Traffic Management Vehicle Tracking Guideline
May 2018

1 GUIDELINE PURPOSE

1 This guideline provides an overview of when a check or analysis of vehicle tracking may be required when designing and planning Traffic Management Plans (TMPs).

2 WHEN ARE VEHICLE TRACKING CHECKS REQUIRED?

Development of Traffic Management Plans

2 Traffic Management Plans (TMPs) are required when a planned event effects the typical operating conditions of the road¹. TMPs may include adjusting the paths of vehicles through the traffic network, e.g. by narrowing or shifting traffic lanes, reconfiguring intersections, creating temporary accesses etc.

3 Vehicle tracking may need to be checked where a TMP could involve a revision to the existing vehicle paths/movements, creation of new temporary accesses or traffic facilities (intersections, roads etc), or a change to the way certain vehicles use the transport network (e.g. detouring bus routes away from their usual route).

Example of Simple Vehicle Tracking Check

4 The images below show a simple representation of an intersection, worksite, a series of simple checks on vehicle swept paths, and an example of how the worksite could be altered to safely accommodate traffic movements.

¹ Best practice for TMPs is described by the Code of Practice Temporary Traffic Management (COPTTM) and the local area Local Operating Procedures (LOPs).
Figure 1: Example of a simple, e.g. transparency, vehicle tracking check and adjustment

**Requirement to Check Vehicle Tracking**

5 During TMP development vehicle tracking checks are typically not required when:

5.1 Vehicle movements remain as-is or the change to vehicle movement is minor. Examples may include minor lane narrowing, mid-block lane drops which comfortably achieve COPTTM standards and similar scenarios.

6 During TMP development vehicle tracking checks are typically required when:

6.1 Larger vehicles (heavy trucks, buses, over dimension vehicles, high productivity motor vehicles (HPMVs) etc.) need to be facilitated on roads or accesses not designed to accommodate these vehicles and/or in locations that they would not usually travel.

6.2 Traffic Management reduces the physical space available at an intersection, access, or key section of road. E.g. narrowing lanes at an intersection, working on a bend in the road or working on a corner or immediate approach at an intersection.

6.3 A worksite access is physically constrained and vehicle movement in / out of the site (e.g. heavy vehicles) could be a problem.

6.4 Vehicles are anticipated to travel over multiple lanes or opposing lanes to enter / exit a worksite, or through an intersection.

6.5 Traffic Management significantly changes the road, particularly intersection, layout e.g. changing roundabout to signals or vice versa.

6.6 Traffic Management includes the temporary construction of a new section of road, intersection, etc.
3 SELECTING THE APPROPRIATE TRACKING CHECK APPROACH

<table>
<thead>
<tr>
<th>TMP Design Scenario</th>
<th>&quot;Inspection&quot; Check / On-Site Adjustment</th>
<th>Transparency Check</th>
<th>CAD Swept Path Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal change to existing layout and vehicle movements, minor impact to existing</td>
<td>Likely to be useful</td>
<td>May be useful</td>
<td>Unlikely to be required</td>
</tr>
<tr>
<td>lane widths / available space</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site access with physical constraints</td>
<td>Likely to be useful</td>
<td>Likely to be useful</td>
<td>May be useful</td>
</tr>
<tr>
<td>Minor constraint / restriction to the movement of larger vehicles</td>
<td>Likely to be useful</td>
<td>Likely to be useful</td>
<td>May be useful</td>
</tr>
<tr>
<td>Significant intersection reconfiguration (e.g. converting signals to roundabout or</td>
<td>Unlikely to be appropriate</td>
<td>May be useful</td>
<td>May be useful</td>
</tr>
<tr>
<td>vice versa etc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major physical constraint, detour, or change effecting movement of larger vehicles</td>
<td>Unlikely to be appropriate</td>
<td>May be useful</td>
<td>Likely to be useful</td>
</tr>
<tr>
<td>New temporary intersection</td>
<td>Unlikely to be appropriate</td>
<td>May be useful</td>
<td>Likely to be useful</td>
</tr>
</tbody>
</table>

Table 1 below provides a guide around when certain tracking checks could be appropriate. The different key methods are described in the section below.

4 METHODS OF CHECKING VEHICLE TRACKING (SWEPT PATHS)

Basic Inspection of Remaining Space / Lane Widths

The most straightforward vehicle tracking check is a simple “inspection” of the proposed TM layout. This typically focuses on the space remaining (particularly any reductions to lane widths at intersections) and whether any vehicle movements (particularly larger vehicles) could cross into other lanes.
An inspection would be carried out by reviewing the proposed TM layout against the existing road layout, usually from aerial photos, Google streetview, or similar imagery.

