3. MODEL DEVELOPMENT

3.3 MODEL GEOGRAPHIC AREA

The GMIA mesoscopic simulation model is comprised of two components:

- Sydney GMA static assignment model
- GMIA mesoscopic model.

Both of these components have been developed and run within the Aimsun environment. The Sydney GMA model covers the entirety of the Sydney Greater Metropolitan Area as well as Newcastle and Wollongong, covering some 2,715 travel zones, based on census statistical local areas.

The GMIA mesoscopic model is a sub-area model derived from the Sydney GMA model that covers the study area for GMIA whilst also extending north to Narellan Road and west to Old Hume Highway/Camden Bypass.

An overview of the GMIA model extents is shown in Figure 3.3 and Figure 3.4. This model is comprised of:

- Over 2,000 individual road sections
- Approximately 150 zones
- Over 100 signalised intersections.

Figure 3.3: Aimsun network and centroid configuration

Figure 3.4: Model extents
3.4 CALIBRATION AND VALIDATION

The GMIA base mesoscopic traffic model has been calibrated and validated according to the principles outlined in the RMS Traffic Modelling Guidelines, 2013. Calibration and validation of models is essential to ensure that they are an accurate reflection of observed traffic conditions.

This subsection provides an overview of the calibration and validation results. Further detail on the calibration and validation process is provided in the Greater Macarthur Mesoscopic Traffic Model Calibration and Validation Report (Jacobs, 2017).

Data sources

The GMIA model has been calibrated using turning movement counts collected across the study area between 2013 and 2016. This data was validated to check for internal inconsistencies between intersections. A number of inconsistencies were identified, generally between counts taken at different times. In these cases, traffic count data was adjusted to try to resolve these inconsistencies by identifying the most recent or reliable source of data and adjusting accordingly.

Travel time surveys were undertaken along key corridors in November 2016 in order to provide a basis for model validation. Travel times were collected for:

- M31 Hume Motorway
- Narellan Road
- Picton Road.

Model calibration

Through a process of demand adjustment and refinement of traffic signal settings and route attractiveness, the models were calibrated to the observed counts. The GMIA model has been calibrated according to the following criteria:

- Greater than 95% of turn comparisons with GEH less than 10.
- Greater than 85% of all movements with GEH less than 5.
- $R^2$ of greater than 0.95
- Regression slope between 0.95 and 1.05.

The GEH statistic is used in the calibration of traffic models to compare the differences between modelled and observed traffic flows. The $R^2$ value generally represents the closeness of fit of the observed data points with the modelled data points and the slope of the trendline provides an indication of whether the model is generally over assigning (slope greater than 1) or under assigning (slope less than 1) traffic across the network.

A summary of the regression statistics for the morning and evening peak DUE calibration is provided in Table 3.1. GEH statistics are shown in Table 3.2 and Table 3.3. Plots of aggregate turning movement regressions are shown in Figure 3.3, 3.5 and Figure 3.6. Review of these statistics shows that the model is sufficiently well-calibrated on the basis of turning movement flows, for both peak periods in aggregate and for each hour within those peak periods.

### Table 3.1: Summary of model calibration – Regression analysis

<table>
<thead>
<tr>
<th>Time period</th>
<th>$R^2$</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:00 AM to 7:00 AM</td>
<td>0.971</td>
<td>1.00</td>
</tr>
<tr>
<td>7:00 AM to 8:00 AM</td>
<td>0.971</td>
<td>1.02</td>
</tr>
<tr>
<td>8:00 AM to 9:00 AM</td>
<td>0.977</td>
<td>1.04</td>
</tr>
<tr>
<td>9:00 AM to 10:00 AM</td>
<td>0.972</td>
<td>1.11</td>
</tr>
<tr>
<td>Total AM peak – all hourly volumes</td>
<td>0.983</td>
<td>1.05</td>
</tr>
<tr>
<td>3:00 PM to 4:00 PM</td>
<td>0.974</td>
<td>1.05</td>
</tr>
<tr>
<td>4:00 PM to 5:00 PM</td>
<td>0.977</td>
<td>1.02</td>
</tr>
<tr>
<td>5:00 PM to 6:00 PM</td>
<td>0.974</td>
<td>1.04</td>
</tr>
<tr>
<td>6:00 PM to 7:00 PM</td>
<td>0.957</td>
<td>1.03</td>
</tr>
<tr>
<td>Total PM peak – all hourly volumes</td>
<td>0.981</td>
<td>1.05</td>
</tr>
</tbody>
</table>

### Table 3.2: Summary of turning movement comparisons (AM peak)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEH&lt;5</td>
<td>85%</td>
</tr>
<tr>
<td>GEH&lt;10</td>
<td>95%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hour starting</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:00am</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>GEH&lt;5</td>
</tr>
<tr>
<td>GEH&lt;10</td>
</tr>
</tbody>
</table>

### Table 3.3: Summary of turning movement comparisons (PM peak)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEH&lt;5</td>
<td>85%</td>
</tr>
<tr>
<td>GEH&lt;10</td>
<td>95%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hour starting</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:00pm</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>GEH&lt;5</td>
</tr>
<tr>
<td>GEH&lt;10</td>
</tr>
</tbody>
</table>
3. MODEL DEVELOPMENT

Model validation

In order to determine the suitability of the GMIA mesoscopic simulation model in forecasting future traffic conditions, it is necessary to validate the model against a set of data that is independent from that used in the demand estimation and calibration process.

