Visitor Flows Model for Queensland – a new approach

Jason. van Paassen[1], Mark. Olsen[2]
[1] Parsons Brinckerhoff Australia Pty Ltd, Brisbane, QLD, Australia
[2] Tourism Queensland, Brisbane, QLD, Australia

1 Introduction

Understanding how the tourist "drive market" moves around the state is fundamental to the future planning and provision of tourism infrastructure across Queensland. The visitor flows model was formulated to gain this understanding of the drive market.

The drive market brings $4.5 billion dollars (2005) of revenue to Queensland each year. Targeted infrastructure development to support growth in the tourism industry is facilitated through the use of a "visitor flows model" (the "model"). This model is the subject of this paper.

This paper outlines the "first-steps" in the development of a visitor flows model for Queensland and also discusses its application and future development opportunities for the model.

2 Background

In 1999 Tourism Queensland (TQ) and the Department of Main Roads (DMR) initiated a Strategic Tourism Roads Study which identified the main tourism routes in Queensland. This study was the basis for ongoing work on tourism road infrastructure needs. The analysis in this study used Domestic Tourism Monitor (DTM) and early National Visitor Survey (NVS) results to track visitor movements by road corridor using the travel grid in both surveys. This form of presentation linking tourist movements to the road network was identified as a useful tool both by DMR and TQ.

TQ progressed with the above methodology in partnership with the CRC for Sustainable Tourism (Centre for Regional Tourism – Southern Cross). This partnership aimed to take the NVS data and develop a model for ongoing Geographic Information System (GIS) outputs linked to the road network to use as an input to DMR infrastructure planning, a tool to support regional development and a research model to track change over time along identified key routes in Queensland.

The above processes were seen to be a "first step" with potential for improvement. The visitor flows model was seen to be the appropriate method of analysing the visitor survey data that was available. The dataset that has been chosen to be analysed using the visitor flows model (the "model") has been the NVS.

The National Visitor Survey (NVS) is the key database for the purposes of understanding tourist movements in Australia. The NVS has been progressively developing over the past 5 years and is now becoming a robust dataset for the purposes of tourism planning and analyses.

Given the nature of the NVS it is not easily translated into meaningful "visitor flows" across a road network. Being able to map the drive market elements contained within the NVS is the objective driving the development of the model.

Subsequent to the early development steps outlined above Parsons Brinckerhoff (PB), an internationally recognised engineering firm with expertise in the planning and development of transportation infrastructure and transport modelling, were engaged to further develop the model (GIS and database interrogation elements) and also ensure the

model was robust enough for use by DMR. PB have developed the first stage of the model in conjunction with TQ. The current state-of-play with the model is outlined below in the following sections.

3 Visitor flows model – framework

3.1 Overall framework and context

The model is being developed to be a state-wide model for visitor flows. Figure 1 below illustrates the overall visitor flows model structure.

