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Visualising Relatively Unpredictable Movement (VRUM™):

the Tourism Flows Modelling Project

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The Desert Knowledge Cooperative Research Centre (2003–2010) was an unincorporated joint venture with 28 partners whose mission was to develop and disseminate an understanding of sustainable living in remote desert environments, deliver enduring regional economies and livelihoods based on Desert Knowledge, and create the networks to market this knowledge in other desert lands.

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1. Visualising Relatively Unpredictable Movement (VRUM™): the Tourism Flows Modelling Project

1.1 Scope

This report describes the development of a Geographic Information System (GIS) that models the patterns of travel of self-drive visitors to desert Australia. The VRUM™ system (Visualising Relatively Unpredictable Movement) depicts road segments used, overnight stop locations and direction of travel. At completion of the initial development stage, the system was populated with data covering travel in the period 2000–2006. This report is concerned with the user needs and logical specifications of VRUM™. It includes some description of the technical specifications, but details thereof remain commercial in confidence and are proprietary to the Desert Knowledge Cooperative Research Centre. The report also includes some examples of analysis of VRUM™ output. Aspects of the report have been published elsewhere in Holyoak and Carson 2009, Holyoak et al. 2009 and Chewings et al. 2007.

1.2 Self-drive visitors and desert tourism

The relatively poor performance of Australia's desert tourism destinations in attracting visitors during the 2000s has been previously documented (Carson & Taylor 2009). Between 1999 and 2008, domestic visits to desert areas declined by 10% and international visits by 8%. Nationally, domestic travel also declined, but by just 3%, while international travel grew by 25%. Decline in tourist activity does not necessarily reflect decline in tourism businesses and desert-based economic activity. However, it is apparent that desert areas are home to fewer businesses per capita than non-desert areas, and that the proportion of the desert population in the 'key worker' or 'entrepreneurial' demographic (25–44 years old) has declined over the past decade (ABS National Regional Profile). Tourism does not appear to have performed any better than other sectors, despite repeated claims of its potential to do so. There were about 2000 fewer people reporting that they worked in accommodation or food services jobs and lived in desert Australia in the 2006 Census compared with the 1996 Census. There has also been a decline in the number of registered businesses in the sector, compared with strong growth nationally.

Changes in transport infrastructure have also meant that what tourism activity does occur in desert Australia occurs in a smaller number of places. Accommodation activity, for example, is clustered around Alice Springs, Broken Hill, Mt Isa and a few locations on the north coast of Western Australia. Of these, only the north coast of Western Australia has experienced growth in tourist activity since 2000, and it is debatable whether visitors there are seeking 'desert' rather than 'coastal' travel experiences (Carson & Taylor 2009). Excluding the north coast of Western Australia, the number and frequency of air services to desert locations has declined since the late 1990s. Rail services, while iconic, have limited capacity in terms of volume and frequency. Three of the five major national coach companies have ceased operations over the past ten years. Important international markets, which were once catered to by specific forms of transport – particularly backpackers and their organised tours (Carson et al. 2007), but also charter flights from Japan, Europe and the United States – have also declined dramatically.

Desert tourism, then, is faced with the issues of needing to address declining popularity, declining business infrastructure, declining dispersal and increasing 'remoteness' brought about by increasingly limited access points and transport modes. This story of 'doom and gloom' can actually present opportunities to desert-based people, since tourism in the boom times of the late 1980s and 1990s was largely the business of external investors, transient labour and government marketing agencies (Schmallegger, forthcoming). The key to strengthening the sector from within the desert is to identify markets that are more stable and profitable over time, and which can be encouraged to explore new

destinations and activities (Carson & Taylor 2008). Past research by the Desert Knowledge Cooperative Research Centre (Tremblay 2005, Carson & Taylor 2010, Taylor & Carson 2007a) has identified self-drive markets, and in particular the four-wheel-drive market, as having potential in this regard.

It is, in fact, quite difficult to distinguish self-drive and four-wheel-drive markets in many desert destinations. While few datasets specifically identify four-wheel-drive as a mode of transport, where such identification has been made, estimates suggest that over 40% of all self-drive visitors to desert Australia do some form of off-road travel during their trip, and many more use four-wheel-drive vehicles (towing caravans, etc) even if they do not intend to travel off road (Carson & Taylor 2010). Four-wheel-drive visitors to desert Australia have been found to have higher rates of repeat visits than other markets. They also visit more destinations, take longer trips and have higher in-trip expenditure (Taylor & Carson 2007b).