Validation of the GMIA model has been undertaken using travel time surveys. A summary of travel time comparisons is provided in Table 3.4.

Comparison of modelled travel times with observed data shows that the model is generally replicating the pattern of delays and observed cumulative travel times during the peak periods. There are no significant departures from the validation criteria.

Table 3.4: Summary of model validation

<table>
<thead>
<tr>
<th>Route</th>
<th>AM Peak</th>
<th></th>
<th>PM Peak</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observed</td>
<td>Modelled</td>
<td>Observed</td>
<td>Modelled</td>
</tr>
<tr>
<td>Picton Road EB</td>
<td>13:53</td>
<td>14:25</td>
<td>15:09</td>
<td>14:42</td>
</tr>
<tr>
<td>Picton Road WB</td>
<td>14:15</td>
<td>14:23</td>
<td>13:42</td>
<td>14:57</td>
</tr>
<tr>
<td>M31 Hume Motorway NB</td>
<td>14:00</td>
<td>14:27</td>
<td>14:47</td>
<td>14:36</td>
</tr>
<tr>
<td>M31 Hume Motorway SB</td>
<td>14:08</td>
<td>14:11</td>
<td>15:12</td>
<td>14:21</td>
</tr>
<tr>
<td>Narellan Road EB</td>
<td>19:40</td>
<td>19:45</td>
<td>19:10</td>
<td>19:50</td>
</tr>
<tr>
<td>Narellan Road WB</td>
<td>13:55</td>
<td>14:05</td>
<td>22:15</td>
<td>20:48</td>
</tr>
</tbody>
</table>
3. MODEL DEVELOPMENT

3.5 TRIP GENERATION

There are two methods to estimate the overall trip generation of the land use structure plan for GMIA. The first method involves the application of the Sydney Strategic Travel Model (STM) and the second method is based on the RMS Guide to Traffic Generating Developments (2002).

The trip generation derived from the STM is based on a tour-based methodology, where the key inputs of employment and population are linked using behavioral models to create two-way "tours", which represent the daily trip behavior of journey to work trips. These tours then represent the travel demand across the network for different times of the day, ultimately generating matrices of origin-destination trips for each of the modeled time periods. These trips are then run through a modal choice model, which segments trips into different travel modes including car, bus, rail and others.

The trip generation derived from the RMS guidelines shown in Appendix A are based on the number of vehicle trips entering and exiting a specific area without any consideration of the actual trip purpose. Various traffic generation rates are used for different land use types.

The method of trip generation for the GMIA model is a combination of both the STM and RMS guidelines. The STM has been used to generate external trips - neither originating nor ending in the study area – whilst the RMS guidelines have been used to generate internal trips.

Table 3.5 provides the traffic generation potential for 2026, 2036, and 2051 AM and PM peaks based on the proposed land use and traffic generation rates presented in Appendix A.

<table>
<thead>
<tr>
<th>Area</th>
<th>2026 AM</th>
<th>2026 PM</th>
<th>2036 AM</th>
<th>2036 PM</th>
<th>2051 AM</th>
<th>2051 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In</td>
<td>Out</td>
<td>In</td>
<td>Out</td>
<td>In</td>
<td>Out</td>
</tr>
<tr>
<td>Menangle Park</td>
<td>1,406</td>
<td>2,484</td>
<td>947</td>
<td>2,392</td>
<td>1,157</td>
<td>2,514</td>
</tr>
<tr>
<td>Gilead</td>
<td>1,782</td>
<td>3,405</td>
<td>1,981</td>
<td>6,410</td>
<td>2,593</td>
<td>8,119</td>
</tr>
<tr>
<td>West Appin</td>
<td>891</td>
<td>383</td>
<td>2,452</td>
<td>5,999</td>
<td>4,676</td>
<td>12,711</td>
</tr>
<tr>
<td>Wilton</td>
<td>5,095</td>
<td>6,516</td>
<td>5,832</td>
<td>9,255</td>
<td>7,186</td>
<td>10,850</td>
</tr>
<tr>
<td>Total</td>
<td>9,174</td>
<td>12,788</td>
<td>11,212</td>
<td>24,056</td>
<td>15,611</td>
<td>34,194</td>
</tr>
</tbody>
</table>

3.6 TRIP DISTRIBUTION

Overall trip distribution for the GMIA model has been undertaken on the basis of revealed travel patterns from the STM. Trip distribution in STM is an iterative process that distributes trips based on the proximity of jobs and population for the whole Sydney GMIA.

The overall distribution patterns from the STM were used as the basis for a more detailed process to distribute internal trips generated using the RMS guidelines. The RMS guidelines allow for the calculation of the number of ‘to’ and ‘from’ trips in the study area. The adopted trip distribution process then aligns both types of trips with a weighting of zones to represent the increased attractiveness of destinations in close proximity to a particular origin. The process also acknowledges the potential for trips to be attracted to destinations outside the study area. Any surplus "to" or "from" trips is assigned to external zones based on the distribution patterns observed in the STM.