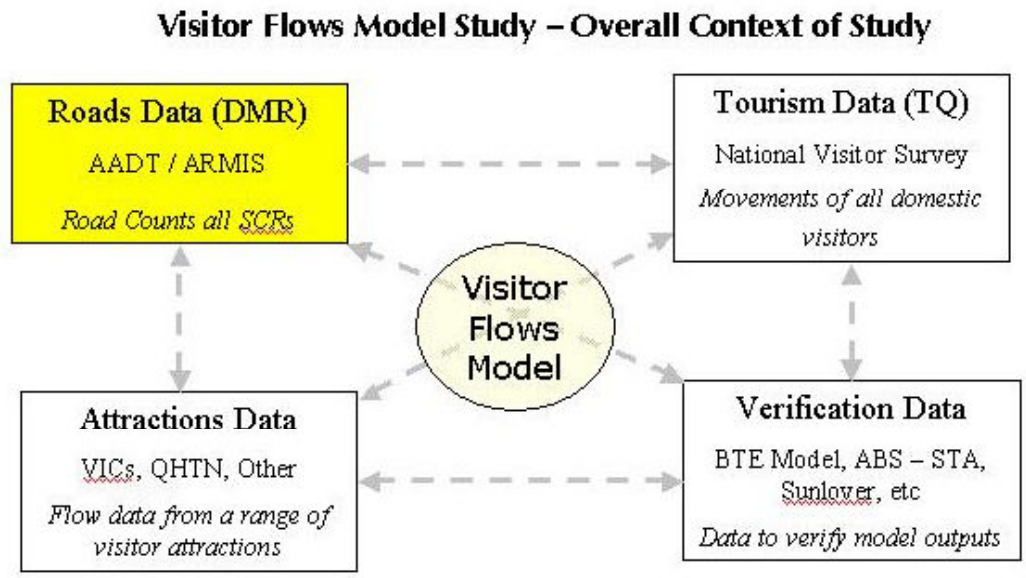

Figure 1 Overall context of visitor flows model

The complete model will be a geographic information system that will allow TQ, amongst others, to track and examine changes in visitor movements along the major strategic tourism road corridors in Queensland. Ultimately, the model will provide TQ with information regarding changes in visitor movements over space (geographically) and time (temporally). Use of the model will likely facilitate improved targeted marketing, assessment of the impacts of events (including campaigns, road upgrades, new infrastructure) and an understanding of the changing patterns of route use by the drive market.

The overall purpose for the model is to geographically display travel patterns over time of the domestic drive market. However, the current first stages for the models development have focussed on examining the NVS data utilising GIS. Specific goals of this first stage were:

- to create a functional Geographic Information System that draws on the NVS data and links visitor movements to road corridors;
- that it provides an opportunity to further examine the unit record data in the NVS (e.g. assess which lifecycle segments travel on each route, etc); and

- to allow TQ at a later date to actively examine shifts in the drive market over time and to add additional years data to the model.

The above goals have been achieved however further work is continuing to improve the process and model outputs.

3.2 Overview of model process

The model has been developed using a combination of MS Excel, MS Access and MapInfo macros. C++ has also been applied to compile code developed to undertake path building between each Statistical Local Area (SLA). This was necessary due to the limited speed of using uncompiled code such as used in say either MS Excel, MS Access or MapInfo macros.

The three key system components that have been developed are:

- "snapping" each SLA centroid to the closest node on the closest road corridor;
- determining the "shortest path" (drive time) between each SLA using the major key road corridors as the potential routes; and
- "assigning" each NVS trip record to the network between each SLA using the "shortest path" methodology (Dijkstra's Theorem).

The model process that has been adopted is illustrated in Figure 2.