There are four key segments within the four-wheel-drive market in desert Australia (Taylor & Prideaux 2008). The largest segment is the ‘explorers’, who tend to design trips around the iconic desert ‘tracks’ (Canning Stock Route, Oodnadatta Track, Gunbarrel Highway, etc), and the aim of their trip is to explore places away from the main tourist haunts. The second segment is the ‘activity seekers’. These are travellers who use the four-wheel-drive vehicle to support their core activity, be it bird watching, fossicking, hiking or the like. The third segment is the ‘thrill seekers’, who travel with the explicit intention of testing the capabilities of their vehicles and themselves as drivers: conquering the highest sand dune, navigating the boggiest creek bed, and so on. The fourth segment is the ‘novices’, who tend to have a four-wheel-drive vehicle for towing a caravan or because of perceptions of safety and may be encouraged to experiment with four-wheel-driving as an activity. Each segment undertakes different itineraries and has different behaviours in terms of destinations visited, length of trip and items of expenditure.

Concerns about the potential of the four-wheel-drive/self-drive market include their low level of interest in Aboriginal culture and Aboriginal tourism product (Schmallegger 2007, Jacobsen forthcoming), the competition for the market from other environments (Taylor & Carson 2007a), and whether the market can continue to grow in the face of increasing concerns about the environmental costs of self-drive travel (Carson & Taylor 2008). The desert’s historical failure to compete in the tourism marketplace generally may well transfer into failure to compete in the four-wheel-drive market specifically as more destinations target this market over time. Addressing these concerns requires better knowledge about the nature of the market, and the Desert Knowledge Cooperative Research Centre On Track research program has begun the process of knowledge building (see Carson & Taylor 2010). The VRUM™ GIS is one output from the On Track program.

1.3 The importance of understanding visitor flows – VRUM™ user needs assessment

Forces, both internal (the reshaping of desert tourism as smaller and less dispersed) and external (environmental concerns, rising fuel prices, cheaper transport alternatives), will surely have had impacts on where people travel as well as how and when they travel. Carson and Holyoak (2008) presented on the future of self-drive tourism in Australia at the 2008 *Tourism Futures* Conference. They suggested that there were conflicting forces driving market growth and travel patterns. Continuing increase in private vehicle ownership across the world, and particularly increase in four-wheel-drive vehicle ownership among the baby boomer demographic, increases the likelihood of more self-drive travel in the foreseeable future. The extent of growth will be tempered, however, by increasing travel alternatives (particularly low cost air travel) and rising costs of self-drive travel. The market is shifting more towards people who want to have their vehicles with them, rather than those who are using their

vehicles to reduce costs. The market is also becoming more affluent – vehicles are more expensive, in-vehicle technologies more complex, and the market itself is wealthier and more travel-experienced than it has been in the past.

While the broad trends have been well described (see Prideaux & Carson forthcoming), there appears to be little information available about the impacts of market change on specific destinations and the businesses that operate within them. Fundamental information gaps include assessments of how many people travel through a destination, what market segments they represent, where they have come from and where they are going. Trip patterns are notoriously complex (Lue et al. 1993, Lew & McKercher 2006), particularly for multiple destination trips (which are more common in desert Australia than in coastal and urban destinations). Knowing the place of origin and main destination of a trip (and not all trips may even have ‘main’ destinations) provides very little information about the activities in between. Even if all destinations are known, the order in which they are visited can have significant implications for product consumption (which destination is selected for lunchtime meal or overnight stop, for example) and hence business opportunities.

Holyoak et al. (2009: 239) claimed that more detailed trip information, such as that provided by VRUM™ ‘can be vitally important for a number of destination and business management functions including marketing, product distribution, product packaging, product development, transport/access planning, policy and research’. Examples of applications for these functions are in Table 1.