Figure 3.7 and Figure 3.8 outline the overall trip distribution of trips in the GMIA in the 2051 AM peak. It is observed that the majority of trips leaving the study area do so towards the north. This reflects the regional distribution of jobs within Sydney with the fact that based on current projections many people will still need to access major employment centres in Sydney CBD and Parramatta.
3.7 MODE CHOICE

Modelling of mode choice has been undertaken using the Sydney Strategic Travel Model (STM). Mode choice is determined in the STM through an iterative procedure that considers the relative attractiveness of different modes. Proximity to public transport at the home and work ends of a tour and other factors including car ownership, licensing and the frequency of public transport are also considered.

For external trips, the mode choice in STM is reflected in the resultant trip matrices used directly in the GMIA mesoscopic model.

For internal trips, the mode shares in STM have been considered when choosing an appropriate trip generation rate from the RMS guidelines. Trip generation rates have an implied mode split factored in which reflects the public transport accessibility of the surveyed sites.

Figure 3.9 shows potential future mode shares based on STM results.

It is noted that the unconstrained nature of the STM means that these mode share results represent pure demand. Without sufficient infrastructure and services to cater for this demand some customers will not be able to use public transport, leading to an increased car mode share.

3.8 TRAFFIC ASSIGNMENT

Traffic assignment for the GMIA mesoscopic traffic modelling has been undertaken in two stages:

- Stage 1: Static traffic assignment in STM to determine sub-area traffic demand based on a traversal matrix from STM
- Stage 2: Dynamic equilibrium assignment in GMIA Aimsun model.

This assignment methodology is detailed below.

Static assignment in STM

The static assignment step has been undertaken to generate a sub-area traversal of the whole Sydney Greater Metropolitan Area model, suitable for use as an input for future traffic demand within the smaller GMIA mesoscopic model.

As this traversal is undertaken based on an assignment in the STM, volumes at the borders of the traversal area are fixed to the volumes assigned in STM. This restriction is not true for assignment within the model area, which is free to assign in a manner that differs from the static assignment in STM.

Dynamic equilibrium in mesoscopic model

Traffic generation as previously described was assigned to the GMIA Aimsun model using a Dynamic User Equilibrium (DUE) assignment method.

DUE uses the same concept as above, however unlike static equilibrium, vehicle simulation is used to generate route costs, rather than a mathematical expression of a speed/flow curve. This has the advantage of taking into account the capacity constraints of the network in greater detail including traffic signals and intersections, merging and weaving on freeways and the accumulation of traffic in queues.
3. MODEL DEVELOPMENT

4. APPRAISAL OF THE PREFERRED PLAN
4. APPRAISAL OF THE PREFERRED PLAN

4.1 OVERVIEW

The GMIA mesoscopic model has been used as the basis for assessing the surface transportation road network presented in the structure plan. This section examines the overall road network performance based on the land use estimates proposed for the GMIA and assesses future road infrastructure enhancements for 2026, 2036 and 2051. In assessing the adequacy of the structure plan road network to meet the proposed future land-based demands, a desired assessment criteria for strategic road network planning and intersection performance has been developed.

4.2 DESIRED SERVICE CRITERIA

Midblock flow density

The GMIA mesoscopic model has traffic flows constrained by capacity whether due to saturation flows in midblock sections or due to capacity limitations at intersections. When traffic demand exceeds capacity, traffic queues form and these are depicted within the mesoscopic model as increases in flow density.

In this context, the road network flow density was used to examine key capacity constraints within the road network developed for the structure plan. The assessment of network performance on the basis of flow density was used to resolve capacity constraints such as:

- Traffic unable to exit the M31 Hume Motorway, resulting in traffic queued on the motorway
- Traffic held up at traffic lights due to traffic signal timing
- “Gridlock” conditions where latent queuing from intersections resulted in traffic being unable to enter the network at zone connectors.

Road network infrastructure improvements identified on the basis of flow density were assessed according to whether they increased the volume of traffic that could be assigned to the network.

Midblock level of service

When assessing the performance of sections of road under future traffic demands, the concept of midblock level of service has been used to determine the performance of these sections. The midblock level of service has been determined by comparing the average travel speed on a section of road to the signposted speed. This measure is most effective at identifying sections of motorway or major arterial roads which have insufficient midblock capacity.

Level of service criteria are shown in Table 4.1.

Intersection level of service

The performance of an urban road network is largely dependent on the operating performance of key intersections, which are critical capacity control points on the road network. It is therefore appropriate to consider intersection operation as a measure of the capacity of the road network.

The criteria for evaluating the operational performance of intersections is provided by the RTA Guide to Traffic Generating Development (2002); these criteria are shown in Table 4.2.