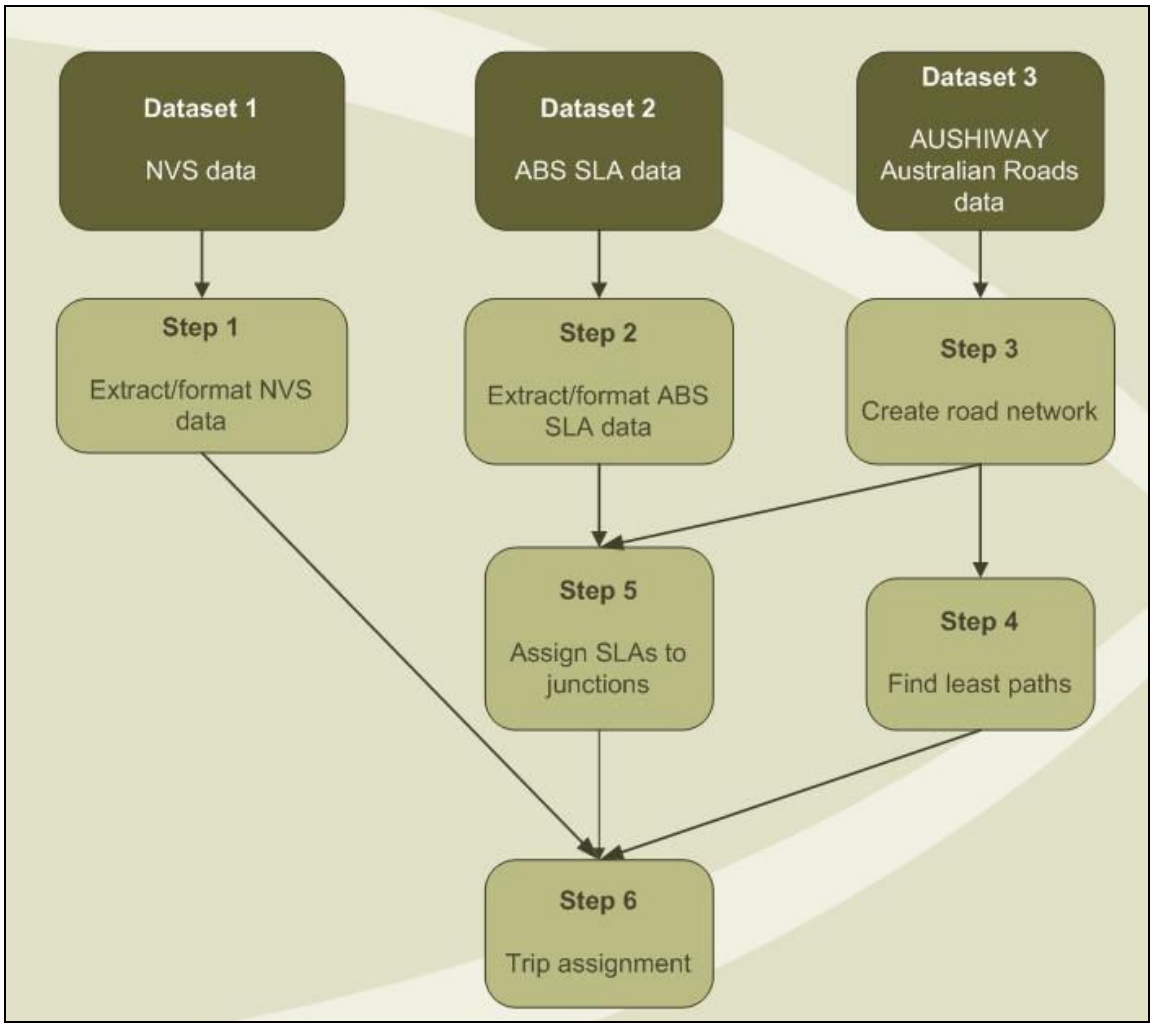

Figure 2 Model process

More detailed descriptions of each of these system components, including their limitations, are provided below in Table 1.

The key assumptions that have been made in the formulation of the model are as follows:

National Visitor Survey Records

- the NVS information is only reliable for the 1st 21 stopovers for a particular journey record;
- stopovers where SLA's cannot be matched to any ABS data were ignored;
- origin for the first stopover of a journey is the interviewees home SLA;
- only trips where State visited: Qld is true, and where user travel options are personal car or rental car have been included;
- SLA's are identified by a 5 digit number, where the first digit represents the state, and the final 4 represent the SLA; and
- only data for the calendar years of 2000, 2001 and 2002 have been used owing to the low level of confidence placed in the 1998 and 1999 NVS datasets.

Shortest Paths

- shortest paths between junctions were found;
- the shortest path between two linked points will be defined by the user, for example the use of the shortest distance rather than the use of a formula; and
- the shortest path has been based on the use of shortest distance only, assuming equivalent travel speed over the network. In this case, "shortest distance" can be a proxy for "drive time".

Table 1 System components, process and limitations

System element	Process	Limitations
NVS Extraction	Extract data from NVS text file to spreadsheet using *MS Excel*.	Occasional text will cause an error in the program. Some SLA data in NVS has been erroneously entered and cannot be used (estimated at about 5% of SLA's for Queensland Trips).
Build travel network (major corridors)	Create and label continuous corridor segments and junctions from highway strands.	Ignores alternative travel routes.
	Create and label network nodes every 10km as entry/exit surrogates.	Ignores secondary road network and natural barriers.
	Border crossing method based on location of previous night's stopover and trips assigned to a "wider" road network. The "wider" road network includes all major highway routes across Australia.	An additional validation factor may be required to improve "matching" to known visitor flows across border crossings.
Build stop (SLA) database	Create SLA centroids from ABS boundaries as stop surrogates.	Geographic centroid may not correspond to most likely stop location.

System element	Process	Limitations
	Compute nearest network node, segment and junction for each stop.	Ignores actual road network and natural barriers.
Merging of data	The respective NVS, Corridor (Least paths) and SLA tables were entered into *MS Access*, where several queries were created to assign vehicles to the network.	Trips where Origin Junction and Destination Junction are equal are removed from the dataset. Trips where the distance between SLA's is less than the distance to the network are removed.
Analyse visitor flows	Provide "point and click" access to summaries of surveyed holidays using each travel corridor. Formulation of graphic output via *MapInfo* illustrating total flow across each corridor segment.	About 20% of holiday trip segments are missing or allocated to incorrect corridors due to NVS miscodes. Currently only calculates total flow, other calculations may also be performed as part of future improvements.