Table 1: Applications of visitor flows information

Process area	Application examples
Marketing	- Markets may be segmented according to the trip patterns they employ. These segments may have distinguishing demographic, socioeconomic, or psychographic characteristics. - Visualising tourist movements will help evaluate marketing campaigns designed to influence dispersal or visitation to specific nodes. - Market changes can be tracked by linking changes in tourist movements to ‘events’ such as marketing campaigns, infrastructure upgrades, tourist events, new product development and so on.
Product distribution	Understanding the order and direction of tourist movements will help in making decisions about the placement of product and destination information. This might range from decisions about which visitor information centres may be useful for distributing in-trip but pre-visit information, to what side of the road will bring maximum benefit from billboard advertising for an accommodation business or tourist attraction.
Product packaging	The pattern of tourist movements suggests links between destinations and regions. Product packaging may extend beyond the boundaries of a single region to improve the total visitor experience.
Product development	Nodes with different functions in itineraries may require or benefit from different types of product. Nodes which are, or may become hubs, for example, will require accommodation, food and beverage, and service products. Nodes which are spokes or transit points may be better served developing attractions, shopping and other ‘day time’ product.
Transport/ access	Changing the level of transport access to a destination may affect its relationship to other destinations. In general, destinations that act as dispersers or hubs require good entry access and a variety of ground transport options. Terminus nodes have efficient transport from places of origin, but limited transport for dispersal.
Policy	The research demonstrates substantial linkages between destinations crossing existing administrative boundaries (local government, tourism region, and even state borders). To exploit these linkages, it will be necessary to have policy leadership that not only approves, but encourages multi-regional collaborations.
Research	Understanding the spatial movements of travellers offers opportunities for conducting cost-effective visitor research. Hub nodes are likely to present opportunities to collect data from a wide range of visitors to regions outside that hub, for example. Nodes that are closer to the end of trips may be useful for measuring visitor satisfaction with previously visited nodes. Research may be undertaken at facilities such as transport terminuses or visitor information centres.

There have been previous attempts to model visitor flows. In Australia, GIS work by Wu and Carson (2008) showed how locations of overnight stops changed according to the length of stay of visitors in Tasmania, and described the clusters of destinations visited on multiple destination trips to South Australia. In New Zealand, Becken et al. (2004) developed a GIS showing the most popular routes for air travel on multiple destination trips. Outside the academic research sphere, Tourism Queensland has developed a GIS estimating the number of tourist vehicles that use specific road segments. Other jurisdictions have proposed various models (as reported at a workshop on visitor flows modelling hosted by the Sustainable Tourism Cooperative Research Centre in July, 2005) but there is no evidence of these having progressed.

1.4 Summary of logical specifications

VRUM™ inherited some of the characteristics of each of the previous known visitor flows modelling applications, and includes some additional logical specifications. In contrast to the previous (Australian) efforts, VRUM™ was intended to have multi-jurisdictional coverage, with a focus on desert regions in Queensland, New South Wales, South Australia, Western Australia and the Northern Territory. The entire mainland road network was included because VRUM™ aimed to show all roads used and destinations visited by desert travellers – even those destinations outside of the desert.

VRUM™ was specifically focused on self-drive travellers, with the road network and settlement locations comprising the key spatial layers. The importance of four-wheel-drive travel meant that the ‘road network’ was expanded to incorporate all gazetted roads, including unsealed roads and tracks. Settlements were defined as locations with built infrastructure and resident human inhabitants. The system was designed to show how many travellers used each segment of the road network and how many travellers stayed overnight at each settlement. In addition, the system would show the number of travellers travelling in either direction along any road segment and the number of nights (length of stay) spent in each settlement.

The core logical specifications for VRUM™ were multi-jurisdictional coverage, detailed road network, volume of road use, direction of travel, and volume and length of stay at settlements. Three other aspects of the system were also considered important:

1. The system should be capable of integrating data from multiple sources, given that the tourism information marketplace in Australia is notoriously fragmented (Taylor 2005)
2. Structures should be developed to allow for validation of data given the consistent criticisms of tourism data having limited application at regional and local levels (Carson & Richards 2007)
3. To fulfil the aim of describing what type of visitors use which road segments and stay at which settlements, the system needed to retain the demographic and psychographic information usually included in visitor databases, along with the spatial and trip length information.

1.5 Data sources

The minimum dataset for VRUM™ records is:

1. location of overnight stops (coded to a geographic location)
2. order of overnight stops
3. mode of transport between overnight stops
4. length of stay (number of nights) in overnight stop.

