently less than 10,000 vpd and at least 15% HCVs, education with follow-up enforcement as well as TDM would usually be considered as part of a regional programme.
- ITS measures are usually not applied.

Passing only strategies

- For SH sections involving 2+1 lanes, initially under-length PLs are usually extended and new PLs are installed to provide an interim 1.3-1.5 km PL @ 5 km spacings. This interim strategy applies where traffic volumes are still within the mixed passing and overtaking AADT range.
- If SH sections are 6-10 km, a single PL in each direction is considered.
- If sections are 5 km long or less, no passing lanes are provided. If appropriate, the SH section is merged with the adjacent SH section strategy.
- Central median cables should be applied. If PLs in series are the interim strategy provision could be made for later installation.
- Curve treatments would usually require a major upgrade of all curves, if not addressed within earlier SH section strategies.
- Intersection treatments may require either a left in/out restriction, if the central median cable is to be installed through the previous intersection. Improved seagull intersection with jug handles would be considered every 3-5 km. A leg closure is considered if the intersection is a four cross roads and still open to turning traffic (i.e. not reduced to left in/out.
- Resource planning measures are likely to require designations for localised curve improvements, overlapping 2+1 lanes and extra area for intersection upgrades. Safeguarding of future PL sites would also be a key activity. Submissions on land use and encouraging use of the alternative District road network may be appropriate for some locations.
- For all SH sections with more than 10,000 vpd as part of any interim or long-term strategy, education and follow-up enforcement would be considered as part of a Regional programme, particularly high HCV sections and high HCV generators.
- For some high demand locations, travel demand management measures would also be considered as part of a Regional programme, particularly for rural commuting and possibly alternative hours for some overweight/oversized loads.
- For some high demand locations, intelligent transport systems would consider ITS-assisted merging using variable message signs.

4.7 Prioritisation Sheet

4.7.1 Part of a prioritisation sheet is provided as an example (Appendix I). SH sections that are the most deficient over the next 10 years are given a high priority (1). SH sections are automatically identified as priority 1, if their AADTs are within the range for a long-term passing only strategies.

4.7.2 SH sections where the current level of PLs and/or overtaking sight distance will be adequate for the next 10 years are given a lower priority (2 or 3).

4.7.3 When determining the potential deficiency of the SH section, the following influences are considered. These influences are combined to determine the SH section deficiency, which reflects potential travel time savings:

- Shortfall in PLs within the next 10 year layout including under-length PLs,
- Section length,
- Projected AADT,
- Proportion of HCVs (only if on mountainous road gradient),
- Relative demand compared to other strategies.

4.7.4 High-level impacts are also taken into account:

- Current HCVs/day (reflects freight use),
- Number of fatal and serious injuries per km for passing/overtaking-related crashes over the last 5 or 10 years, depending on current AADT (reflects road safety),
- Number of tourists/year (reflects tourist use).

5. IMPLEMENTATION ISSUES

5.1 Decision-Making for PO Plans

5.1.1 A three phased approach enables a progressive transfer of decision-making responsibilities:

- Stage 1: Preparation of initial draft PO Plan for each region by NZTA National Office.
- Stage 2: Acceptance and implementation of the suggested PO Plan by NZTA regional office. Engagement with some key stakeholders, if there are specific issues.
- Stage 3: Engagement and integration with key regional stakeholders' programme of works/activities (e.g. NZ Police, Regional Land Transport Committees) and other NZTA groups (e.g. education, resource planning).

5.2 Input into Strategic Studies

5.2.1 The PO Plans provide input into SH corridor plans for selected high-priority routes. These SH corridor plans include other SH activities, such as pavement maintenance, road safety and bridge requirements.

5.2.2 The PO Plans are a key part of these studies and act as a catalyst to coordinate other work within the nearby vicinity. Regional stakeholder engagement is part of the strategic studies process and should help with acceptance and integration of PO input into their work/activity programmes.

5.3 Prioritisation

5.3.1 The SH Classification system has helped to identify high-priority routes, which reflect high-level policy. However, prioritisation of PO projects focuses on deficient sections rather than entire routes.

5.3.2 With the introduction of SH Classification, national and regional strategic routes rather than selected regions are now being targeted. About 4,800 km of rural two-lane SHs (c.f. total 9,900 km) has currently been evaluated as Stage 1 PO Plans. This figure includes about 1,700 km of national and regional strategic routes (c.f. total 3,600 km on rural two-lane SHs).

5.3.3 Higher-volume sections of national strategic routes generally have more intensive adjacent land-use. Projects on these types of SH section are more likely to be delayed by property purchases and resource consent issues. Therefore, a mix of both national and regional strategic routes is being evaluated, with preference given to projects on deficient sections of national strategic routes if they are ready to construct.

5.3.4 Once levels of service have been finalised for each SH classification, NZTA would revisit the implementation of the Policy.

5.4 EEM Procedures

5.4.1 Two research projects currently within NZTA's research programme will have an impact on the Policy. The research project "Operating Characteristics and Economic Evaluation of 2+1 lanes with/without ITS-Assisted Merging" will investigate the development of an evaluation procedure for 2+1 lanes. As mentioned earlier, preliminary work was undertaken before undertaking this larger project (Beca, June 2010).

5.4.2 NZTA research programme project "Use of Roadside Barriers versus Clear Zones" will investigate the use of side restraint barriers as opposed to the current practice of clear zoning. Amongst other run-off-road situations, this research will help to mitigate run-off-road crashes downstream of PLs at potentially a lower cost than current clear zoning practices.

5.4.3 Beca, Dec 2010 has identified revised PL length factors, which reflect the increased efficiency of longer PLs as traffic volumes increase. It is planned to disseminate these revised factors as a technical circular with an amended EEM Table A7.11 to follow later.

6. EXAMPLES OF PASSING & OVERTAKING PLANS

6.1 Pilot studies have added credibility to the PO Plan process. Initial work has been carried out for the Manawatu-Whanganui & Taranaki regions. However, the effect of overtaking zones at lower traffic volumes was not taken into account until later PO Plans, such as Waikato. Following on from the Waikato PO Plan, an interim (10 year) and long-term (30 year) programme was also provided for supporting treatments/measures.

6.2 Mountainous parts of SH 2 Napier to Gisborne were assessed and helped to refine the layout frameworks for mountainous gradients at low traffic volumes. This experience contributed to developing a methodology for applying the Policy to a low-volume part of the SH network, such as West Coast, South Island.

6.1 Waikato

Overtaking or Mainly Overtaking

6.1.1 About 240 km of Waikato's rural two-lane SHs within the projected 4,000-7,000 vpd range (Total 380 km approx) could support either an overtaking or mainly overtaking strategy over the next 30 years. Therefore, the overtaking sight distance framework has been useful in deferring unnecessary expenditure within this projected AADT range.