4 The benefits

The visitor flows model provides the user with a visual representation and analysis capability of the NVS data set over pre-defined major road corridors set within a GIS framework. This is understood to be a first in Australia.

Other tourism data analysis tools are available and are currently utilised within the marketplace, for example, the VISMAD data analysis tool, Centre for Regional Tourism Research (2004) and Tourist Tracker, Tourism Queensland (2005), this is currently under development by Tourism Queensland and associated agencies. The Tourist Tracker approach has as a sub-set the visitor flows model approach. The Tourist Tracker is the overall package for the visitor flows model and as such the Tourist Tracker concept covers a broader level of analyses than the visitor flows model alone.

The VISMAD system utilises GIS but it does not focus on road corridors, or the "drive market" alone. Instead the VISMAD system has the capability to provide the following outputs (see Figure 3 below) but these are represented not at the "on road" level rather they are output in terms of another mapping or area base such as at an SLA level:

- Assessing to what extent 'icon' destinations encourage visitor dispersal throughout a broader region (used by State and regional marketing agencies to make decisions regarding focus of marketing efforts within a region)
- Assessing whether actual visitor flows match marketed flow strategies (such as drive routes) and using this information to change marketing or develop new flow strategies
- Identifying the likely transport corridors through which visitors enter and exit a region to help make decisions about the placement of marketing collateral
- Identifying destinations which are commonly linked on visitor itineraries to improve collaboration in marketing and product development
- Identifying market characteristics for groups undertaking different itinerary types to enable tailored promotional collateral and product packages to be developed for these markets
- Identifying the role of destinations in typical trip itineraries to provide insights as to what product and product types may be developed there (for example, a destination

which has the potential to act as a hub for multi-destination itineraries may pay attention to developing accommodation and Food & Beverage product while an outlying destination may need to develop more short stay and day-time product)

- Using time series analysis to assign changes in flow patterns to key events such as marketing campaigns, special or shock events, transport infrastructure changes, consumer behaviour and consumer characteristic changes, policy or access changes. This information can be used to assess the impacts of those changes and project these to impacts of similar planned changes in the same or other regions.

(Source: Centre for Regional Tourism Research (2004))