If the inspection identified any more significant issues, e.g. tight turning movements, narrower lanes, potential for large vehicle paths to cross into other lanes etc., this would trigger the need to carry out a more thorough vehicle tracking check using one of the approaches below.

**On-Street Tests and Adjustments**

A straightforward inspection check of vehicle swept paths may identify that the TMP arrangement is ‘tight’ for certain movements, although not necessarily generating a need for a more thorough swept path analysis. This may be flagged for on-site setup, with review and adjustment to accommodate traffic movements carried out as a ‘live test’.

If concerns were more significant, e.g. if a high frequency bus route could be affected, then a planned ‘live’ on-site test may be carried out. This would typically be carried out by setting up / mocking up the site as designed prior to the planned event (e.g. physical works) starting and allowing vehicles to navigate the site on-street in a controlled manner. The on-street manoeuvres would be inspected and could be videoed ‘live’ to check for any issues including crossing into opposing lanes and any physical constraints in the available road space. This would often be done during a ‘low traffic flow’ period, e.g. at night, where any issues with the site and vehicle tracking would not have a significant effect on other travellers.

On-street tests are an option where it is straightforward to carry out the test, the results of other tracking analysis remain unclear, uncertain, or are challenged, and/or the TMP setup is particularly unique, innovative, or new.

**Transparency Swept Path Method**

The transparency method involves printing out the TMP layout to the correct scale and overlaying on the TMP transparencies showing specific vehicle swept paths (also printed to the same correct scale). To correctly scale the TMP, this would either involve drawing the plan in AutoCAD or similar CAD software, or scaling the printed plan with aerial photograph background carefully using printer scaling and scale ruler.

This method can give a relatively quick result and is easy to complete however it is only indicative as the print outs are not likely to be completely accurate.

Tracking layouts for various movements are available for a range of vehicles such as those in the Christchurch District Plan. A list of vehicles is provided in Section 5 below and plans which can be printed to the correct scale provided in the Appendix.

**Computer Based Swept Path Method**

As indicated in Table 1, a Computer Assisted Drafting (CAD) approach is likely to be useful in scenarios where significant temporary network reconfigurations are deployed, e.g. major roading projects such as motorway constructions. CAD analysis is not anticipated as a core requirement in day-to-day urban traffic management activities.

Drawing the plan in AutoCAD and using AutoTURN (or similar CAD software) is the most robust form of vehicle tracking analysis as it is done using software which can produce accurate outputs. This means the plans can be drawn robustly and tracking paths checked accurately providing confidence that the planned layout would work in practice. As well as this, AutoCAD has several adjustable parameters such as speed and clearance which can be used to calibrate tracking and carry out sensitivity tests on the swept paths. This means that tracking paths of
complex turning manoeuvres can be completed with a high level of accuracy unlike the transparency swept path method.

18 The software also allows new vehicle types to be made if all the parameters relating to the vehicle (size, speed, axels etc) are known.

19 Outputs can be presented to show different aspects including a body envelop, clearance and tyre tracking. These are described below:

19.1 The body envelop would show the area that the vehicle uses to manoeuvre.

19.2 The clearance is offset from the body envelop and gives an indication of how much clear space is required on each side of a vehicle for comfortable manoeuvring. Typically clearances are set at 0.3m for light vehicles and 0.5m for heavy vehicles.

19.3 The tyre tracking would show where the tyres are going to travel over (within the body envelop). This is useful when avoiding kerbs or other such constraints.

20 An example of CAD-based vehicle tracking for over-dimension vehicles is shown below.

21 AutoCAD will give an accurate result and a good indication of time required to complete the manoeuvre. The time to complete the manoeuvre is useful further information when checking vehicle tracking, i.e. if it’s taking a long time for a vehicle to complete a manoeuvre this could indicate potential issues with the plan which could cause problems on-site.