From this information, VRUM™ can represent location/stopover information and can estimate the roads used (and direction of travel) between stopovers.

Spatial data layers were drawn from a variety of sources. Boundary files associated with the Australian Standard Geographical Classification were downloaded from the Australian Bureau of Statistics web site. These included national and state borders, tourism regions, statistical local areas, and urban centres and localities (UCLs) which are settlements of 200 people or more. There were 121 UCLs in desert Australia in 2006.

The Australian strategic road network layer was drawn from the GeoScience Australia road network mapping base. The network includes strategic tourist road links that allow for travel between UCL destinations, and it includes the following road classes:

- dual carriageway
- minor road
- principal road
- secondary road
- track.

Within these classifications, the road types may be sealed, unsealed, under construction or have an unknown formation. In addition to these attributes, an assumed speed is applied to the road classifications to allow for the travel time calculations required in the later modelling stages. These speeds are as follows.

Table 2: Speeds allocated to road classes

Road class	Description	Speed (km/hr)
1	Dual carriageway	100
2	Principal road	80
3	Secondary road	60
4	Minor road	40
5	Track	20

The road network included in VRUM™ is depicted in Figure 2 in section 1.6 of this report. The utilised road network is denser around the east coast, south-eastern and south-western parts of Australia. It is also clustered around Perth and Alice Springs, with vast regions in the west lacking a defined road network.

Holyoak et al. (2009: 239–240) described the core visitor data used in the initial development of VRUM™:

The base data for VRUM™ is drawn from the International Visitor Survey (IVS) and the National Visitor Survey (NVS) (2000–2006), both administered by Tourism Research Australia (2006a, 2006b). Each survey included approximately 25 000 respondents each year from 2000 to 2004 and 40 000 respondents in 2005 and 2006. Respondents were asked where they spent each night on their trip (in order), transport used to access each of these stopovers, and how many nights they spent in each location.

The surveys also include a wealth of additional data about the respondent and the trip itself. Respondent data includes age, sex, lifecycle stage (e.g. singles, couples, families, etc), country of origin or place of residence in Australia, income and employment status. While trip variables change each year, regularly collected data includes size and composition of the travel party, purpose of travel, accommodation used, major attractions visited, activities undertaken, and expenditure. Linking unit records to the trip matrices allows VRUM™ to create trip pattern analysis for different groups of tourists based on individual or trip related variables.

There are some important limitations in the base data, beyond the fact that specific travel routes are not recorded. While the surveys are large, detailed regional analysis often results in very small sub-samples of people recorded as visiting specific locations. Data

also has to be weighted because, while the international and domestic visitor samples are similar in size, international travellers account for just 5% of all visitor nights in Australia each year. Finally, the data is subject to variable interviewer and data entry error over time, particularly in the order of stopovers. Standard analysis of the datasets produced by Tourism Research Australia does not include reporting on the order of stopovers, and as a result, people capturing and entering data have not always been incentivised to accurately record order. This seems to be particularly the case in older datasets where the errors appear greater.

To address some of the limitations of the base data, VRUM™ uses a range of validation techniques. These include techniques to check for errors in the Tourism Research Australia data. For example, a filter is applied so that self-drive travel segments (i.e. travel from one stopover to the next) must be no more than 1500 kilometres (the maximum travel distance in one day). Various filters are also applied to check that recorded locations correspond with actual locations.

Additional data has been sourced from the Departments of Main Roads (and equivalent) in several States. They collect counts of traffic at various intersections within the road network. Similarly, the national Survey of Tourist Accommodation (administered by the Australian Bureau of Statistics) provides occupancy data for a range of accommodation businesses reported at quite small geographic area level. Other local tourism data collections (surveys at Visitor Information Centres, for example) can also be used for validation purposes.

A number of datasets was accessed to test the concept of integrating multiple data sources (beyond the integration of IVS and NVS data described above). These included:

- the Northern Territory Travel Monitor (see Carson & Schmallegger 2009), which was a survey of people staying in commercial accommodation in the Northern Territory conducted by Tourism NT between 1998 and 2004
- a small number of Destination Visitor Surveys, which were conducted by Tourism Research Australia and commissioned by various tourism marketing regions in 2006
- a survey conducted at one particular desert-based visitor information centre in 2005
- surveys of visitors to selected national parks in the Northern Territory and South Australia.