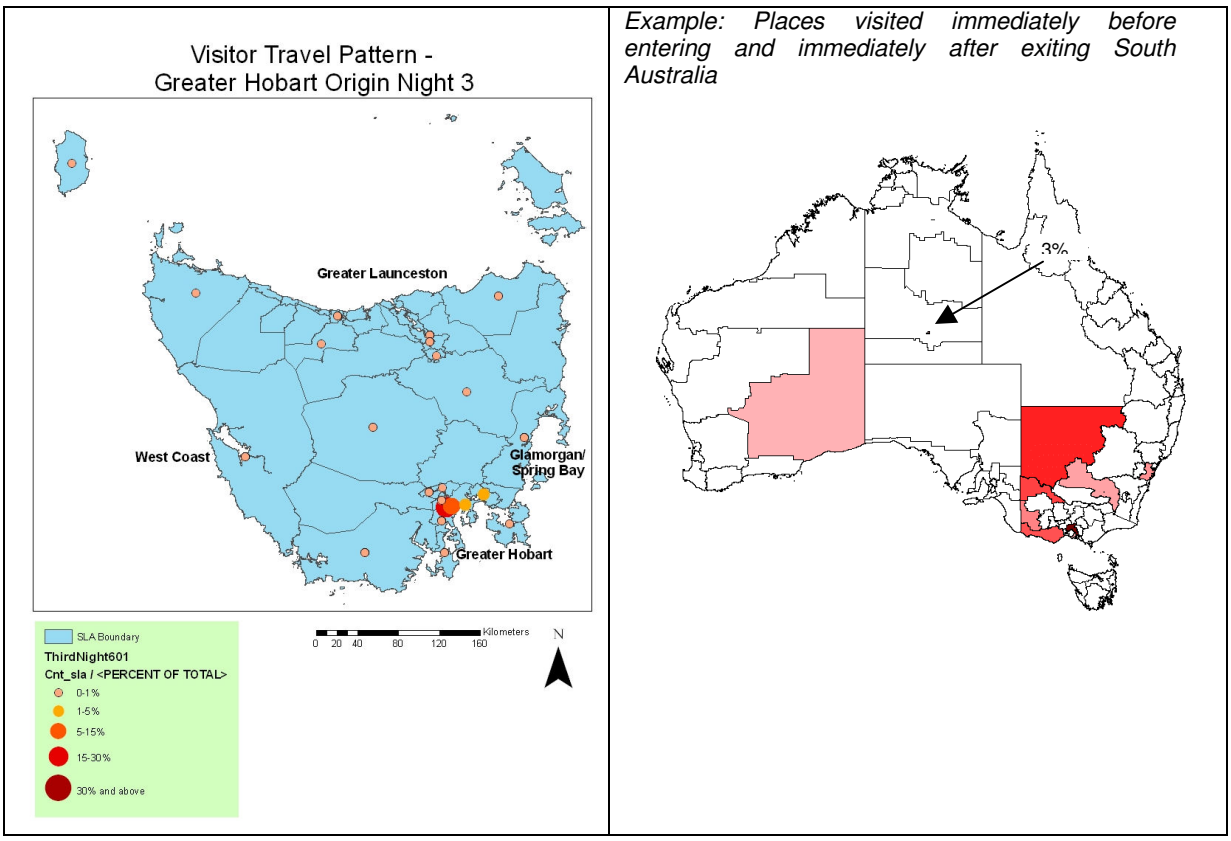

Figure 3 VISMAD System – example outputs, Centre for Regional Tourism Research (2004)

Consistent with many of the capabilities of the VISMAD system the visitor flows model also provides the following benefits to the analysis of tourism "drive market" flows across a region, but the distinct difference between the visitor flows model and the VISMAD system is that the visitor flows model provides this information for road links as opposed to by a geographical area:

- map the annual or other period (eg quarterly) estimated drive market visitor flows onto the road network (see example Figure 4 below for preliminary working draft output)
- map the various NVS data elements, eg party size, lifecycle group, home origin, amongst others for each major link on the road network (see example Figure 5 below for preliminary working draft output)
- ability to focus on changes in the use of particular road by the drive market, this could be in terms of the lifecycle group, home origin, party size amongst others as defined within the NVS