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>Average delay (sec/veh)</th>
<th>Signalised intersections and roundabouts</th>
<th>Give way and stop signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt;14</td>
<td>Good operation</td>
<td>Good operation</td>
</tr>
<tr>
<td>B</td>
<td>15 – 28</td>
<td>Good with acceptable delays and spare capacity</td>
<td>Acceptable delays and spare capacity</td>
</tr>
<tr>
<td>C</td>
<td>29-42</td>
<td>Satisfactory</td>
<td>Satisfactory but accident study required</td>
</tr>
<tr>
<td>D</td>
<td>43-56</td>
<td>Operating near capacity</td>
<td>Near capacity and accident study required</td>
</tr>
<tr>
<td>E</td>
<td>56-70</td>
<td>At capacity; incidents will cause excessive delays</td>
<td>At capacity, requires other control mode</td>
</tr>
<tr>
<td>F</td>
<td>&gt;70</td>
<td>Over capacity, unstable operation, excessive queuing</td>
<td>Over capacity, Unstable operation</td>
</tr>
</tbody>
</table>

Table 4.2: Intersection level of service

4.3 FUTURE NETWORK PERFORMANCE

Future traffic volumes
The traffic volume plots demonstrate the major vehicle movement corridors in the GMIA. They provide a useful indication of the volume of traffic using a road and helps to understand the demand for access to the road network.

The future traffic volume plots show:

- The M31 Hume Motorway continues to serve as the primary movement corridor with flows in excess of 6,000 vehicles per hour in each direction by 2036
- Sections of Narellan Road and Appin Road are forecast to carry up to 4,000 vehicles per hour in each direction.
- Spring Farm Link Road and Macquariedale Road are the key east-west connections through the centre of the study area with flows in excess of 2,000 vehicles per hour in each direction.
- Picton Road is forecast to carry up to 3,000 vehicles per hour in each direction.
- Sections of Menangle Road near Maldon are forecast to carry 3,000 vehicles per hour in each direction.

Legend

<table>
<thead>
<tr>
<th>Flow (veh/hr)</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1000</td>
<td>Lightest</td>
</tr>
<tr>
<td>1000 - 2000</td>
<td>Light</td>
</tr>
<tr>
<td>2000 - 3000</td>
<td>Medium</td>
</tr>
<tr>
<td>3000 - 4000</td>
<td>Medium Dark</td>
</tr>
<tr>
<td>4000 - 5000</td>
<td>Dark</td>
</tr>
<tr>
<td>&gt; 6000</td>
<td>Darkest</td>
</tr>
</tbody>
</table>

Figure 4.1: 2026 AM volumes
Figure 4.2: 2026 PM volumes
Figure 4.3: 2036 AM volumes
Figure 4.4: 2036 PM volumes
Figure 4.5: 2051 AM volumes
Figure 4.6: 2051 PM volumes
Future midblock level of service

A ratio of modelled vehicle speed compared to free flow speed has been calculated for all road sections within GMIA. Midblock sections of the network forecast to experience lower levels of service include:

- Narellan Road, particularly eastbound in the PM peak on approach to the M31 Hume Motorway interchange
- Approaches to the Spring Farm Link Road/Hume Motorway interchange
- Sections of Appin Road (between Spring Farm Parkway and Appin), southbound in the PM peak.

It is noted that slower speeds on approach to signalised intersections are to be expected in an urban road network during critical peak periods. Midblock level of service measurements are most appropriately used to examine uninterrupted sections of road without closely spaced intersections. In this context, the M31 Hume Motorway is observed to perform satisfactorily (with some minor congestion at Spring Farm Link Road) in all future scenarios after capacity enhancements, which is further discussed in Section 4.4.
Future intersection level of service

Future intersection performance metrics are provided in Figures 4.13 to 4.18. The results represent only the busiest one hour period on the road network.

Results from the mesoscopic model show that:

- The network performs satisfactorily in the 2026 scenario, with the majority of intersections operating at level of service D or better. Some localised constraints are evident along Narellan Road and at the Spring Farm Parkway/Hume Motorway interchange.

- Results of the 2036 scenario demonstrate that Narellan Road continues to experience moderate delay. Access into and out of new development at Mt Gilead also places more pressure on the Spring Farm Parkway/Hume Motorway interchange and the northern section of Appin Road.

- Results of the ultimate development scenario in 2051 show continued constraints at Narellan Road, Camden Bypass, Spring Farm Parkway/Hume Motorway interchange and the northern section of Appin Road.

- Intersection performance is worse at the North Eastern part of the study area. This is evident in 2036 and worse in future years.

- The number of over capacity intersections (level of service E and F) generally increases over time, with eight intersections in 2036 and up to 15 intersections in 2051.

Legend

Intersection LoS

A  B  C  D  E  F

Figure 4.13: 2026 AM intersection level of service  Figure 4.14: 2026 PM intersection level of service

Figure 4.15: 2036 AM intersection level of service  Figure 4.16: 2036 PM intersection level of service

Figure 4.17: 2051 AM intersection level of service  Figure 4.18: 2051 PM intersection level of service
4.4 STAGING OF THE NETWORK

The GMIA mesoscopic traffic model has been used to determine the optimum staging of the proposed road infrastructure improvements to the transport network.

This staging plan aims to provide sufficient network capacity in line with the development of the region. Infrastructure has been staged in accordance with the following modelled scenarios:

- 2026 - approximately 15,000 dwellings
- 2036 - approximately 38,000 dwellings
- 2051 - approximately 60,000 dwellings

In reality, infrastructure will be gradually delivered between these time horizons. In this context, it will be vital to deliver key public transport infrastructure as soon as possible within the given timeframe in order to shape the travel patterns of residents and employees of the GMIA. Instilling efficient travel behaviour will give the region the best chance to develop into a thriving and sustainable community.