The demonstration system eventually included only IVS and NVS data from 2000–2006 as permission was not obtained from data custodians to use other datasets. The condition of data integration was, however, sufficiently established.

The validation exercise proved more difficult, and was not completed due to time and resource constraints. Average Annual Daily Traffic (AADT) data were obtained from Main Roads Western Australia and the Northern Territory Department of Primary Industries. The process for validation using these data was described, but actual validation was not undertaken in the demonstration system.

1.6 Data treatment

Figure 1 illustrates the data and processes that are involved in the VRUM™ application.

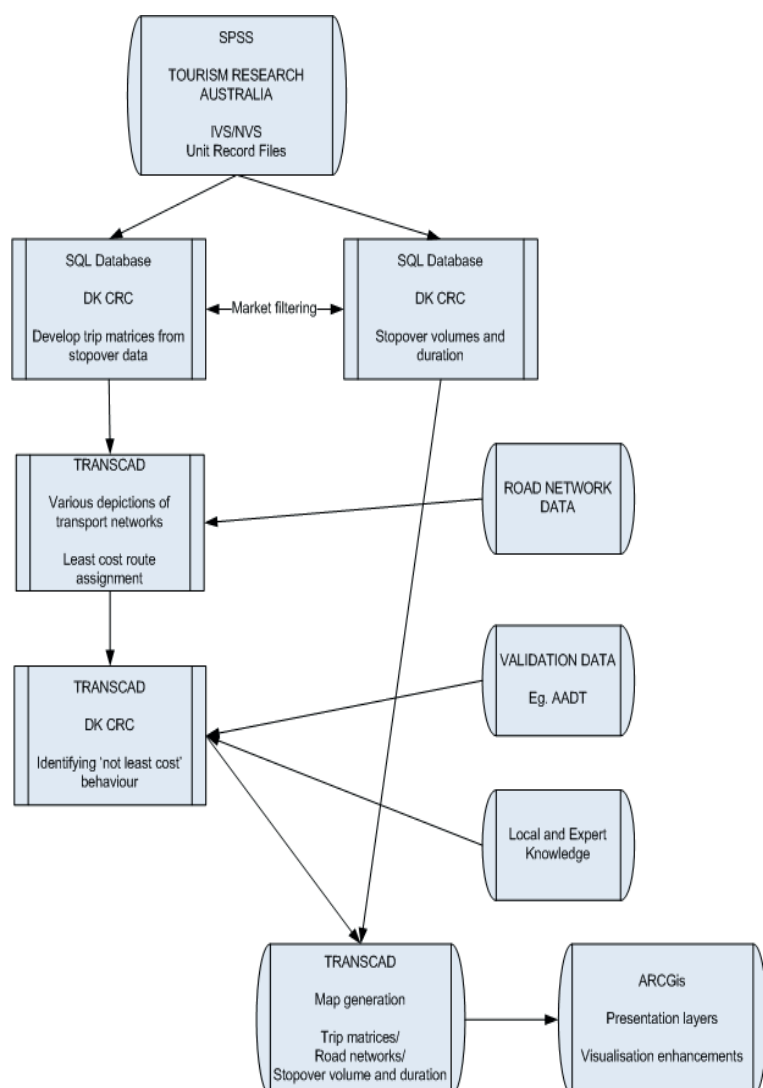


Figure 1: VRUM™ modelling architecture

At the start of the modelling process, the raw IVS and NVS unit record files are provided in an SPSS data format. From this, the model accepts the data into an SQL database environment for manipulations and derivation of the trips matrices and stopover data.

In order to model tourist travel patterns in remote Australia it is important to perform initial database filtering to gain only the appropriate journeys for the modelling task. These journeys are defined as those that have at least one overnight stop in the desert region and are achieved by self-drive tourists travelling on the road network. The self-drive tourist is a subset selected from the 13 possible modes that include car, motor-home, coach, air, train and many others.

Tourist destinations are represented by a total of 475 UCLs across Australia. These locations are connected for the self-drive tourist by a road network that provides for all major and strategic tourist movements across Australia, including road classes that range from high capacity freeways to desert tracks that are significant for outback tourist travel. Overnight stopover locations are also defined by

the UCL configuration, as it is assumed that the vast majority of accommodation is provided at these localities. Figure 2 illustrates the UCL and road network configurations for all of Australia included in VRUM™, with the desert or remote region shaded.