PLs in series

6.1.2 NZ research into PL efficiency relative to PL length and AADT has given a better understanding of under-length PLs (Beca, Dec 2010). Currently, there are 103 existing PLs. About 72 of these existing lanes will be under-length after 30 years, consisting of 18 PLs being 60-80% of Policy length and a further 54 PLs having less than 60% of Policy length. Refer to Appendix C for Policy lengths relative to projected AADT and road gradient. About 41 of these under-length PLs should be lengthened over the next 10 years.

2+1 lanes

6.1.3 About 170 km of two-lane rural SH will lie within the projected 10,000-25,000 vpd range. About 74 km of the 170 km has a high priority for improvements within the next 10 years.

6.1.4 An intermediate 2+1 layout has been suggested for about 67 km, which is about 40% of the total SH length within the projected AADT range. The remaining 103 km relate to mountainous sections (25 km), flat/rolling sections with projected AADT in the 10,000-14,000 vpd range (40 km) and flat/rolling shorter sections of 10 km or less (38 km) with a PL provided in each direction for 5-10 km long SH sections. The 2+1 lane treatment will be deferred on the above-mentioned 40 km of SH sections with projected 10,000-14,000 vpd but operational efficiency and safety will be monitored.

Intersections

6.1.5 Seventeen (8%) PL sites out of a total of 215 existing and planned PL/2+1 lane sites over the next 30 years will have an intersection on the left hand side within the PL. A further 12 PLs already have a intersection on the right hand side within the PL but are not considered desirable for any future planned PLs.

6.1.6 NZ research on intersections close to PLs (Wanty, 2011) suggests that these 29 PLs should not present a safety problem. However, it would still be wise to monitor the crash history of PLs with right hand side intersections. A further 29 upstream or downstream PL sites may also be affected if the road section layout had to be rearranged. Therefore, the NZ intersection research has potentially enabled about 58 (25%) sites to be used.

Supporting Treatments/Measures

6.1.7 The suggested work programme for PLs and 2+1 lanes has enabled better co-ordination with proposed safety works scheduled over the next 10 years on the same SH sections. Supporting intersection and curve treatments were linked to specific PLs and 2+1 lanes within the individual SH sheets. A further refinement within later PO Plans has been to include parallel interim and long-term strategies for all supporting treatments/measures as part of the work summary sheet.

6.2 West Coast, South Island

Stakeholder Engagement

6.2.1 The West Coast Regional Council wished to spend its regional funding on SH passing opportunities. Typically, the current SH traffic volumes are 2,000 vpd or less. Earlier involvement with the West Coast Regional Council and the trucking industry had raised concerns about various locations.

6.2.2 A deficiency analysis was undertaken as part of the PO Plan process and identified these same locations, along with some other potentially problematic SH sections. The West Coast Regional Council accepted the proposed PO Plan and published the suggested sites within the region's local newspapers.

Vegetation control

6.2.3 About 100 candidate sites had been previously identified for PLs, SVBs or shoulder widening. Of those 100 sites, 50 sites were later determined to be on SH sections with adequate ASD. About 35 locations were identified where ASD could be improved through vegetation clearance. NZTA's low growth vegetation policy may need to be considered to reduce on-going maintenance.

Passing facilities

6.2.4 About 15 sites were identified where there was both inadequate sight distance that could not be improved and no passing facilities. From these 15 sites, 5 sites were chosen as they had a crash history involving overtaking related crashes. One additional site was later added as increased tourist coach traffic was expected.

Seal widening

6.2.5 SH road sections with AADTs close to a transition limit may need to be considered within the interim or long-term strategy e.g. AADT 1,000 vpd or 4,000 vpd. Some SH sections had over 50% of their length with insufficient seal width. However, it may not be practical to improve all overtaking zones. Crash saving benefits might be achieved using seal widening of some locations with either a CD or ED length of clear sight distance.

Realignments

6.2.6 Just outside of the West Coast boundary, a realignment project was proposed on SH 73 at Ninga Bluffs, east of Arthurs Pass township. This realignment would provide about 1 km of clear sight distance in both directions. Current traffic volumes were about 1,600 vpd and likely to remain low. Taking into account the availability of other overtaking opportunities in the near vicinity, estimated benefits equivalent to 100% of a 600 m PL in one direction and about 50% in the other direction were added to the project's BCR.

Education measures

6.2.7 The value of 15% HCVs was used as a threshold for education measures and helps to identify critical SH road sections. SHs 7, 69, 73 and parts of SH 6 were recommended for education measures. As part of education measures, feedback from transport and HCV operators on using existing/new facilities should be considered. Improved signage may be required to help the operation of facilities on some routes, particularly if there are a large number of recreational vehicles.

Ice Prone Locations

6.2.8 Some crash prone locations were possibly suitable for vegetation control and/or drainage improvements. While there are parts of the SH network that are ice-prone, there appear to be only a few locations where ice related crashes occur. Care needed be to taken to avoid ice-prone locations when providing passing facilities or upgraded overtaking zones.

7. IMPLICATIONS FOR LOCALISED SOLUTIONS

7.1 Translating high-level policy to localised solutions can be divided into two steps, namely: first changing high-level policy into operational strategies and second customising operational strategies to local conditions. A key part of the PO Plan process has been to adapt these factors to address local issues. Table 2 outlines some of the key factors.

Table 2. Key Factors for Translation of High-Level Policy to Localised Solutions	
High-Level to Operational Strategy	**Operational Strategy to Localised Solutions**
Literature Review/Research NZTA commissioned research to address knowledge gaps and to apply overseas research to NZ context.	Projected AADTs for each SH section.
Strategy Standardised strategies. Four strategies to suit different conditions.	Fine grained division of SH sections.
Inventory of assets Inventory of SVBs, PLs marked shoulder and sight distance.	Layout frameworks to help assess deficiencies. Variety of pilot studies to confirm layout frameworks.
Work/activity programmes 10 year strategy. Co-ordination with other SH work/activities.	Incremental development towards 30 year strategy. Parallel strategies for supporting treatments/measures.
Prioritisation (including SH classification with levels of service to follow). Emphasis on national and regional strategic routes.	Prioritise deficient sections over next 10 years on national and regional strategic routes.
Work processes EEM Procedures.	Targeted research to improve EEM procedures for specific treatments e.g. SVBs, 2+1 lanes.
Engagement Input into strategic planning processes with joint-party involvement e.g. Regional Growth Strategies, area-wide studies. Input into external processes e.g. RMA.	Staged transfer of decision-making responsibilities but with continued advice. Specific resource planning, education, enforcement measures for each SH section.

7.2 The use of four SH section strategies, the fine subdivision of SH sections, estimated current and future traffic volumes for each SH section plus layout frameworks have all helped to make each type of strategy appropriate to local conditions. For the PO Plan process, a number of pilot studies have been undertaken under different traffic volume and gradient conditions.

7.3 The interim (10 year) PO programme has been linked to a long-term (30 year) strategy that aligns respectively with funding and planning time frames. These time frames reflect short and long-term goals. The interim strategy also progresses incrementally towards a long-term SH section strategy.

