

## Appendix A Technical analysis process

This section describes the technical analysis for the 13 assessment criteria.

### A.1 Freight efficiency

Freight efficiency is defined by the LIC as the *'amount of congestion (mid block and intersection) hindering large trucks from travelling at a steady speed along the road'*. Hence the technical analysis has focussed on understanding traffic congestion, as described in section A.5 of this Appendix.

### A.2 General traffic efficiency

General traffic efficiency is defined by the LIC as the *'amount of congestion (mid-block and intersection) hindering cars and small trucks from travelling at a steady speed along the road'*. The objective of traffic efficiency is to provide an overall road network that balances easy access/ mobility with the economic, social and environmental costs of providing the network. The road network in the study area was therefore analysed by examining traffic congestion, as described in section A.5.

### A.3 Public transport efficiency

Public transport efficiency is defined by the LIC as the *'amount of congestion (mid block and intersection) hindering public transport vehicles on public transport routes from travelling at a steady speed along the road'*.

The technical analysis process has used the traffic congestion analysis process, described in section A.5.

### A.4 Community access

The community access assessment criterion was defined by the LIC as the *'degree of difficulty getting on/off roads when travelling to/from places along the road, when the difficulty is caused by vehicular traffic along the road'*.

Community access is dependant on the level of traffic congestion on a road: if the level of congestion is low there will be plenty of gaps in the traffic, and drivers will be able to get on/off these uncongested roads with little delay. Conversely, if a road is congested there will be very few gaps in the traffic for drivers to enter the road, and it will be difficult to enter and exit.

A road access difficulty index was developed and the results compared to the findings from the community telephone interview surveys.

### **A.5 Traffic congestion**

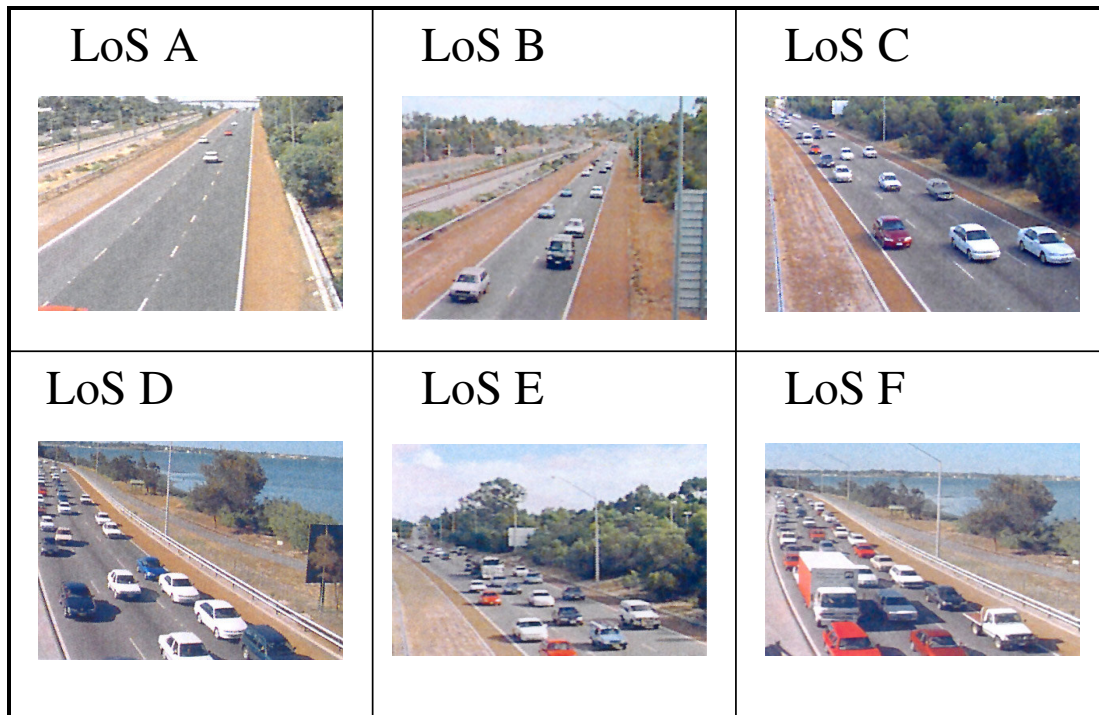
Traffic congestion impacts on all transport modes. Road users experience an increase in overall travel times and a reduction in the level of reliability.