Figure 4.19 to Figure 4.21 and Table 4.3 to Table 4.5 set out the staging of identified infrastructure recommendations for the GMIA.

<table>
<thead>
<tr>
<th>ID</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Picton Road</td>
<td>Widened to 2 lanes in each direction</td>
</tr>
<tr>
<td>2</td>
<td>Hume Motorway</td>
<td>Widened to 3 lanes in each direction</td>
</tr>
<tr>
<td>3</td>
<td>Spring Farm Parkway</td>
<td>New arterial road with 2 lanes in each direction</td>
</tr>
<tr>
<td>4</td>
<td>Spring Farm Parkway interchange</td>
<td>Full grade separated interchange with Hume Motorway. North and south facing ramps</td>
</tr>
<tr>
<td>5</td>
<td>Appin Road - North</td>
<td>Widened to 2 lanes in each direction</td>
</tr>
<tr>
<td>6</td>
<td>Camden Bypass</td>
<td>Widened to 2 lanes in each direction between Old Hume Highway and Macarthur Road</td>
</tr>
<tr>
<td>7</td>
<td>Camden Bypass</td>
<td>Widened to 3 lanes in each direction between Spring Farm Parkway and Narellan Road</td>
</tr>
<tr>
<td>8</td>
<td>Transit corridor - North</td>
<td>New corridor with segregated transit and 1 traffic lane in each direction</td>
</tr>
</tbody>
</table>
Table 4.4: Infrastructure recommendations - 2036 (approx 38,000 dwellings)

<table>
<thead>
<tr>
<th>ID</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Macquariedale Road</td>
<td>Widened to 3 lanes in each direction and extended to Finns Road</td>
</tr>
<tr>
<td>10</td>
<td>Macquariedale Road interchange</td>
<td>Full grade separated interchange with Hume Motorway. North and south facing ramps</td>
</tr>
<tr>
<td>11</td>
<td>Hume Motorway</td>
<td>Widened to 4 lanes in each direction north of Macquariedale Road</td>
</tr>
<tr>
<td>12</td>
<td>Spring Farm Parkway - West</td>
<td>Widened to 3 lanes in each direction west of Hume Motorway</td>
</tr>
<tr>
<td>13</td>
<td>Appin Road – North</td>
<td>Widened to 3 lanes in each direction</td>
</tr>
<tr>
<td>14</td>
<td>Appin Road - South</td>
<td>Widened to 2 lanes in each direction</td>
</tr>
<tr>
<td>15</td>
<td>Camden Bypass</td>
<td>Widened to 3 lanes in each direction between Spring Farm Parkway and Narellan Road</td>
</tr>
<tr>
<td>16</td>
<td>Narellan Road</td>
<td>Widened to 4 lanes in each direction</td>
</tr>
<tr>
<td>17</td>
<td>Hume Motorway/Picton Road Interchange</td>
<td>Interchange upgrade with flyover from Picton Road to Hume Motorway northbound.</td>
</tr>
<tr>
<td>18</td>
<td>North Wilton Connection</td>
<td>New road and bridge connecting North Wilton to Menangle Road</td>
</tr>
<tr>
<td>19</td>
<td>Menangle Road</td>
<td>Widened to 2 lanes in each direction</td>
</tr>
<tr>
<td>20</td>
<td>Finns Road</td>
<td>Widened to 2 lanes in each direction</td>
</tr>
<tr>
<td>21</td>
<td>Link Road B</td>
<td>New arterial road and bridge connecting West Appin and Macquariedale Road with 2 lanes in each direction.</td>
</tr>
<tr>
<td>22</td>
<td>Transit corridor - South</td>
<td>New corridor with segregated transit and 1 traffic lane in each direction. Bridge and connection to Douglas Park.</td>
</tr>
<tr>
<td>N/A</td>
<td>Southern Highlands rail line</td>
<td>Electrification of line to Maldon</td>
</tr>
</tbody>
</table>
## 4. APPRAISAL OF THE PREFERRED PLAN

### Table 4.5: Infrastructure recommendations - 2051 (approx 60,000 dwellings)

<table>
<thead>
<tr>
<th>ID</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Link Road A</td>
<td>New east-west arterial road linking Menangle and Appin Road. 2 lanes in each direction</td>
</tr>
<tr>
<td>24</td>
<td>Link Road A interchange</td>
<td>Full grade separated interchange with Hume Motorway. North and south facing ramps</td>
</tr>
<tr>
<td>26</td>
<td>Transit corridor</td>
<td>Widened to 2 traffic lanes in each direction and transit connected to Douglas Park</td>
</tr>
<tr>
<td>27</td>
<td>Spring Farm Parkway – East</td>
<td>Widened to 3 lanes in each direction east of Hume Motorway</td>
</tr>
<tr>
<td>28</td>
<td>Picton Road</td>
<td>Widened to 3 lanes in each direction 1.5km either side of the Hume Motorway interchange</td>
</tr>
<tr>
<td>29</td>
<td>Broughton Pass</td>
<td>New bridge over Broughton Pass</td>
</tr>
<tr>
<td>30</td>
<td>Douglas Park Drive</td>
<td>Upgraded and extended arterial road between Wilton Road and Menangle Road via Douglas Park. Included full grade separated interchange with Hume Motorway. North and south facing ramps.</td>
</tr>
</tbody>
</table>

![Figure 4.21: Recommended network - 2051 (approx 60,000 dwellings)](image)
5. SUMMARY AND FINDINGS

5.1 OVERVIEW
A cobs has developed and tested a staged transport network in order to support the long term growth of the Greater Macarthur Investigation Area. This has included strategic transport modelling in STM and mesoscopic traffic modelling using Aimsun in order to determine the scope of road and public transport infrastructure.