7.4 While co-ordination with other SH activities scheduled for the general location is desirable, the programmes for passing and overtaking treatments also include parallel programmes linked to supporting treatments/measures. These linked programmes recognise that passing and overtaking treatments cannot be implemented in isolation from other influences.

7.5 Prioritisation of deficient SH sections along a high priority route seems a better approach than prioritising the route as a whole and helps to focus regional office resources. On-going research has been undertaken with an emphasis on providing improvements to current work systems, such as NZTA's Economic Evaluation Manual.

7.6 Joint party involvement at a local level is a common technique for identifying local issues. However, the staged transfer of responsibility for preparing the PO Plan plus early engagement with key stakeholders is an additional way to ensure that local issues are taken into account.

7.7 Some of the supporting treatments and measures involve input from regional/district stakeholders outside of NZTA. Specific supporting measures for resource planning, education and enforcement are linked to each SH section strategy.

8. CONCLUSION

8.1 PO Plans provide a systematic approach to addressing a wide range of road and traffic conditions on NZ's rural two-lane SHs. The division of larger SH lengths into appropriate SH sections relative to traffic volumes and road gradients is an important part of applying the most appropriate strategy to each SH section.

8.2 Each SH section has an individual work/activity programme for an interim (10 year) layout that incrementally leads to a long-term (30 year) layout. Parallel strategies are applied for supporting treatments/measures. Where possible, passing and overtaking projects are linked with other SH activities that are scheduled for the same SH section or route.

8.3 Standardised assessment frameworks are applied to ensure that deficiencies and hence work is identified in a consistent manner. Work processes, such as EEM procedures, have been improved to help support implementation of the work programmes.

8.4 Prioritisation of SH sections takes into account higher level impacts as well as deficiency over the next 10 years. However, prioritisation focuses on deficient sections along high priority routes rather than prioritising the route as a whole.

8.5 After reviewing and agreeing which SH sections have the highest priority, NZTA regions and their stakeholders are better placed in terms of local knowledge to implement and co-ordinate individual projects/activities within these higher priority SH sections.

8.6 The Policy also seeks to improve work processes, such as NZTA's EEM procedures. These improvements help to ensure that solutions are both cost-effective and appropriate for local conditions. An example of these improvements is the research work around EEM procedures for 2+1 lanes, as well as revised EEM PL length factors.

8.7 NZTA's Regional PO Plans recognise that the provision of overtaking zones and passing treatments has to give effect to in high-level policy, such as the Government Policy Statement impacts.

8.8 These PO Plans provide input into high-level strategic planning initiatives such as SH corridor studies, which in turn link into area-wide strategic studies. These area-wide strategic studies typically involve both multi-party funding agreements and multi-party input from local and regional representatives.

9. DISCLAIMER

9.1 The opinions presented in this paper are the views of the author and not necessarily the views of NZTA. The examples of PO Plans and the appended sheets are taken from Stage 1 Draft PO Plans and may vary from the final Stage 3 PO Plan.

10. REFERENCES

a. AUSTROADS, 2003. "Rural Road Design A Guide to the Geometric Design of Rural Roads", Eighth Edition, Sydney, Australia.

b. Beca Infrastructure, 2008. "Simple Screening Method for Slow Vehicle Bays", Unpublished Report prepared by Beca Infrastructure for New Zealand Transport Agency. 2008.

c. Beca Infrastructure, 2009. "SVB Evaluation Tool Version 2.1", Unpublished Excel macro-based Evaluation Tool prepared by Beca Infrastructure for New Zealand Transport Agency. 2009.

d. Beca Infrastructure, June 2010. "ITS-Assisted Merging at Passing Lanes", Revision 1.3, Unpublished Report prepared by Beca Infrastructure for New Zealand Transport Agency. 10 June 2010.

e. Beca Infrastructure, Dec 2010. "Review of Economic Evaluation Manual's Passing Lane Length Factors". Unpublished Report prepared by Beca Infrastructure for New Zealand Transport Agency. 24 December 2010.

f. Bergh T. & Carlsson A., 1995. "Design Criteria and Traffic Performance Research in New Swedish Guidelines on Rural Highways", International Symposium on Highway Geometric Design Practices, Transportation Research Board, Boston, USA, Aug. 30-Sept. 1 1995, pp.1-15.

g. Cenek P. & Lester T., 2008. "Operational Evaluation of Representative Passing Lanes against Proposed Guidelines", Unpublished Report prepared by Opus Central Laboratories for New Zealand Transport Agency. 2008.

h. Koorey G.F., Farrelly P.M., Mitchell T.J. & Nicholson C.S., 1999. "Assessing Passing Opportunities – Stage 2", Transfund New Zealand Research Report No. 146.

i. New Zealand Transport Agency, 2001. "State Highway Performance Indicators and Targets", Unpublished Report prepared by New Zealand Transport Agency, Aug 2002.

j. New Zealand Transport Agency, 2006. "Background Technical Report on NZTA's Passing & Overtaking Policy", Unpublished Report prepared by NZTA, June 2006.

k. New Zealand Transport Agency, 2006. "Economic Evaluation Manual Volume 1", ISBN 0-478-28983-9, October 2006.

l. Wanty D., 2007. "Pilot Study on Assessing Passing/Overtaking Demand using TMS", Unpublished Report prepared by MWH NZ Ltd for New Zealand Transport Agency. 2007

m. Wanty D., 2011. "NZTA Passing Lane Research", Unpublished Report prepared by MWH NZ Ltd for New Zealand Transport Agency, April 2011.

n. Werner A. & Morrall J.K., 1984. "A Unified Traffic Flow Theory Model for Two Lane Rural Highways", Transportation Forum Vol. 1-3, pp.79-87, 1984.

11. ACKNOWLEDGEMENTS

11.1 The author acknowledges the support of NZTA in preparing and presenting this paper. Various consultants, particularly Beca Infrastructure Ltd, MWH NZ Ltd and Opus Central Laboratories are also acknowledged for the work undertaken on a number of NZ research projects, as well as inventory and crash database work for PO Plans.