The selected measure of congestion is 'level of service'. The level of service (LoS) describes operational conditions on a road and ranges from **LoS A** to **LoS F** where:

- **LoS A** – free flow, high freedom to select speed and manoeuvre, virtually no interruptions; and
- **LoS F** – forced flow, no freedom to select speed or manoeuvre, flow breaks down, queuing and delays.

**LoS A** to **LoS F** are illustrated photographically in **Figure A1**.

The analysis of congestion has developed new concepts and ideas that are innovative in Perth. In particular the investigation has developed the concepts of acceptance of different levels of service on different types of roads, and the impact on 'peak spreading' (ie extending the length of the peak periods as motorists travel earlier or later to try to avoid the worst of the congestion periods).

**Figure A1 Levels of service categories for road sections**

Full details of the technical analysis methodology are described in *Traffic Congestion Technical Paper*. In summary, the analysis process had seven steps:

- 1) Mapping of road attributes (such as number of lanes, speed limit, intersection types, etc) and traffic volumes for 2001 and future years 2006, 2011 and 2031.
- 2) Compilation of a LoS table providing the mid-block capacity of each road type under different LoS.
- 3) Mapping of LoS for 2001, 2006, 2011, 2031 for each road (mid-block) based on a comparison of the actual or estimated traffic volumes with the LoS table.
- 4) Mapping of intersection LoS for 2001, 2006, 2011, 2031 based on analysis of known congested and heavily used intersections.
- 5) Identification of congestion problem locations based on technical analysis for 2001, 2006, 2011, 2031.
- 6) Comparison with congestion problem locations identified by the community.
- 7) Selection of final community/ technical congestion problem locations.

### **A.6 Safety**

The assessment criteria for safety is the number of casualty crashes over a five year period. The analysis process is described in full detail in *Road Traffic Safety Technical Paper*.

In summary, the evaluation process involved five stages:

- 1) Tabulation of road and intersection attributes, and crash statistics (mid-block and intersections) for the previous 5 years.
- 2) Mapping of crashes for intersections and mid-block road sections.
- 3) Identification of traffic safety problem areas, based on casualty crashes (number for intersections, and the number per km for mid-block sections).
- 4) Comparison with safety problem areas identified by the community.
- 5) Selection of final community/ technical safety problem areas.

### **A.7 Traffic Noise**

The analysis process was aimed at determining which sections of the road network have existing or estimated noise levels greater than levels adopted by the LIC after considering Eastern States practice.

Traffic noise was considered during the daytime (6am to midnight) and night time (10pm to 6am). Daytime levels were measured as  $L_{10(18 \text{ hr})}$  dB(A) which means 'the sound level that is exceeded for 10 percent of the time, measured as an average of 1 hour measurements over an 18 hour period (6am to midnight)'. Night time levels were measured as  $L_{\text{eq}(8 \text{ hr})}$  dB(A) which is often used to measure the average noise level and means 'the equivalent sound level measured over 8 hours (10pm to 6am)'.

Assessment of the impact of traffic noise incorporated both direct noise measurements at selected sites, together with noise modelling for the road network as a whole. Full details of the analysis process are described in *Traffic Noise Technical Paper*. In summary the technical analysis process involved six stages:

- 1) Measurement of noise levels at selected locations along state and local roads.
- 2) Tabulation of road attributes, traffic noise measurements and existing/estimated road traffic volumes.
- 3) Decision on roads to investigate in detail. These were the routes carrying the most freight and general traffic.

- 4) Development of a noise model to provide noise estimates for areas between measurement sites along the selected routes, to provide noise level estimates for future years and to assess the effect of remedial measures.
- 5) Mapping of traffic noise estimates for 2001, 2006, 2011 and 2031 and identification of problem areas.
- 6) Comparison with problem areas identified by the community.
- 7) Selection of final community/technical noise problem areas.

### **A.8 Air Pollution**

Air pollution has been defined by the LIC as the *'effect of emissions from vehicular traffic and from vehicle loads; ie fumes, soot and odour'*. The criteria used to analyse air pollution was the estimated level of emissions of carbon dioxide (CO<sub>2</sub>) and oxides of nitrogen (NO<sub>x</sub>). Full details of the technical analysis methodology are described in *Traffic Congestion Technical Paper*. In summary, the analysis process included:

- 1) Analysis of estimated vehicle emissions at 17 key intersections using the SIDRA intersection analysis tool.
- 2) Extrapolation of emissions analysis to other interrupted flow locations.
- 3) Identification of air pollution problem locations based on technical analysis for 2001, 2006, 2011 and 2031.
- 4) Comparison with air pollution problem locations identified by the community.
- 5) Selection of final community/ technical congestion problem locations.