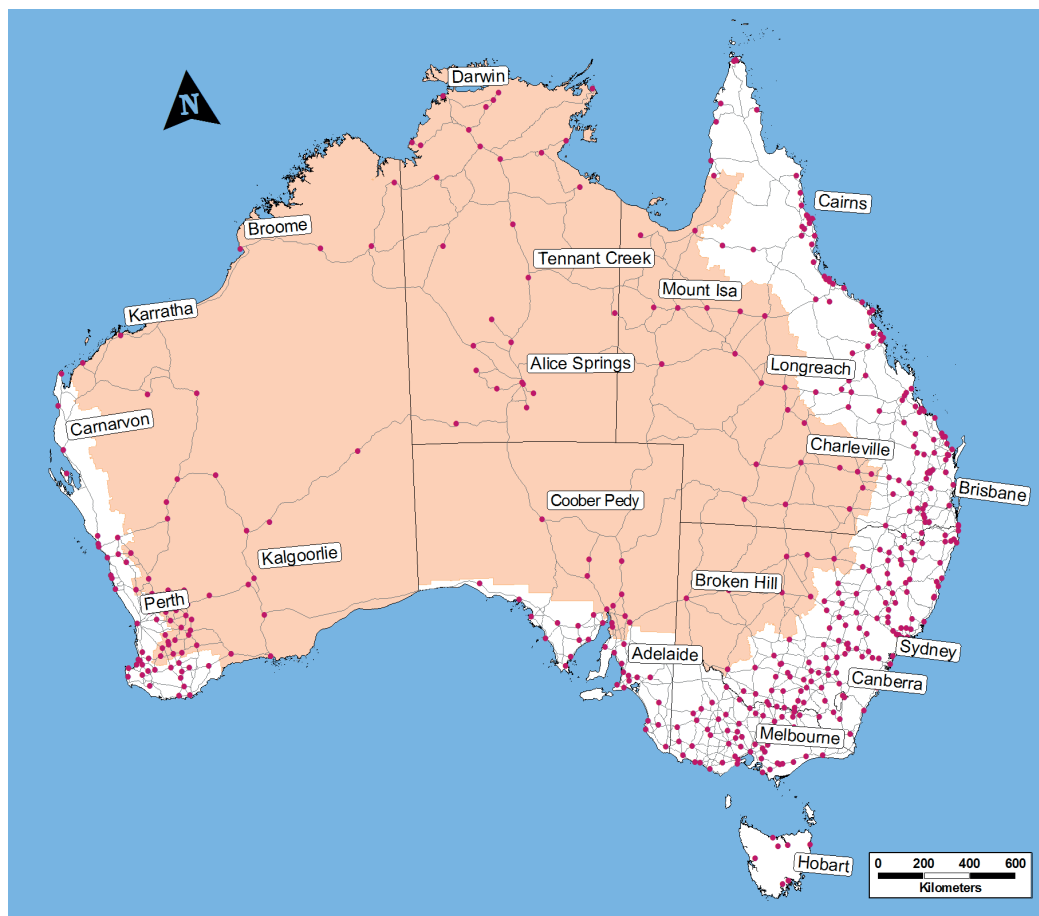


Figure 2: Australia's UCL and road network configuration

From a total of 475 UCLs in Australia, 121 exist in the remote areas and are sparsely distributed. Some concentrations exist closer to Perth and Alice Springs, with vast regions in the west without UCLs or a defined road network. The remainder that lie outside of the remote area are clustered around east coast, south-eastern and south-western parts of Australia. The road network is denser in these areas also.

Tourist travel behaviour is represented in VRUM™ by the journeys occurring between UCLs and the stopovers that take place at them. Initially, all complete 'round-trip' journeys are disaggregated into their respective trips between a single origin and destination (OD). The market filtering option allows for subsets of the database to be established based on characteristics of travel and traveller profile. For example, subsets may be based on select destinations, accommodation types, expenditure or travel purpose.

A trip matrix is compiled from all single OD tourist movements and provides a record of the total travel demand. This is added to with the development of stopover records assembled from the same IVS/NVS database. Stopover information summarises the overnight stop activity at each UCL as total volumes of tourists and average overnight duration.