APPENDIX A
Tool-Kit of Options

	Treatments and Measures	Overtaking	Mainly Overtaking	Mixed [6] Passing & Overtaking	Passing
		Passing and Overtaking Strategy Type			
Overtaking treatments	**OVERTAKING SIGHT IMPROVEMENTS**				
	Vegetation control, batter relocation	C	C	C	-
	Pavement rehabilitation, realignment	C	C	C	-
	OVERTAKING ENHANCEMENTS				
	Seal widening	P	P	C	-
	Overtake at PLs or SVBs, configuration of PLs or SVBs	P [1]	P [1]	P [1]	-
Passing treatments	**LOW-VOLUME TREATMENTS [2]**				
	Shoulder widening or crawler shoulder	P [1]	C [1]	-	-
	SVB or short PL	C [1]	P [1]	-	-
	MODERATE-VOLUME TREATMENTS [3]				
	Wide shoulder (special use requirement)	-	-	C	-
	PLs in series	-	-	P	P [4]
	Crawler lanes	-	-	C	C
	2+1 lanes (subject to four-lane comparison)	-	-	-	P [5]
Supporting treatments & measures	**CENTRELINE TREATMENTS**				
	Line markings	P	P	P	C
	Gap separation	-	-	C	P
	Central median cables	-	-	C	P
	ROADSIDE/EDGELINE TREATMENTS				
	Clear zone and shoulder run-off	P	P	P	P
	Increased signs and markings	P	P	P	P
	Wide profile markings	C	C	P	P
	Local shoulder widening and/or chip seal	C	C	P	P
	Cable or guard rails	C	C	C	C
	INTERSECTION TREATMENTS				
	OT zones/PLs with respect to intersection	P [1]	P [1]	P	P
	Provision for through traffic	C	C	P	P
	Intersection rationalisation	-	-	P	P
	RESOURCE PLANNING MEASURES				
	Control of direct access onto SH	C	C	P	P
	Submission (plan docs, RC application)	C	C	P	P
	Encourage alternative District networks	C	C	C	C
	New alignments	C	C	C	C
	EDUCATION MEASURES				
	Target audience	C	C	C	P
	General public	C	C	C	C
	ENFORCEMENT MEASURES				
	Problem locations	C	C	C	P
	General public	C	C	C	C
	TRAVEL DEMAND MGT (TDM) MEASURES				
	Alternative hours, routes or modes	C	C	C	P
	INTELLIGENT TRANSPORT SYSTEMS (ITS) MEASURES				
	Variable message signs with/without web camera	C	C	C	C
	Speed cameras	C	C	C	C

NOTES: Not an exclusive list, others may be added at a later date. If more than one preferred option for same treatment/measure, consider one or combination on a case-by-case basis. P = preferred option/s, C = consider if specific problem. 1 = only if overtaking strategy is not viable (For OT Zones/PLs not shown in same table in PPM). 2 = low- volume is typically less than projected 5,000 vpd. 3 = moderate-volume is typically projected 4,000-25,000 vpd. 4 = preferred on mountainous terrain. 5 = preferred on flat/rolling terrain, subject to comparison with four-lanes. 6. "Mixed" added not in same table in PO Policy within PPM.

APPENDIX B
Long-Term Framework for Overtaking Sight Distance

Available Sight Distance	Speed Profile of HCVs (Slow Moving Vehicles) (km/h)			
	Flat 90-100 km/h	**Rolling 80-90 km/h**	**Mountainous 50-70 km/h**	**Very Mountainous 25-50 km/h**
CD & ED spacing	680 m @ 20 km	560 m @ 20 km	400 m @ 10 km	280 m @ 5 km
% ASD	& 20 %	& 20 %	-	-
CD or ED spacing	680 m @ 10 km OR 1 km @ 20km	560 m @ 10 km OR 1 km @ 20 km	400 m @ 5 km OR 770 m @10 km	280 m @ 3 km OR 510 m @ 5 km
% ASD	& 25-30%	& 25-30%	-	-
CD & ED spacing	680 m @ 5 km OR 1 km @ 10 km	560 m @ 5 km OR 1 km @ 10 km	400 m @ 3 km OR 770 m @ 5 km	280 m @ 1-2 km OR 510 m @ 3 km
% ASD	& 35-45%	& 35-45%	-	-
CD & ED spacing	680 m @ 3 km OR 1 km @ 5 km	560 m @ 3 km OR 1 km @ 5 km	400 m@1-2 km OR 770 m @ 3 km	510 m @1-2 km
% ASD	& 50-65%	& 50-65%	-	-
CD & ED spacing	680 m@1-2 km OR 1 km @ 3 km	560 m@1-2 km OR 1 km @ 3 km		
% ASD	& 70-90%	& 70-90%		
Key - Strategy Type	Overtaking	Mainly Overtaking	Mixed Passing & Overtaking	

Note: For each speed profile, the average HCV (slow moving vehicle) speed is used for distance travelled. The proportion of ASD relates to 300 m ASD or more. Proportion of each hour with gaps for overtaking = $e^{-(0.0018626 \times OFLOW)}$ where OFLOW is the opposing one-way flow in vph. Assume a cumulative binomial distribution for the Probability of Opposing Traffic. For relating AADT to peak one-way flow, assume 55/45 directional split and 10.5% AADT.

APPENDIX C.
Long-Term Framework for Passing & Overtaking Treatments

Projected AADT (vpd)	Road Gradient		
	Flat	**Rolling**	**Mountainous**
<2,000	Overtaking (OT) (OT sight distance improvements, OT enhancements, possible isolated shoulder widening/crawler shoulder/SVBs[1]/short PLs).		
2,000-4,000	Overtaking (As above).	Mainly OT, as above but possibly some SVBs[1] or short PLs @ 10 km.	
4,000-5,000 (General transition to PLs)	Mainly OT, as above but possibly some SVBs[1] or short PLs @ 10 km.	Mixed PLs @ 10km 1.2 km + tapers & OT enhancements.	Mixed PLs @ 5 km 1.0 km + tapers & possible OT enhancements.
5,000-7,000 [3]	Mixed PLs[2] @ 5 or 10 km 1.2 km + tapers & OT enhancements.		
7,000-10000	Mixed PLs[2] @ 5 or 10 km 1.5 km + tapers & OT enhancements.		Mixed PLs @ 5 km 1.2 km + tapers & possible OT enhancements.
10,000-12,000 [3,4] **(General transition to 2+1 lanes)**	Mixed PLs @ 5 km 1.5 km + tapers & possible OT enhancements	Passing 2+1 lanes (subject to four-lane comparison).	Passing PLs @ 5 km 1.2-1.5 km + tapers.
12,000-20,000	Passing 2+1 lanes (subject to four-lane comparison).		
20,000-25,000 (General transition to 4 lanes)			
Key - Strategy Type	Overtaking / Mainly Overtaking	Mixed Passing & Overtaking	Passing

Notes:
1. Where appropriate, a slow vehicle bay (SVB) is able to be easily altered to a PL at a later date.
2. Along the same road section, a mixed layout with 5 km spacing in higher demand locations and 10 km spacing in lower demand locations.
3. For flat or rolling road gradient, the combination of passing lane length and spacing may not be sufficient to dissipate vehicle queues and a more frequent provision of passing opportunities would be required. Therefore, passing treatments, such as 2+1 lanes (subject to comparison with four-lanes), are likely to be required for state highways with a flat or rolling gradient and projected 10,000-25,000 vpd.
4. 10,000-12,000 vpd represents a general upper limit for passing lanes in series with flat or rolling gradient. Above this threshold, treatments such as 2+1 lanes (subject to comparison with four-lanes), are likely to be required. Some locations may have a higher upper limit of about 14,000 vpd depending on other factors, such as the directional flow split and traffic composition.