5.2 FUTURE TRANSPORT TASK
The proposed land use scenario for the GMIA includes the establishment of new population centres at Menangle Park, Mt Gilead, West Appin and Wilton. These four centres have the potential to deliver up to 60,000 homes (160,000 people) and 37,000 jobs in the GMIA. These land uses have the potential to generate in excess of 70,000 vehicle trips in the 1hr AM peak when fully developed. Additional capacity needs to be added to the GMIA transport network in the form of higher-order modes of public transport to meet the future growing population needs. It is important to provide an integrated range of options such as public transport, walking and cycling that can be efficiently accessed and used by people travelling to and from GMIA to serve their individual needs.

5.3 ROAD NETWORK REQUIREMENTS
The study has found the following transport infrastructure improvements to be required if GMIA develops as forecast. The below represents the ultimate configurations required by 2051:
- Picton Road – widened to 3 lanes in each direction through the new Wilton urban area and 2 lanes in each direction elsewhere
- Hume Motorway – widened to 3 lanes in each direction between Picton Road and Macquariedale Road and 4 lanes in each direction north of Macquariedale Road
- Spring Farm Parkway – New arterial road with 3 lanes in each direction
- Spring Farm Parkway interchange - Grade separated interchange with the Hume Motorway with north and south facing ramps
- Appin Road – Widened to 3 lanes in each direction between Narellan Road and Macquariedale Road, and 2 lanes in each direction south of Macquariedale Road
- Camden Bypass – Widened to 2 lanes in each direction with 3 lanes in each direction north of the Old Hume Highway
- Macquariedale Road – New arterial road with 2 lanes in each direction
- Macquariedale Road interchange – Grade separated interchange with the Hume Motorway with north and south facing ramps
- Narellan Road – Widened to 4 lanes in each direction
- Hume Motorway/Picot Road Interchange – Interchange upgrade with flyover from Picton Road to Hume Motorway northbound
- Link Road A – New arterial road with 2 lanes, in each direction connecting Menangle Road with Appin Road
- Link Road A interchange – Grade separated interchange with the Hume Motorway with north and south facing ramps
- North Wilton Connection – New connection between Menangle Road and Wilton Town Centre
- Menangle Road – Widened to 2 lanes in each direction
- Finns Road – Widened to 2 lanes in each direction
- Link Road B – New arterial road and bridge connecting West Appin and Macquariedale Road with 2 lanes in each direction.
- Broughton Pass – New bridge over Broughton Pass
- Link Road C – New sub-arterial road connecting West Wilton and Picton Road.

5.4 PUBLIC TRANSPORT NETWORK REQUIREMENTS
The proposed strategic network is centred around core north-south transit spines with higher density development focused around transit stops, supported by a local network. The following strategic public transport services have been identified:
- Mass transit spine (M1) – Picton to Macarthur
- Intermediate transit (I1) – Douglas Park to Macarthur via Appin
- Intermediate transit (I2) – Douglas Park North to Wollongong via a University of Wollongong
- Intermediate transit (I3) – Maldon to East Wilton. To be investigated as part of Maldon to Dombarton business case
- Local transit (L1) – Picton to Wilton Junction via a West Wilton
- Local transit (L2) – Douglas Park to Wilton South via Bingara Gorge
- Local transit (L3) – Camden to Douglas Park North via a Camden South
- Local transit (L4) – Appin to Macarthur via Appin Road
- Local transit (L5) – Gilead to Narellan via Menangle Park

The required infrastructure to support this network includes:
- Transit corridor – North west corridor linking Macarthur and Douglas Park.
- Southern Highlands rail line - Potential electrification of line south of Macarthur
- New rail stations –Potential new stations at Maldon and Douglas Park North
- Key interchanges - Interchange locations at Macarthur, Menangle Park, Douglas Park and Picton.

5.5 WALKING AND CYCLING NETWORK REQUIREMENTS
The proposed walking and cycling network has been developed in order to maximise the attractiveness of active modes throughout the GMIA. All key strategic road corridors will include provision for safe, connected and efficient cycling and walking infrastructure.
- Key north-south regional connections will be provided by fully segregated off-road paths along:
  - Hume Motorway
  - Menangle Road
  - Finns Road-Old Hume Highway-Camden Bypass
  - Appin Road.
- Key east-west regional connections will be provided by fully segregated off-road paths along:
  - Narellan Road
  - Spring Farm Parkway
  - Macquariedale Road
  - Picton Road.