At the core of the VRUM™ modelling environment is the TransCAD transport planning software (Caliper 2004). TransCAD contains a variety of transport planning modules, which in this case are utilised to interpret tourist movements and assign trips to the road network. The software combines this

with a GIS engine with specialised extensions to enable an accurate and efficient model development process. As with any other GIS, the interface provides a graphical solution that is easily interpreted and allows the user to perform many different types of spatial analysis. The wider VRUM™ architecture is also supported by SQL programming language, and ArcGIS software (Price 2008).

The principle purpose of the TransCAD operation is to accurately match the tourist travel demands (i.e. trip matrix) with the road network supply. For TransCAD to achieve this, a route assignment algorithm is used based on developing minimum cost paths between origins and destinations. An all-or-nothing type assignment with a stochastic element (Ortúzar & Willumsen 1994) is used and cost is represented as road network travel times.

Figure 3 is an example map from VRUM™ demonstrating the various aspects of data visualisation. The shaded section of the map background represents the boundaries for tourism regions that are partially or completely within the arid and semi-arid climate zones (desert Australia). The exception is the inclusion of all tourism regions in the Northern Territory, which was done because of the support for the development of the system by Tourism NT. The road network is depicted on the map as lines. Volume of traffic (proportion of trips) is represented by green shading of road lines. Thicker lines represent higher proportions of traffic. Direction of travel is represented by the thickness of the green line on either side of the road line. A–B travel is represented on the left hand side of the road line. Locations are represented by points on the map. The size of the point indicates the proportion of travellers who stayed overnight in that location. The intensity of colour of the point indicates the relative length of stay in the location. For example, the average length of stay (in nights) in Alice Springs or Darwin was longer than that in Tennant Creek or Coober Pedy. Figure 3 is illustrative of VRUM™ output only, but includes all records from the IVS and NVS (weighted to reflect relative contribution to the total market) 2002–2006.

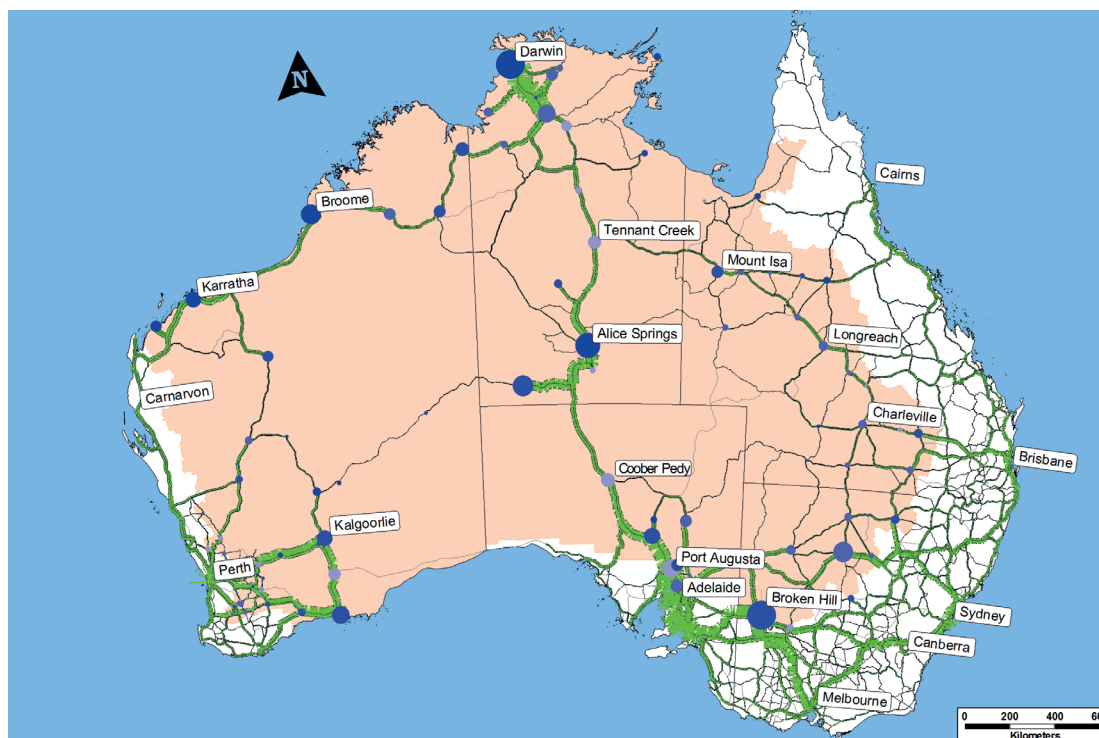


Figure 3: An example of VRUM™ Output

Source: Tourism Research Australia: International Visitor Survey and National Visitor Survey