APPENDIX D
Example of SH Section with Overtaking Strategy

REGION 1 - SH 1N (PUKENUI TO AWANUI) PASSING & OVERTAKING STRATEGY														
Prep by	**IDR**				**Prep Date 03/03/10**		**Updated by LJC**						**Date Last Updated 26/11/10**	
ROAD SECTIONS														
From	**To**	**Length**	**Approx Dist Start**	**Approx Dist End**	**SH Section**	**Approx AADT 2010**	**Approx AADT 2020**	**Approx AADT 2040**	**%LVT**	**%HCV**	**TMS Stn**	**Road Grade**	**PO Strategy**	**Comments (incl Long-Term PO strategy)**
PUKENUI TO AWANUI @ SH10														
64/5.35	83/2.32	16	69	85	Pukenui to Katavich Rd	1655	1626	1567		12	00100097	F	1	Generally CD & ED OK up to 2,000 vpd. Relies on CDs.
83/2.32	83/18.57	17	85	102	Katavich Rd to Awanui	1655	1626	1567		12	00100097	RM		Generally CD & ED OK up to 2,000 vpd.
83/18.57	83/19.73	1	102	103	Awanui @ SH10									
PASSING & OVERTAKING TREATMENTS														
From	**To**	**Length (incl tapers)**	**Dist Start**	**Dist End**	**Description**	**Direction**	**Incr D/strm Effect**	**Decr D/strm Effect**	**Treatmt / Measure**	**PO Option**	**Status**	**Linked**	**Priority/ Action Reqd**	**Comments**
PUKENUI TO AWANUI @ SH10														
65/5.35			70		**PUKENUI sth urban bdy**	I					EX			50 km/hr urban area
65/5.35			70		**START 80-90 km/hr APPROX SLOW VEHICLE SPEED, <20 km/hr speed differential.**									ASD Incr 5.36/15 km= 36%, Decr 5.08/15 = 34%
65/5.35	83/2.32		70	85	***Check speed differential***									
65/6.21	65/6.54		71	72	330 m ASD	I					EX			
65/6.54	65/6.21		72	71	330 m ASD	D					EX			
65/6.77	65/7.23		72	72	460 m ASD	I					EX			
65/7.23	65/6.77		72	72	460 m ASD	D					EX			
65/7.52	65/8.38		73	73	**860 m ASD**	I	10				EX			560 m CD
65/8.29					75 km/hr curve									
65/8.38	65/7.52		73	73	**860 m ASD**	D		20			EX			560 m CD. Two close spaced CDs.
						I								
65/8.45	65/8.83		73	74	380 m ASD	I					EX			
65/8.83	65/8.46		74	73	380 m ASD	D					EX			
65/9.10	65/9.89		74	75	**790 m ASD**	I	10+(0.5x3)+7=19				EX			560 m CD. Two close spaced CDs.
65/9.89	65/9.10		75	74	**790 m ASD**	D		10			EX			560 m CD
65/11.24	65/11.83		76	77	**590 m ASD**	I	10				EX			560 m CD
65/11.83	65/11.24		77	76	**590 m ASD**	D		10			EX			560 m CD
65/15.70	65/16.01		81	81	310 m ASD	I					EX			
65/16.01	65/15.70		81	81	310 m ASD	D					EX			
65/16.37	65/16.95		81	82	**580 m ASD**	I	10				EX			560 m CD
65/16.95	65/16.39		82	81	**560 m ASD**	D		10			EX			560 m CD
65/17.34	65/17.40		82	82	340 m ASD	D					EX			

APPENDIX E
Example of SH Section with Mainly Overtaking Strategy

REGION 1 - SH 1N (OKAIHAU TO OHAEAWAI) PASSING & OVERTAKING STRATEGY														
Prep by	**IDR**				**Prep Date 03/03/10**		**Updated by LJC**						**Date Last Updated 26/11/10**	
ROAD SECTIONS														
From	**To**	**Length**	**Approx Dist Start**	**Approx Dist End**	**SH Section**	**Approx AADT 2010**	**Approx AADT 2020**	**Approx AADT 2040**	**%LVT**	**%HCV**	**TMS Stn**	**Road Grade**	**PO Strategy**	**Comments (incl Long-Term PO strategy)**
RANGIAHUA BRIDGE TO OKAIHAU TO OHAEAWAI @ SH 12														
149/14.79	167/12.06	15	164	179	Rangiahua River Bridge to Okaihau	1648	1984	2657		13	00100171	FR	2	Generally CD & ED OK up to 4,000 vpd except to RP 167/10-14=4 km in incr dim. Monitor crashes
167/12.06	190/0.00	11	179	190	Okaihau to Ohaeawai urban nth bdy	1510	1592	1754		13	00100190	F	1	Generally CD & ED OK up to 2,000 vpd except RP 185/5.37-167/15.53 = 7 km in decr dim. Monitor crashes
PASSING & OVERTAKING TREATMENTS														
From	**To**	**Length (incl tapers)**	**Dist Start**	**Dist End**	**Description**	**Direction**	**Incr D/strm Effect**	**Decr D/strm Effect**	**Treatmt / Measure**	**PO Option**	**Status**	**Linked**	**Priority/ Action Reqd**	**Comments**
RANGIAHUA BRIDGE TO OKAIHAU TO OHAEAWAI @ SH 12														
149/14.79			164		**RANGIAHUA RIVER BRIDGE**	I					EX			
149/14.79			164		**START 90-100 km/hr APPROX SLOW VEHICLE SPEED, <20 km/hr speed differential.**									ASD Incr 4.24/8 km= 53.0%, Decr 3.56/8 = 44.5%
149/15.78	149/16.50		165	166	**710 m ASD**	I	5				EX			680 m CD
149/16.50	149/15.78		166	165	**710 m ASD**	D		10			EX			680 m CD. Two close spaced CDs.
149/16.55	167/0.18		166	167	**1.00 km ASD**	I	10				EX			1 km ED
167/0.18	149/16.55		167	166	**1.00 km ASD**	D		10			EX			1 km ED
167/0.52	167/1.02		168	168	500 m ASD	I					EX			
167/1.02	167/0.52		168	168	500 m ASD	D					EX			
167/1.14	167/1.82		168	169	**680 m ASD**	I	5				EX			680 m CD
167/2.39	167/2.86		169	170	470 m ASD	I					EX			
167/2.86	167/2.39		170	169	470 m ASD	D					EX			
167/3.07	167/3.64		170	171	570 m ASD	I					EX			
167/3.64	167/3.07		171	170	570 m ASD	D					EX			
167/4.47	167/4.98		171	172	310 m ASD	I					EX			
167/4.98	167/4.47		172	171	310 m ASD	D					EX			
167/5.00			172		**END 90-100 km/hr APPROX SLOW VEHICLE SPEED, <20 km/hr speed differential.**									
167/5.00			172		**START 80-90 km/hr APPROX SLOW VEHICLE SPEED, <20 km/hr speed differential.**									ASD Incr 1.48/6.8 km= 21.9%, Decr 1.08/6.8 = 16.0%
167/7.45	167/7.77		174	175	320 m ASD	I					EX			