### **A.9 Community Severance**

The LIC has defined Community Severance as the *'degree of difficulty for pedestrians and cyclists getting across a road, when the difficulty is caused by vehicular traffic along the road'*. The analysis process is described in detail in the *'Community Severance Technical Paper'*.

In summary, the evaluation process involved five stages:

- 1) Identification of selected road crossings that present significant difficulties for pedestrians and cyclists. Selected crossings were on major roads, were part of the Perth Bicycle Network main routes and/or were significant pedestrian crossing points.
- 2) Calculation of the severance score for each crossing. The severance score was based on the type of crossing, number of traffic lanes and levels of demand by pedestrians and cyclists.

- 3) Mapping of severance scores and identification of technical problem areas.
- 4) Comparison with problem areas identified by the community.
- 5) Selection of final community/ technical community severance problem areas.

### **A.10      Vibration**

The LIC has defined vibration as the *‘amount of disturbance to buildings, or annoyance to the people in those buildings, by vibration from vehicular traffic on the road’*. The analysis process is described in detail in the *Vibration Technical Paper*. In summary, the evaluation process involved five stages:

- 1) On site measurements of ground vibration.
- 2) Analysis and comparison of vibration levels with accepted standards.
- 3) Mapping of vibration technical problem areas.
- 4) Comparison with problem areas identified by the community.
- 5) Identification that there are no ‘high’ or ‘very high’ ground vibration problem areas, but that more investigation into road vibration is needed.

### **A.11      Water Pollution**

The LIC has defined water pollution as *‘concerns about pollution from vehicles travelling on the road getting into significant water sources; whether ground water, surface water and/or wetlands’*. The analysis process is described in the presentation *Water Pollution*. In summary, the assessment process involved five stages:

- 1) For wetlands:
  - Classification and mapping of wetlands into three management categories of conservation (highest priority), resource enhancement and multiple use (lowest priority).
  - Classification and mapping of road drainage into piped and unpiped (stormwater discharged from unkerbed roads into groundwater) .
  - Classification and mapping of dangerous goods routes.
  - Overlay of mapping to identify very high risk routes near wetland conservation areas.
- 2) For public water supply:
  - Classification and mapping of water supply priority zones and bore locations.

- Overlay of mapping to identify very high risk locations where priority water supply locations and bore locations are near dangerous goods routes.
  - Mapping of public water supply problem locations.
- 3) Mapping of combined wetlands and public water supply water pollution problem locations.
  - 4) Comparison with problem locations identified by the community.
  - 5) Selection of final community/technical community water pollution problem locations.

### **A.12 Built and Cultural Heritage**

The LIC has defined built and cultural heritage as *'impact by vehicular traffic along the road on cultural heritage areas and buildings next to the road – maybe indigenous or non-indigenous heritage'*. The analysis process involved:

- 1) Mapping of known heritage sites adjacent to roads.
- 2) Review of community and stakeholder submissions.
- 3) Identification that there were no 'high' or 'very high' problem locations that should be carried forward to 'bringing it together'.

### **A.13 Natural Heritage**

The LIC has defined natural heritage as *'impact by vehicular traffic along the road on natural heritage areas such as severance of habitat area or severance of wildlife migratory routes. The impact may be on vegetation or on wetland areas'*. The analysis process is described in the *Natural Heritage Technical Paper* and involved:

- 1) Impact assessment, mapping and ranking of roads on wetlands and Bush Forever sites.
- 2) Impact assessment of roads on areas containing rare flora, threatened ecological communities and declining bird species.
- 3) Mapping of combined impacts of roads on wetlands and bush forever locations.
- 4) Comparison with problem areas identified by the community.
- 5) Selection of final community/ technical community natural heritage problem locations.

### **A.14 Visual Amenity**

The LIC has defined visual amenity as *‘intrusion by road infrastructure into views from adjacent land to buildings. Reduction in privacy of adjacent land and buildings from road users overlooking that land or buildings’*. The analysis process involved:

- 1) Review of community and stakeholder submissions.
- 2) Identification that there were no ‘high’ or ‘very high’ problem locations that should be carried forward to ‘bringing it together’.