A legible and well connected grid network of local streets will ensure permeability is maximised for walking and cycling trips. Proving high levels of priority to pedestrians and cyclists throughout the lower order network will help to minimise auto-dependency by promoting active modes and increasing public transport accessibility.
5.6 FREIGHT NETWORK REQUIREMENTS

The preferred plan makes provision to respond to implications of future rail-based goods movement and intermodal transfer of goods between road and rail and other freight handling strategies.

Key freight corridors that will drive freight movement in and around the GMIA include:

- Protection of future freight corridors such as Maldon to Dombarton (M2D) freight rail link and the Outer Sydney Orbital
- Investigate the potential re-alignment of M2D on the southern side of Picton Road to minimise conflict between community and freight uses within Wilton Town Centre
- Capacity enhancements along the Southern Sydney Freight Line (SSFL)
- Capacity, efficiency and safety enhancements for freight movement at the M31 Motorway and Picton Road interchange to cater for future expansion of Port Kembla
- Upgrades to Narellan Road, Picton Road and M31 Motorway to cater for increase in growth and freight related movement.

5.7 WILTON ACCESS REQUIREMENTS

Detailed microsimulation modelling has been undertaken to assess the specific access requirements for Wilton. Infrastructure required to facilitate access to/from the new Wilton town centre under the proposed land-use scenario:

The results of the detailed analysis of access options for Wilton Town Centre are located in Appendix A.
A.1 OVERVIEW

Based on the preferred land use scenario described in Section 2 and following several workshops with stakeholder agencies, three access options have been prepared for Wilton Town Centre. These are summarised below and described in more detail within the following section. It is anticipated that the majority of future development within GMIA will be completed by 2051. Accordingly, one horizon year (2051) has been chosen representing a longer-term horizon used to assess the ability of future road infrastructure to accommodate future traffic loads and to identify a preferred option.

A.2 SUMMARY OF ACCESS OPTIONS

To take this approach, traffic forecasts and assessments have been produced in consultation with DPE, TNSW and RMS for the three access options shown. Given the complex nature of the road network and access ramps connecting to the M31 Hume Motorway, microsimulation modelling using the traffic model was undertaken to more accurately assess the impacts of merging and weaving movements associated with motorway access ramps.

Option 1

Option 1 assumes the network developed as part of proponent led structure plan for Wilton Centre. The key road network planning elements:

- North facing ramps near the existing overpass at Niloc Bridge. New overpass to be provided.
- Southbound exit ramp on the M31 Hume Motorway between Picton Road and Niloc Bridge
- Upgrade of the M31 Hume Motorway and Picton Road interchange.

Option 2

Option 2 assumes the following road network planning elements:

- The same configuration of M31 Hume Motorway ramps as defined in Option 1
- Upgrade of the M31 Hume Motorway and Picton Road interchange
- Additional external connection from Wilton Centre road network to Menangle Road.

Option 3

Option 3 assumes the following road network planning elements:

- No direct connections to the M31 Hume Motorway between Douglas Park Drive and Picton Road
- Upgrade of the M31 Hume Motorway and Picton Road interchange
- Additional external connection from Wilton Centre road network to Menangle Road.
A.3 ACCESS OPTIONS EVALUATION

In assessing the adequacy of the road network to meet future demands, the concept of ‘mid-block’ level of service has been used to provide indication of acceptable operation of the various parts of the Wilton road network. The mid-block level service has been defined based on a combination of speed and the ratio volume to capacity. A Level of Service of D or mid-block sections or better is generally considered an acceptable network performance.

Option 1

Figure 5.1 and 5.2 provides a summary of mid-block level of service performance for Option 1 for 2051 during the AM and PM peak periods. The analysis shows:

- Significant congestion resulting in reduced travel speeds for both the M31 Hume Motorway and Picton Road
- Internal link roads within Wilton Centre experiencing significant congestion during the peak periods
- North facing ramps at Niloc Bridge experiencing significant congestion impacting mainline flows on the M31 Hume Motorway as a result of queues propagating north from this interchange
- Delays at intersections on Picton Road (west of M31 Hume Motorway) are likely to increase beyond manageable levels impacting access to internal link roads. This is a result of queues propagating within the internal road network from the primary constraints at Picton Road.

Option 2

Figure 5.3 and 5.4 provides a summary of mid-block level of service performance for Option 2 for 2051 during the AM and PM peak periods. The analysis shows:

- Reduced congestion on Picton Road due to additional capacity provided by connection to Menangle Road
- Internal road network performs satisfactorily during the AM and PM peak periods
- Minor congestion for vehicles entering/exiting the M31 Hume Motorway with minimal impacts to mainline flows
- Menangle Road connection performs satisfactorily reducing traffic loads on M31 Hume Motorway and Picton Road
- Some internal links at Wilton (southeast) experience some congestion on the approach to Picton Road (east of M31 Hume Motorway).
Option 3

Figure 5.5 and 5.6 provides a summary of mid-block level of service performance for Option 3 for 2051 during the AM and PM peak periods. The analysis shows:

- Significant congestion resulting in reduced travel speeds for both the M31 Hume Motorway and Picton Road
- Internal link roads within Wilton Centre experiencing significant congestion during the PM peak period
- The performance of Picton Road and Menangle Road significantly deteriorates in the PM peak
- Significant increase in congestion along Picton Road (east of M31 Hume Motorway) during the AM peak
- Menangle Road near new connection from Wilton Centre experiences delays westbound during the PM peak.