APPENDIX F
Example of SH section with Mixed Passing & Overtaking Strategy

REGION 1 - SH 1N (OHAEAWAI TO KAWAKAWA) PASSING & OVERTAKING STRATEGY														
Prep by	IDR				Prep Date 05/03/10		Updated by LJC						Date Last Updated 26/11/10	
ROAD SECTIONS														
From	To	Length	Approx Dist Start	Approx Dist End	SH Section	Approx AADT 2010	Approx AADT 2020	Approx AADT 2040	%LVT	%HCV	TMS Stn	Road Grade	PO Strategy	Comments (incl Long-Term PO strategy)
OHAEAWAI TO KAWAKAWA														
190/0.29	198/0.00	8	190	198	Ohaeawai urban east bdy to Pakaraka @ SH 10	5389	7125	10597		8	00100192	F	4	
198/0.00	198/6.57	7	198	205	Pakaraka @ SH 10 to Moerewa urban nth bdy	9031	10429	13224		7	00100211	FR	6	
198/6.57	198/8.34	1	205	206	Moerewa urban nth to sth urban bdy									Urban excluded
198/8.34	198/12.50	5	206	211	Moerewa urban sth bdy to Kawakawa urban nth bdy	9031	10429	13224		7	00100211	FR	6	
198/12.50	211/0.00		211	211	Kawakawa urban nth to sth bdy									Urban excluded

PASSING & OVERTAKING TREATMENTS														
From	To	Length (incl tapers)	Dist Start	Dist End	Description	Direction	Incr D/strm Effect	Decr D/strm Effect	Treatmt / Measure	PO Option	Status	Linked	Priority/ Action Reqd	Comments
OHAEAWAI TO KAWAKAWA														
185/5.37	190/0.31		190		**OHAEAWAI north to east urban bdy**	I					EX			Incl SH 12 RP 185/5.70 = 190/0.0
190/0.31			190		**START 90-100 km/hr APPROX SLOW VEHICLE SPEED, <20 km/hr speed differential.**									
190/1.16	190/0.50		191	191	**390 m PL**	D					EX			RP 190/1.06 - 0.66 excl tapers.
			191		***Investigate possible remarking as marked shoulder***	D					LT			
190/1.51	190/3.33		192	194	***Investigate possible Sbd 1.6 km PL***	I	5				LT			
					Investigate possible curve treatment at crash prone location.	I								
190/2.30			192		LHS T Jn Old Bay Rd									Ex Narrow seal widen for RT turns & ex Decel lane for LT Turns
190/2.30			192		***Investigate possible RT turn treatment***	I						L		Linked to possible Sbd 1.6km PL
190/7.67			198		**END 90-100 km/hr APPROX SLOW VEHICLE SPEED, <20 km/hr speed differential.**									
190/6.33	190/4.77		196	195	***Investigate possible Nbd 1.3 km PL***	D		5			LT			
					Check advance sight distance at merge									
190/7.67	198/0.00		198	198	**PAKARAKA @ SH 10**	I					EX			
198/0.00			198		**START 90-100 km/hr APPROX SLOW VEHICLE SPEED, <20 km/hr speed differential.**									

APPENDIX G
Example of SH Section with Passing Only Strategy

REGION 1 - SH 1N (WAIOTU TO KAMO TO WHANGAREI) PASSING & OVERTAKING STRATEGY														
Prep by	**IDR**				**Prep Date 05/03/10**		**Updated by LJC**						**Date Last Updated 26/11/10**	

ROAD SECTIONS

From	To	Length	Approx Dist Start	Approx Dist End	SH Section	Approx AADT 2010	Approx AADT 2020	Approx AADT 2040	%LVT	%HCV	TMS Stn	Road Grade	PO Strategy	Comments (incl Long-Term PO strategy)
WAIOTU TO KAMO TO WHANGAREI														
233/5.50	245/2.86	9	239	248	Waiotu to Hikurangi (Buchanan Rd/Gilbey Ave)	9234	11868	17135		10	00100246	R	6	2+1 lanes. Traffic growth currently declining.
245/2.86	245/7.62	5	248	253	Hikurangi to Mangahahuru Stream (Piano) Bridge	10309	13249	19129		10		F		2+1 lanes. Possible four lanes (Option B). Traffic growth currently declining. Averge of TMS 00100246 & 00100254.
245/7.62	245/12.04	4	253	257	Mangahahuru Stream (Piano) Bridge to Kamo urban nth bdy	11383	14630	21123		10	00100254	R		Possible four-laning (Option A), Possible 80 km/hr speed zone.
245/12.04	245/13.02	1	257	258	Kamo urban nth to sth bdy									Urban excluded
245/13.02	245/15.89	3	258	261	Kamo urban st bdy to Kamo South urban nth bdy								6	Ex 80 km/hr speed zone. Possible four-laning.
245/15.89	261/4.83	5	261	266	Kamo South urban nth bdy to Whangarei urban nth bdy									Urban excluded
266/0.00	266/1.74	2	266	268	Whangarei urban nth bdy to sth bdy									Urban excluded
266/1.74	266/3.70	2	268	270	Whangarei 80 km/hr zone nth to sth bdy	16983	22023	32103		9	00100271	F		Exclude as projected AADT greater than 25,000 vpd (2040)

PASSING & OVERTAKING TREATMENTS

From	To	Length (incl tapers)	Dist Start	Dist End	Description	Direction	Incr D/strm Effect	Decr D/strm Effect	Treatmt / Measure	PO Option	Status	Linked	Priority/ Action Reqd	Comments
WAIOTU TO KAMO TO WHANGAREI														
233/5.50			239		**LHS T Jn Waiotu Block Rd**	I					EX			
233/5.50			239		**START 90-100 km/hr APPROX SLOW VEHICLE SPEED, <20 km/hr speed differential.**									
233/6.24			239		**Waiariki Stream Bridge**	I								
233/6.36	233/6.98		239	240	**320 m PL**	I					EX			RP 233/6.36 - 6.98 excl tapers.
233/6.92	233/7.05		240	240	LHS 130 m Marked Shoulder	I					EX			
233/5.70	233/7.34		239	241	***Investigate possible extended 1.4 km PL (Option 1A)***	I	5				I, LT			Check merge sight distance. Linked to Deferred proposed Nbd Waiotu Nth Rd, Nbd PL & Option 1B Sbd PL & possible Nbd PL RP 233/9.30-7.51
233/6.36	233/8.07		239	241	***Investigate possible extended 1.5 km PL (Option 1B, overlapping)***	I								Check merge sight distance. Linked to Deferred proposed Nbd Waiotu Nth Rd, Nbd PL & Option 1A Sbd PL & possible Nbd PL RP 233/9.30-7.51
233/9.3	233/7.1		241	242	***DEFER Proposed Northbound Passing Lane (Waiotu North Nbd PL)***	D		5	P	PL	SHP			
233/9.30	233/7.51		242	241	***Investigate possible PL to provide 1.5 km PL***	D					I, LT	L		Linked to deferred proposed Nbd Waiotu Nth Rd Nbd PL & Option 1A & 1B Sbd PL
233/9.41			242		**LHS T Jn Puhipuhi Rd**	I								Ex narrow seal widen for RT turns, ex seal widen for LT turns
233/9.41					Access to railway line									