## Appendix B Details of worst 35 problem locations plus 6 additional worst of type locations (see also figure 20)

Rank	Location	Composite Values	Congestion 64	Traffic Safety 23	Traffic Noise 16	Community Access 9	Air Pollution 8	Severance 6	Water Pollution 4	Natural Heritage 2	Suggested Priority Action Location
1	<b>South St/ Bannister Rd</b>										
	2001/2003	107									<b>Yes</b>
	LOC 1	2006	107								First ranked location
	2011	115									
2	<b>Leach Hwy/ Manning Rd</b>										
	2001/2003	107									<b>Yes</b>
	LOC 2	2006	107								Second ranked location
	2011	107									
3A	<b>Leach Hwy/ North Lake Rd</b>										
	2001/2003	103									<b>Yes</b>
	LOC 3	2006	103								Equal third ranked location
	2011	103									
3B	<b>High St/ Carrington St</b>										
	2001/2003	84									<b>Yes</b>
	LOC 4	2006	107								Equal third ranked location
	2011	107									
5	<b>Leach Hwy/ Kwinana Fwy</b>										
	2001/2003	97									<b>Yes</b>
	LOC 5	2006	97								Fifth ranked location
	2011	97									
6	<b>Hampton Rd - South St to Rockingham Rd</b>										
	2001/2003	96									<b>Yes</b>
	LOC 6	2006	96								Sixth ranked location.
	2011	96									
7	<b>South St/ Kwinana Fwy</b>										
	2001/2003	93									<b>Yes</b>
	LOC 7	2006	93								Seventh ranked location
	2011	93									
8	<b>Leach Hwy at Shelley Bridge</b>										
	2001/2003	91									<b>Yes</b>
	LOC 8	2006	91								Eighth ranked location
	2011	91									
9	<b>South St/ Stock Rd</b>										
	2001/2003	80									<b>Yes</b>
	LOC 9	2006	80								Ninth ranked location
	2011	88									
10	<b>Leach Hwy/ Stock Rd</b>										
	2001/2003	80									<b>Yes</b>
	LOC 10	2006	80								Tenth ranked. Also part of strategic freight routes. Also in FNR
	2011	80									
11A	<b>Canning Hwy/ Riseley St</b>										
	2001/2003	68									<b>Yes</b>
	LOC 11	2006	76								"Worst of Type" Congestion Air Pollution
	2011	76									
11B	<b>Canning Hwy/ Sleat Rd</b>										
	2001/2003	68									<b>No</b>
	2006	76									Stage 2 time and resource limitations
	2011	76									
11C	<b>South St/ Murdoch Dr</b>										
	2001/2003	74									<b>Yes</b>
	LOC 12	2006	74								Strategic location for access to future tertiary hospital
	2011	74									
14	<b>Stirling Hwy/ Canning Hwy</b>										
	2001/2003	68									<b>Yes</b>
	LOC 13	2006	68								Part of strategic freight route
	2011	68									
		2031	99								