5 VEHICLE TYPES

22 A number of design vehicles are available in the District Plan and from NZTA. The tracking curves specify the technical parameter of each vehicle so that they can be made in AutoCAD or similar software if required. These are attached in the Appendix and can be printed on
transparency to scale to carry out transparency vehicle tracking checks. The vehicle type tracking paths included are;

22.1 85 Percentile design motor car

22.2 99 Percentile design vehicle

22.3 Small Rigid Vehicle

22.4 Medium Rigid Vehicle

22.5 Large Rigid Vehicle

22.6 Semi-Trailer

22.7 City Bus

22.8 Tour Coach
B85 Vehicle (Realistic min radius) (2004)
Overall Length 4.910m
Overall Width 1.870m
Overall Body Height 1.421m
Min Body Ground Clearance 0.159m
Track Width 1.770m
Lock to Lock Time 4.00s
Kerb to Kerb Turning Radius 5.750m
B99 Vehicle (Realistic min radius) (2004)

- Overall Length: 5.200m
- Overall Width: 1.940m
- Overall Body Height: 2.200m
- Min Body Ground Clearance: 0.312m
- Track Width: 1.840m
- Lock to Lock Time: 4.00s
- Kerb to Kerb Turning Radius: 6.520m
SRV - Small Rigid Vehicle

- Overall Length: 6.400 m
- Overall Width: 2.330 m
- Overall Body Height: 3.602 m
- Min Body Ground Clearance: 0.398 m
- Track Width: 2.330 m
- Lock to Lock Time: 4.00 s
- Kerb to Kerb Turning Radius: 7.100 m
Kerb to Kerb Turning Radius: 10.000m
Lock to Lock Time: 4.00s
Track Width: 0.428m
Min Body Ground Clearance: 3.633m
Overall Body Height: 2.500m
Overall Width: 8.800m
Overall Length: 8.800m

MRV - Medium Rigid Vehicle
Overall Length: 8.800m
Overall Width: 2.500m
Overall Body Height: 3.633m
Min Body Ground Clearance: 0.428m
Track Width: 2.500m
Lock to Lock Time: 4.00s
Kerb to Kerb Turning Radius: 10.000m
DESIGN VEHICLE DIMENSIONS (mm)

SLIGHT DEVIATION
DUE TO TAIL SWING

8m MEDIUM
RIGID TRUCK

1:250 Scale @ A3

2007 ON-ROAD TRACKING CURVES
VEHICLE: 8m MEDIUM RIGID TRUCK
TURN: 10m RADIUS

Recommended clearances (500mm) must be added to each side of the tracking curve (refer to text)

QUICK REFERENCE
- 8m Medium Rigid Truck
- 1:250
- 10m radius

THIS SWEPT PATH ENVELOPE SHOWS THE EXTREMITY OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.
DESIGN VEHICLE DIMENSIONS (mm)

VEHICLE WIDTH 2500

SLIGHT DEVIATION DUE TO TAIL SWING

8m MEDIUM RIGID TRUCK

12.5m radius

30°

60°

90°

120°

180°

150°

20m

30m

10m

20m

30m

1:250 Scale @ A3

THIS SWEPT PATH ENVELOPE SHOWS THE EXTREMITY OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.

2007 ON-ROAD TRACKING CURVES
VEHICLE: 8m MEDIUM RIGID TRUCK
TURN: 12.5m RADIUS

Recommended clearances (500mm) must be added to both sides of the tracking curve (refer to task)

Land Transport NZ
Ikiiki Whenua Aotearoa

Sheet 2 of 17

QUICK REFERENCE
- 8m Medium Rigid Truck
- 1:250
- 12.5m radius
2007 ON-ROAD TRACKING CURVES

VEHICLE: 8m MEDIUM RIGID TRUCK
TURN: 15m RADIUS

Recommended clearances (500mm) must be added to each side of the tracking curve (refer to text)

QUICK REFERENCE
- 8m Medium Rigid Truck
- 1:250
- 15m radius

Sheet 3 of 17
DESIGN VEHICLE DIMENSIONS (mm)

VEHICLE WIDTH 2500

SLIGHT DEVIATION DUE TO TAIL SWING

1:250 Scale @ A3

8m MEDIUM RIGID TRUCK

20m radius

THIS SWEPT PATH ENVELOPE SHOWS THE EXTREMITY OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.

2007 ON-ROAD TRACKING CURVES
VEHICLE: 8m MEDIUM RIGID TRUCK
TURN: 20m RADIUS

Recommended clearances (500mm) must be added to each side of the tracking curve (refer to text)

QUICK REFERENCE
- 8m Medium Rigid Truck
- 1:250
- 20m radius

Sheet 4 of 17
DESIGN VEHICLE DIMENSIONS (mm)

VEHICLE WIDTH 2600

1380  648  1448  2430

SLIGHT DEVIATION DUE TO TAIL SWING

1:250 Scale @ A3

20m radius

20°  60°  90°  120°  150°  180°

30°

LARGE RIGID TRUCK

2007 ON-ROAD TRACKING CURVES
VEHICLE: LARGE RIGID TRUCK
TURN: 20m RADIUS

THIS SWEEP PATH ENVELOPE SHOWS THE EXTREMITIES OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.