APPENDIX H
Example of Work Summary Sheet

REGION 1&2 (NORTHLAND-AUCKLAND) PASSING & OVERTAKING STRATEGY - WORK SUMMARY

Prep by LJC | **Prep Date 1/10/10** | **Updated by LJC** | **Date Last Updated 6/12/10**

ROAD SECTIONS

	From (RP/RS)	To (RP/RS)	Length of Rurak SH Section (km)	Start Running Distance (km)	End Running Distance (km)	Description	Estimated 2010 AADT (vpd)	Estimated 2020 AADT (vpd)	Estimated 2040 AADT (vpd)	%LVT	%HCV	TMS Station	Road Gradient	Combined Terrain	Current Strategy Approx 2010	Target Interim 2020 Strategy	Target Long-Term 2040 Strategy	Interim Strategy (Next 10 years, up to 2020) for Overtaking & Passing Treatments	Long-Term Strategy (Next 25-30 years, up to 2040) for Overtaking & Passing Treatments	Interim Strategy (next 10 years up to 2020) for Supporting Treatments/ Measures	Long-Term Strategy (next 10 years up to 2020) for Supporting Treatments/ Measures
	Note CD = continuation sight distance, ED = establishment sight distance. RP = route position. AADT = annualised average daily traffic flow.																				
	PASSING & OVERTAKING TREATMENTS																				
1	**SH 1N**																				
32	**OHAEAWAI TO WAIOTU**																				
33	**Ohaewai to Kawakawa**																				
34	190/0.29	198/0.00	8	190	198	Ohaeawai urban east bdy to Pakaraka @ SH 10	5389	7125	10597		8	00100192	F		4	4	4	Monitor crash history	**INCR DIRN** RP 190/1.51-3.33 Investigate possible Sbd 1.6 km PL. **DECR DIRN** RP 190/6.33-4.77 Investigate possible Nbd 1.3 km PL & Check advance sight distance at merge. RP 190/1.16-0.50 Investigate possible remarking as marked shoulder.	**OVERTAKING** BR-, CP-, OP-, PR-, RE-, SW- RAMM shows R3 consider R2 Ohaeawai to Kawakawa. VC - See overtaking treatments. **CENTRELINE** CC-, GR-, GS-, LM- **ROADSIDE/EDGELINE** Investigate RP 211/0-1 Proposed Curve Realignment (Bends South of Kawakawa Realign Stage 1). RP 215/14.05-15.9 Proposed Akerama Curves Realignment (Linked to RP 215/14.2-17.3 Proposed Akerama Sbd PL). Consider options for CS-, CZ-, GR-, LS-, SC-, SM-, WP-. **INTERSECTIONS** IN- RP 198/2.82 Investigate possible Marshall Rd (Nth end) leg closure., LO-, TH -RP 190/2.30 Investigate possible RT turn treatment as part of RP 190/1.51-3.33 Sbd 1.6 km PL. RP 198/2.39-2.09 Investigate possible RT turn treatment for Smith Rd. RP 215/16.20 Check for possible Akerama Rd RT turn treatment in conjunction with RP 215/14.2-17.3 Sbd Akerama RD PL **RESOURCE PLAN'G** AC-, AL-, DE -, SU -. **EDUCATION** G-, T-. **ENFORCEMENT** G-, P-. **TDM** H-, M-, R-. **ITS** V-,VM-,S-.	**As for interim EDUCATION** G-, T - Monitor for over 10,000 vpd, Pakaraka to Kawakawa as part of Regional HCV programme on use of PLs/ASDs. Part of Regional HCV programme on use of PLs/ASDs. Investigate rural commuter services
35	198/0.00	198/6.57	7	198	205	Pakaraka @ SH 10 to Moerewa urban nth bdy	9031	10429	13224		7	00100211	FR		4	4	6	**INCR DIRN DECR DIRN** RP 198/5.09 Check advance sight distance.	**INCR DIRN** RP 198/0.81 Check speed differential & RP 198/0.81-2.97 Consider extended 1.9 km PL if speed differential is small.		
36	198/6.57	198/8.34	1	205	206	Moerewa urban nth to sth urban bdy															
37	198/8.34	198/12.50	5	206	211	Moerewa urban sth bdy to Kawakawa urban nth bdy	9031	10429	13224		7	00100211	FR		4	4	6	NA	NA		
38	198/12.50	211/0.00	1	211	211	Kawakawa urban nth to sth bdy															
39	**Kawakawa to Waiotu**																				
40	211/0.00	233/5.50	28	211	239	Kawakawa urban sth bdy to Waiotu Block Rd	6713	8128	10957		11	00100212	RM	RH	5	5	5	**INCR DIRN** RP 211/1.0-2.8 Investigate possible 1.2-1.5 km PL to include RP 211/2.52 Investigate possible 85 km/hr curve realignment or other treatment. Check advance sight distance. RP 215/9.68-11.33 Investigate possible 1.4 km PL & check advance sight distance. RP 215/14.2-17.3 Proposed Akerama Curve Realignment and Sbd PL & (Check RP 215/15.9-17.3 if PL is 1.3-1.5 km PL excl tapers on flat/rolling or 1.1-1.2 km PL excl tapers on hilly/mountainous. If not provide adequate PL length as per gradient). RP 233/0.80-17.3 Proposed Hukerenui Nbd PL extension Stage 2 & Curve Realignment & RP 233/1.03 Proposed Hukerenui NB PL Extension Stage 1. **DECR DIRN** RP 215/7.9-7.1 **DELETE** Proposed Callaghan Rd Nbd PL. RP 215/11.53-10.30 Investigate possible PL extension to provide 1.2 km PL (Option 2A). RP 215/11.53-9.8 Investigate possible PL extension to provide 1.5 km PL (Option 2B).	**INCR DIRN** RP 215/3.63-5.04 Investigate possible extended Sbd 1.5 km PL (Option 1A). RP 215/5.21 Investigate realignment of advisory curve inconjunction with RP 215/4.8-6.53 Possible Sbd 2.6 km PL Installation (Callaghan Rd Sth Bd PL) (Option 1B).		
41																					

Appendix I
Example of Prioritisation Sheet

SUMMARY OF REGION 1& 2 (NORTHLAND & AUCKLAND) - PRIORITISATION OF SH SECTIONS

Prep by & Date: LJC 5/5/10 | Updated by & Date: LJC 6/12/10

To be read in conjunction with Work Summary & Individual SH Passing & Overtaking Plans

NOTES — **Unhide rows 5-23 to read NOTES**

Existing PLs under length for Policy.
- Assume, for existing PLs with projected 7,000 or more vpd approx and < 80% of Policy length, extend to 80-100% of Policy length.
- For ex PLs with proj 4,000-7,000 vpd approx on F & R road gradient/2,000-7,000 vpd approx on M road gradient, extend ex PLs with < 60% of Policy length out to >80%. Monitor ex PLs with 60-80% of Policy length.
- For PLs with less than projected 4,000 vpd approx on F & R road gradient or less than projected 2,000 vpd approx on M conditions, no extension but monitor.