The average speed comparisons for each option are also summarised in Table 5.1 for key road corridors. It is observed that Option 1 and Option 3 result in unacceptable delays to the M31 Hume Motorway, particularly in the PM period. This section of the M31 Hume Motorway is a nationally significant freight corridor and significant delays to freight movements need to be minimised. A network which maintains the efficiency of the M31 Hume Motorway is vital to avoid the long term economic impacts of a significant impediment to freight movements in the region.

Option 1 and Option 3 also result in unacceptable delays and for Picton Road (west of the M31 Hume Motorway) in the PM peak.

<table>
<thead>
<tr>
<th>Route</th>
<th>2051 AM speed (km/h)</th>
<th>2051 PM speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Option 1</td>
<td>Option 2</td>
</tr>
<tr>
<td>Hume Motorway (NB)</td>
<td>93</td>
<td>95</td>
</tr>
<tr>
<td>Hume Motorway (SB)</td>
<td>54</td>
<td>96</td>
</tr>
<tr>
<td>Picton Road (west of Hume Motorway) (EB)</td>
<td>55</td>
<td>62</td>
</tr>
<tr>
<td>Picton Road (west of Hume Motorway) (WB)</td>
<td>48</td>
<td>58</td>
</tr>
<tr>
<td>Picton Road (east of Hume Motorway) (EB)</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Picton Road (east of Hume Motorway) (WB)</td>
<td>64</td>
<td>64</td>
</tr>
</tbody>
</table>

Table A.1: Average speed comparison (colours based on midblock level of service: Green A-C, Yellow D-E, Red F)

Notes:
NB = northbound  WB = westbound
EB = eastbound    SB = southbound
A.4 ROAD NETWORK AND CONNECTIONS

The options evaluation indicates that Option 2 provides an acceptable level of performance from a traffic modelling perspective for the ultimate horizon year 2051 for both the AM and PM peak periods. It is clearly evident that to cater for land use demands imposed by the future development at Wilton, multiple road network access points will be required to provide sufficient road carrying capacity.

The results indicate that an additional road connection to Menangle Road will be required from Wilton Centre to cater for the expected future traffic demands. The initial modelling results indicate that this connection carries more than 2,000 vehicles per hour in the peak direction during the PM period.

Furthermore, the internal road network is required to carry a significant amount of traffic, with some links carrying up to 1,500-2,000 vehicles per hour. This indicates that the classification of these internal road links in the road hierarchy, particularly linking the M31 Hume Motorway are accommodating significantly higher traffic volumes which requires an examination of adjacent land uses and road network functions.

Some roads may also benefit from geometric realignment to maintain network legibility and continuity across Wilton, in particular from the M31 Hume Motorway to Menangle Road. A more direct connection from the M31 Hume Motorway to Menangle Road using a sub-arterial road would avoid the current arrangement of traversing a circuitous local road network to access the motorway. This also assists in adhering to the access management principles identified earlier in this report by ensuring that roads with similar roles within the hierarchy are connected to minimise traffic flow interference associated with access movements to/from the motorway network.

Possible alignment options of this more direct connection may include a re-alignment of the currently proposed internal network or a new connection between Douglas Park Drive and Menangle Road. These indicative options are shown in Figure 5.9 and should be investigated further to determine the optimum location and alignment requirements. A risk assessment from an environmental perspective will be required to understand the comparable impacts of each of the options as some of the alignments transverse high value vegetation.
A.5 SUMMARY

The results of the detailed analysis of access options for Wilton Centre have been used to determine the following summary of requirements:

- Upgrade and capacity enhancements of M31 Hume Motorway/Picton Road interchange. Including grade separated flyover for right turn from Picton Road westbound to M31 Hume Motorway northbound.

- A direct connection from M31 Hume Motorway to Menangle Road with 2 lanes in each direction to provide additional road carrying capacity to accommodate expected traffic demands.

- Direct access from M31 Hume Motorway to be from higher order road connections such as sub-arterial or arterial road.

- In addition to the M31 Hume Motorway/Picton Road interchange, north facing ramps are required from the direct Menangle Road connection. An additional exit ramp is also required connecting to the internal link road.

- Direct access (via ramps) to the M31 Hume Motorway (between Douglas Park Drive and Picton Road) shall be appropriately located and designed to avoid disruption and interference on main line flows to the motorway.

- Picton Rd intersections to have a minimum of 500m spacing to the west of M31 Hume Motorway. Spacing to the east of M31 Hume Motorway shall be at least 1km due to the significant use of this corridor by freight vehicles.

- Major Picton Road intersections at Almond Street, Pembroke Parade and Wilton Park Road operate satisfactorily as signalised intersections by 2051 but it is recommended that these intersections be future proofed for potential grade separated interchanges in the longer term.

- An internal road connection linking Wilton and Bingara Gorge will be required over the M31 Hume Motorway. Ideally a more direct alignment than shown in proponent’s plans would be provided however it is noted that existing residential development and a water treatment facility pose substantial constraints.