Land Transport NZ
Ikiiki Whenua Aotearoa

QUICK REFERENCE

- Large Rigid Truck
- 1:250
- 20m radius

Recommended clearances (600mm) must be added to each side of the tracking curve (refer to text)
DESIGN VEHICLE DIMENSIONS (mm)

SLIGHT DEVIATION DUE TO TAIL SWING

1:250 Scale @ A3

LARGE RIGID TRUCK

25m radius

30°  60°  90°  120°  150°  180°

THIS SWEPT PATH ENVELOPE SHOWS THE EXTREMITY OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.

2007 ON-ROAD TRACKING CURVES
VEHICLE: LARGE RIGID TRUCK
TURN: 25m RADIUS

Recommended clearances (500mm) must be added to each side of the tracking curve (refer to text)
DESIGN VEHICLE DIMENSIONS (mm)

SLIGHT DEVIATION DUE TO TAIL SWING

SEMI-TRAILER

THIS SWEPT PATH ENVELOPE SHOWS THE EXTREMITY OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.

2007 ON-ROAD TRACKING CURVES
VEHICLE: SEMI-TRAILER
TURN: 12.5m RADIUS

Recommended clearances (500mm) must be added to each side of the tracking curve (refer to text)
2007 ON-ROAD TRACKING CURVES
VEHICLE: SEMI-TRAILER
TURN: 20m RADIUS

THIS SWEPT PATH ENVELOPE SHOWS THE EXTREMITY OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.

Recommended clearances (500mm) must be added to each side of the tracking curve (refer to text).

1:250 Scale @ A3

SLIGHT DEVIATION DUE TO TAIL SWING

VEHICLE WIDTH 3600

DESIGN VEHICLE DIMENSIONS (mm)
DESIGN VEHICLE DIMENSIONS (mm)

SLIGHT DEVIATION DUE TO TAIL SWING

25m radius

30° 60° 90° 120° 150° 180°

SEMI-TRAILER

1:250 Scale @ A3

2007 ON-ROAD TRACKING CURVES
VEHICLE: SEMI-TRAILER
TURN: 25m RADIUS

THIS SWEPT PATH ENVELOPE SHOWS THE EXTREMITY OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.

Recommended clearances (600mm) must be added to each side of the tracking curve (refer to text)

Land Transport NZ
Ikiiki Whenua Aotearoa

QUICK REFERENCE
- Semi-trailer
- 1:250
- 25m radius
NOTE:
VEHICLE TRACKED AT 15 km/hr

SCALE 1:250 @ A3
LTNZ-115CB-125R
(11.5M CITY BUS)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Width</td>
<td>2.50</td>
</tr>
<tr>
<td>Track</td>
<td>2.50</td>
</tr>
<tr>
<td>Lock to Lock Time</td>
<td>6.0</td>
</tr>
<tr>
<td>Steering Angle</td>
<td>41.5</td>
</tr>
</tbody>
</table>

NOTE:
VEHICLE TRACKED AT 15 km/hr

SCALE 1:250 @ A3
LTNZ-115CB-125R
(11.5M CITY BUS)

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</tbody>
</table>

NOTE:
VEHICLE TRacked AT 15 km/hr

SCALE 1:250 @ A3
LTNZ-115CB-125R
(11.5M CITY BUS)

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<tr>
<td>Steering Angle</td>
<td>41.5</td>
</tr>
</tbody>
</table>

NOTE:
VEHICLE TRacked AT 15 km/hr

SCALE 1:250 @ A3
DESIGN VEHICLE DIMENSIONS (mm)

SLIGHT DEVIATION DUE TO TAIL SWING

1:250 Scale @ A3

THIS SWEPT PATH ENVELOPE SHOWS THE EXTREMITY OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.

2007 ON-ROAD TRACKING CURVES
VEHICLE: TOUR COACH
TURN: 15m RADIUS

Recommended clearances (500mm) must be added to each side of the tracking curve (refer to text)
DESIGN VEHICLE DIMENSIONS (mm)

SLIGHT DEVIATION DUE TO TAIL SWING

1:250 Scale @ A3

2007 ON-ROAD TRACKING CURVES
VEHICLE: TOUR COACH
TURN: 25m RADIUS

THIS SWEPT PATH ENVELOPE SHOWS THE EXTREMITY OF THE VEHICLE'S BODY AND DOES NOT SHOW THE PATH FOLLOWED BY ANY WHEELS.

Recommended clearances (500mm) must be added to each side of the tracking curve (refer to text)