# Appendix B

Rank	Location	Composite Values	Congestion 64	Traffic Safety 23	Traffic Noise 16	Community Access 9	Air Pollution 8	Severance 6	Water Pollution 4	Natural Heritage 2	Suggested Priority Action Location
15	<b>South St/ Carrington St</b>										
	2001/2003	16									<b>No</b>
	2006	80									Stage 2 time and resource limitations
	2011	80									
	2031	88									
16	<b>Nicholson Rd, Bannister Rd to Roe Hwy</b>										
	2001/2003	66									<b>No</b>
	2006	66									Stage 2 time and resource limitations
	2011	66									
	2031	66									
17A	<b>North Lake Rd, north of Berrigan Dr</b>										
	2001/2003	64									<b>No</b>
	2006	64									Stage 2 time and resource limitations
	2011	64									
	2031	87									
17B	<b>Hampton Rd, north South St</b>										
	2001/2003	64									<b>No</b>
	2006	64									Stage 2 time and resource limitations
	2011	64									
	2031	87									
17C	<b>Nicholson Rd, High Rd to Roe Hwy</b>										
	2001/2003	64									<b>No</b>
	2006	64									Stage 2 time and resource limitations
	2011	64									
	2031	64									
17D	<b>Leach Hwy/ Murdoch Dr</b>										
	2001/2003	86									<b>No</b>
	2006	22									Stage 2
	2011	86									Time and resource limitations
	2031	86									
21	<b>South St, Carrington Rd to Hines Rd</b>										
	2001/2003	48									<b>No</b>
	2006	48									Stage 2 time and resource limitations
	2011	112									
	2031	112									
22	<b>Armada Rd, west Warton Rd</b>										
	2001/2003	4									<b>No</b>
	2006	68									Stage 2 time and resource limitations
	2011	68									
	2031	68									
23A	<b>Beelair Dr, west of Hammond Rd</b>										
	2001/2003	0									<b>No</b>
	2006	64									Stage 2 time and resource limitations
	2011	64									
	2031	64									
23B	<b>James Street, Ord St to Queen Victoria St</b>										
	2001/2003	0									<b>No</b>
	2006	64									Stage 2 time and resource limitations
	2011	64									
	2031	64									
25	<b>South St / Karel Av</b>										
	2001/2003	90									<b>No</b>
	2006	26									Stage 2 time and resource limitations
	2011	26									But monitor
	2031	113									
26A	<b>Leach Hwy, Shelley Bridge to Manning Rd</b>										
	2001/2003	43									<b>No</b>
	2006	43									Stage 2 time and resource limitations
	2011	43									
	2031	43									
26B	<b>Leach Hwy, Karel Av to Bullcreek Dr</b>										
	2001/2003	43									<b>No</b>
	2006	43									Stage 2 time and resource limitations
	2011	43									
	2031	43									
26C	<b>Leach Hwy, Karel Av to High Rd</b>										
	2001/2003	43									<b>No</b>
	2006	43									Stage 2 time and resource limitations
	2011	43									
	2031	43									

Rank	Location	Composite Values	Congestion 64	Traffic Safety 23	Traffic Noise 16	Community Access 9	Air Pollution 8	Severance 6	Water Pollution 4	Natural Heritage 2	Suggested Priority Action Location
26D	Stirling Hwy/ High St										
	2001/2003	43									Yes
	LOC 14	2006	43								Part of strategic freight route Also in FNR
	2011	43									
	2031	43									
30	Leach Hwy/ High Rd										
	2001/2003	43									No
	2006	20									Stage 2 time and resource limitations
	2011	20									
	2031	43									
31	Nicholson Rd, north of Randford Rd										
	2001/2003	2									No
	2006	2									Stage 2 time and resource limitations
	2011	66									
	2031	66									
32A	North Lake Rd, south of Phoenix Rd										
	2001/2003	0									No
	2006	0									Stage 2 time and resource limitations
	2011	64									
	2031	64									
32B	North Lake Rd, south of Berrigan Dr										
	2001/2003	0									No
	2006	0									Stage 2 time and resource limitations
	2011	64									
	2031	64									
32C	North Lake Rd, Marmion St to Canning Hwy										
	2001/2003	0									No
	2006	0									Stage 2 time and resource limitations
	2011	64									
	2031	64									
32D	Ord Street, High St to James St										
	2001/2003	0									No
	2006	0									Stage 2 time and resource limitations
	2011	64									
	2031	64									

Rank	Location	Composite Values	Congestion 64	Traffic Safety 23	Traffic Noise 16	Community Access 9	Air Pollution 8	Severance 6	Water Pollution 4	Natural Heritage 2	Suggested Priority Action Location
W1	Leach Hwy, North Lake Rd to Winthrop Dr										
	2001/2003	32									Yes
	LOC 15	2006	32								"Worst of Type" for community access
	2011	32									
	2031	32									
W2	Canning Hwy, Reynolds Rd to Kwinana Fwy										
	2001/2003	23									Yes
	LOC 16	2006	23								"Worst of Type" for Safety
	2011	23									
	2031	23									
W3	High St, Stirling Hwy to Carrington St										
	2001/2003	20									Yes
	LOC 17	2006	20								"Worst of Type" for noise
	2011	20									
	2031	84									
W4	South St, pedestrian crossings at Murdoch University										
	2001/2003	6									Yes
	LOC 18	2006	6								"Worst of Type" for severance
	2011	6									
	2031	6									
W5	Leach Hwy, Kwinana Fwy to Webb St										
	2001/2003	4									Yes
	LOC 19	2006	4								"Worst of Type" for water pollution
	2011	4									
	2031	4									
W6	Farrington Rd, west of Murdoch Dr										
	2001/2003	2									Yes
	LOC 20	2006	2								"Worst of Type" for natural heritage
	2011	2									
	2031	2									