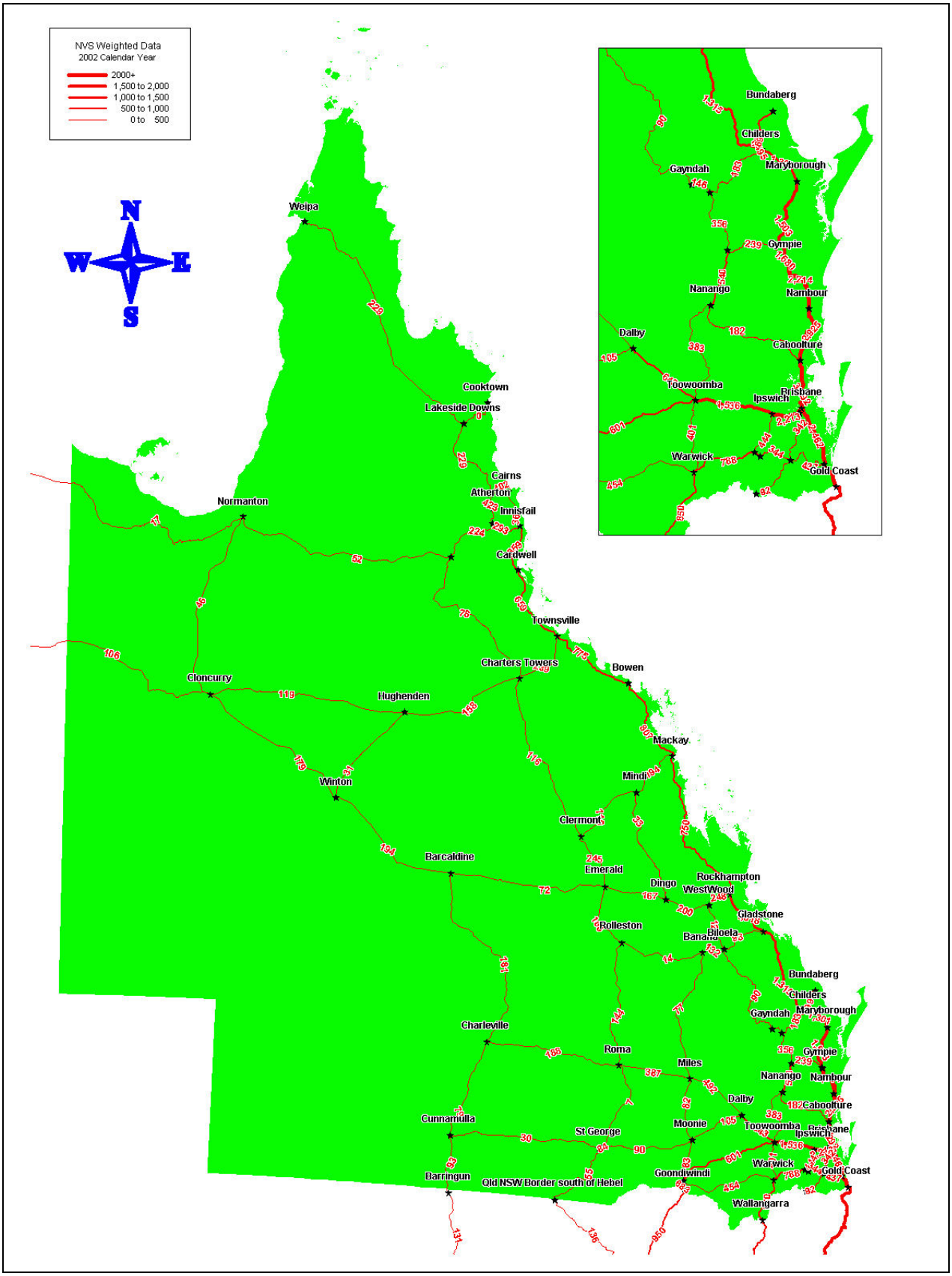

Figure 4 Visitor flows for Queensland (estimated, preliminary working draft) – NVS 2002