Relative Projected Demand
2.0 = PLs/climbing lanes with projected >10,000 vpd (Mountainous).
1.0 = PLs with projected >12,000 vpd (Flat), projected >10,000 vpd (Rolling), 7,000-10,000 vpd (Mt'ous).
0.5 = PLs with projected 7,000-12,000 (F), projected 7,000-10,000 vpd (R) 4,000-7000 vpd (M).
0.3 = PLs with projected 4000-7,000 (F&R), 2,000-4,000 vpd (M).
0.15 = PLs with projected 2,000-4,000 vpd (R).
0.05 = PLs with projected <4000 vpd (F&R), < 2,000 vpd (M).

Safety Factor
Ratio of Fatal & Serious (A, BA, F Type) Crashes/ km of road section (but not less than 5 km). 2= Ratio of 0.6 or more, 1= 0.3-0.5, 0.4= 0.2 , 0.2= 0.1, 0= other.

High HCV Factor (only on mountainous road gradient)
2 = 15% or more HCVs, 1.5 = 10-14% HCVs, 1= less than 10% HCVs.

Freight Factor
2.0=2,000 or more HCVs/day flat/rolling (1,000 or more HCVs/day mountainous), 1.0=1,000-2,000 (500-1,000), 0.5=500-1,000 (250-500), 0.3 =<500 (<250)

Tourist Factor
2=>100,000 people/day, 1=60,000-100,000, 0.5=20,000-60,000, 0.3=10,000-20,000, 0.1=10,000-20,000, 0=<10,000.

Demand Factor
Proportional Shortfall = (PLS in SH Plan, PLs to be altered and Extra PLs required)/Interim Target No. of PLs & SVBs. For SH sections less than 10 km, 10 km was used as the section length.

Priority Grade
1(High) >40, 2(Med) = 10-40, 3(Low) <10. (If section <10 km long match with adj section.
Also, if section has AADTs for Passing Only strategy over the next 10 years
OR high competing land use use 1 (High).

Row	SH	Start Running Distance (km)	End Runnng Distance (km)	Description	Estimated 2010 AADT (vpd)	Estimated 2020 AADT (vpd)	Estimated 2040 AADT (vpd)	TMS Station	Length of Rural SH Section (km)	Road Gradient	Combined Terrain	Current Strategy Approx 2010	Target Interim 2020 Strategy	Target Long-Term 2040 Strategy	Current 2010 Strategy	Interim Strategy (Next 10 years, up to 2020)	Long-Term Strategy (Next 25-30 years, up to 2040)
				TOTALS					110								
1				**SH 1N**													
29				**Mangamuka to Rangiahua River Bridge**													
30	IN	149	164	Mangamuka-Mohuiti Rd to Rangiahua River Bridge	1648	1984	2657	00100171	15	RM		1	1	3	OT impts, if reqd	OT impts, if reqd	0.6-0.8 PL if reqd
31				**Rangiahua Bridge to Ohaeawai @ SH 12**													
32	IN	164	179	Rangiahua River Bridge to Okaihau	1648	1984	2657	00100171	15	FR		1	1	2	OT impts, if reqd	OT impts, if reqd	0.6-0.8 PL @10 if reqd
33	IN	179	190	Okaihau to Ohaeawai urban nth bdy	1510	1592	1754	00100190	11	F		1	1	1	OT impts, if reqd	OT impts, if reqd	OT impts, if reqd
34																	
35				**OHAEAWAI @ SH 12 TO WAITOU**													
36				**Ohaewai @ SH 12 to Kawakawa**													
37	IN	190	198	Ohaeawai urban east bdy to Pakaraka @ SH 10	5389	7125	10597	00100192	8	F		4	4	4	1.5PL @ 10	1.5PL @ 10	1.5PL @ 5
38	IN	198	205	Pakaraka @ SH 10 to Moerewa urban nth bdy	9031	10429	13224	00100211	7	FR		4	4	6	1.5PL @ 5	1.5PL @ 5	1.5PL @ 5
39	IN	205	206	Moerewa urban nth to sth urban bdy													
40	IN	206	211	Moerewa urban sth bdy to Kawakawa urban nth bdy	9031	10429	13224	00100211	5	FR		4	4	6	1.5PL @ 5	1.5PL @ 5	1.5PL @ 5
41	1N	211	211	Kawakawa urban nth to sth bdy													
42				**Kawakawa to Waiotu**													
43	IN	211	239	Kawakawa urban sth bdy to Waiotu Block Rd	6713	8128	10957	00100212	28	RM	H	5	5	5	1.2-1.5PL @ 5	1.2-1.5PL @ 5	1.2-1.5PL @ 5
44																	
45				**WAIOTU TO KAMO TO WHANGAREI**													

Row	2010 100-80% Policy length	2010 80-60% Policy length	2010 60% or less Policy length.	2010 Current Total Ex PLs/SVBs/marked shoulders	2020 New PLs/SVBs/marked shoulders already in 2008/09 SH Plan	2020 Existing PLs/SVBs/marked shldrs to be altered over next 10 yrs	2020 Extra PLs/SVB/marked shoulders reqd built for interim layout.	2020 Interim Target No. of PLs/SVBs/marked shoulders on Priority One SH Sections	2020 Interim Target No. of PLs/SVBs/ marked shoulders	2020 Long-Term Target No. of PLs/SVBs/marked shoulders on Priority One SH Sections	2040 Long-Term Target No. of PLs/SVBs/ marked shoulders	Relative Projected PO Demand	% HCV on mountainous terrain only	Factor High HCVs (only mountainous gradient)	Demand (Projected 2040 AADT x HCV factor x Relative Demand x Length x 10 yr Proportional Facilities Shortfall)	Factor Safety	%HCV	No. of Current HCVs/day @ 2010	Factor Freight	Factor Tourist Route	Prioritisation Number (Larger is more important).	Priority Grade High (1), Medium (2), Low (3)
TOTALS	3	4	7	14	1	10	4	15	18	3	25											
30				0					0		1	0.3	13	1.5	0	0.0	13	214	0.3	0.1	0	3
32				0				0	0		1	0.05		1	0	0.0	13	214	0.3	0.1	0	3
33				0				0	0		0	0.05		1	0	0.2	13	196	0.3	0.1	0	3
37			1	1			1		1		3	0.5		1	4	0.0	8	431	0.3	0.1	2	3
38	1	1		2		1		1	2	0	2	1		1	7	0.2	7	632	1.0	0.1	9	1
40				0					0	0	0	1		1	0	0.4	7	632	1.0	0.1	0	1
43	1	2	2	5	1	3	2	7	7	1	8	1	11	1.5	39	0.2	11	738	1.0	1.0	87	1