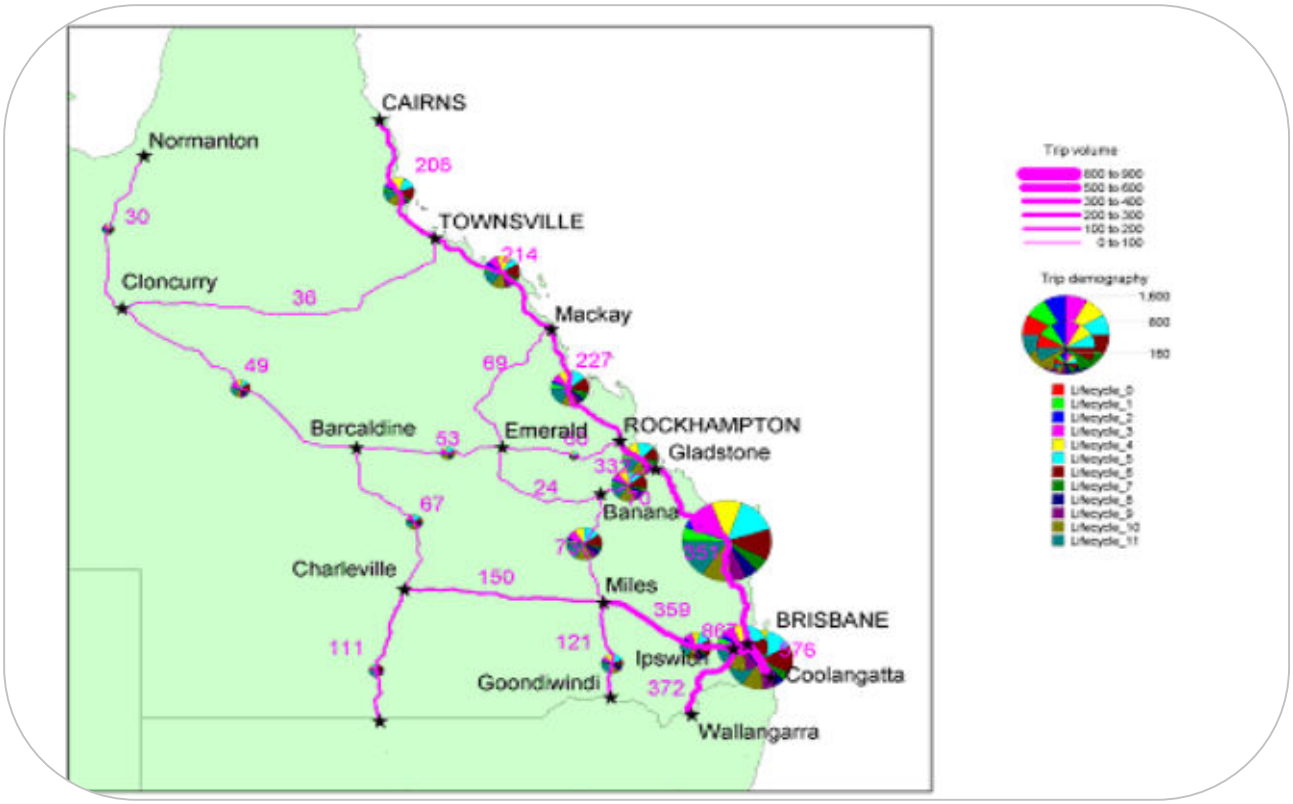

Figure 5 Lifecycle for drive market by major road corridor – Estimated (preliminary working draft) visitor flows, NVS 2002

The above examples only represent a starting point as all of the available data categories included within the NVS can be mapped utilising the visitor flows methodology. Further work and analyses are required to maximise the benefits derived from these starting steps for a visitor flows model.

5 Where to next?

The next steps for the development of the model are currently underway. Parsons Brinckerhoff, in conjunction with Tourism Queensland, are undertaking the following "next steps" to further develop the model.

- *Step 1* – Map flows to the road network using GIS (only those where the trip crosses less than 2 decision points (junctions) or cover over 400km in one journey
- *Step 2* – Check the results against the average daily traffic counts from Main Roads across the road network
- *Step 3* – Introduce an 'impedance' factor for unsealed or single-lane roads to assist the route choice decision making process. This process would build-on the existing simplistic "shortest path" methodology to improve the model estimates for route usage. This process would likely consider number of attractions, accommodation types and other similar characteristics of each route.
- *Step 4* – Work with Visitor Information Centres (VIC) to collect additional flow data and then feed this into the model
- *Step 5* – Develop a user interface for queries of visitor type, yearly comparisons, amongst others

At present TQ and PB are completing Steps 1 and 2, and are in the process of developing the impedance factors. TQ is also piloting a VIC data collection project to feed additional data into the visitor flows model.

It is important to note that this model, while only being used in Queensland, was developed by PB with a number of national links to ensure the route allocation methodology was not affected by the borders. Therefore, it would be a consistent exercise with that of the Queensland experience to then apply the model nationally.

Further to the above next steps there are also other opportunities for the further development of the model. These possible areas of improvement include:

- development of a user-friendly "front-end" for the model, primarily for data input and choice of model functions;
- increasing the resolution in the road network to better reflect route choice;
- improving the stopover allocation by using population or accommodation centroid rather than centroid of SLA;
- developing an interface with other data sources, either for inputs or provision of outputs to another system;
- expanding the model to "known" visitor flows to then match the total population set, for example, average daily flows; and
- developing a user-friendly "back-end" for the model, primarily for data outputs, including graphing of data (as pie charts, bar graphs and the like) and graphics of flows across the network.

The above opportunities will also be investigated in the future stages of the models development.

6 Summary and conclusions

The visitor flows model project has resulted in the development of a system that facilitates the mapping of the National Visitor Survey (NVS) records onto Queensland's major road network.

The ongoing development of the visitor flows model will assist tourism planners in understanding the needs of the drive market across Queensland.

This model has the capacity to be developed as a national model by using the Queensland base as the starting point.

Further development of the model will result in a tourism data analysis tool that will add-value to the development and understanding of the tourism drive market in Australia.

7 References

Centre for Regional Tourism Research (2004) *User Specifications for VISMAD (Visitor Movements And Dispersal) T-GIS*, Southern Cross University, New South Wales

Parsons Brinckerhoff (2003) Visitor *Flows Model – Geographic Information System Final Report* for Tourism Queensland

Tourism Queensland (2005) *Tourist Tracker* – an initiative of the Queensland tourism industry