1.7 Data analysis functions

1.7.1 Geographic

Data analysis in VRUM™ is the creation and visualisation of customised trip matrices. Irrespective of data source, trip matrices can be customised geographically. Geographic customisation queries include:

- all records where a specific location or combination of locations was included as an overnight stop or point of origin
- all records where a specific road segment was likely to have been used.

1.7.2 Temporal

The total VRUM™ trip matrix can also be customised temporally. This includes both producing snapshots of activity in a particular time period, and producing ‘difference plots’ that describe change in trip patterns between two time periods.

1.7.3 Trip length

The total matrix can be customised according to trip length. This can happen in two ways: either by filtering for records with a total trip length of specified nature (following, for example, Olsen’s 2003 classification of short break, short tour, long tour, grand tour), or by filtering for records where a particular period of time was spent in one or more selected locations.

1.7.4 Traveller characteristics

There is also the capacity to produce customised trip matrices based on traveller or trip characteristics included in the specific datasets but not in the minimum dataset. The IVS and NVS, for example, allow customisation by specific mode of travel (caravan, hire vehicle, etc), demographics of traveller, size of travel party, purpose of trip and so on.

Each of these functions has been tested, and examples are included in the next section of this report.

1.7.5 Scenario modelling

A more complex data analysis function is the construction of scenarios. Trip matrices can be constructed from a series of assumptions about changes in consumer behaviour. For example, we would be able to estimate changes in total travel patterns associated with having 20% more international self-drive trips commence in Perth, with a corresponding reduction in trips commencing in Sydney and Brisbane. We might estimate changes in travel patterns if a particular location became unavailable for an overnight stop, or a particular road segment became unusable. The system can make decisions about the most likely alternative routes taken by travellers, given an assumption that they would still choose to travel to the other destinations on their existing trips. It may also be possible to estimate travel patterns if new nodes were entered into the network (new road segments, new locations). The capacity to model scenarios such as these was included as a consideration in this stage of development, but there were insufficient resources to undertake any detailed modelling exercise.

1.7.6 Other potential

VRUM™ is also capable of conducting more detailed analysis of trip timing than was done for this phase of development. For example, it would be possible to make assumptions about the time of departure from overnight stop locations and travel speed to model what time of day travellers would be passing by particular points in the road network. This would be an extremely valuable source of information for product development and marketing purposes. There is some complexity associated with this exercise in terms of varying trip segment (one day’s travel) lengths and travel speeds.

1.8 Examples of data analysis

Three examples of data analysis are presented here using the IVS and NVS datasets 2000–2006. Examples of geographic, temporal and traveller characteristic analysis are presented. Trip length analysis uses the same process as geographic analysis, so need not be presented here.

1.8.1 Geographic analysis: Travel patterns of visitors to the Flinders Ranges tourism region

Aim: To examine how a particular drive tourism destination links with other destinations on multiple destination itineraries. The Flinders Ranges in South Australia were used as a case example to show where drive tourists enter and exit the destination, the most likely directions of visitor flows and the most prominent stopover locations along the way.

Data preparation: Data from the NVS (2000–2006) were used for this analysis. Domestic travellers account for more than 95% of all visitor nights in the Flinders Ranges tourism region. The NVS is a rolling survey, and the use of a cohort allowed for more trip records to be included in the analysis.

Visualisation: Data were visualised using green lines to represent road segments used. The thicker the line, the higher proportion of travellers who used that road segment. Direction is represented by the thickness of the line on the left hand side (A–B direction) of the road centre line. Points on the map represent locations of overnight stops. The size of the point indicates proportion of travellers staying overnight in that location. The depth of colour indicates mean length of stay in that location, with darker points having longer mean lengths of stay.

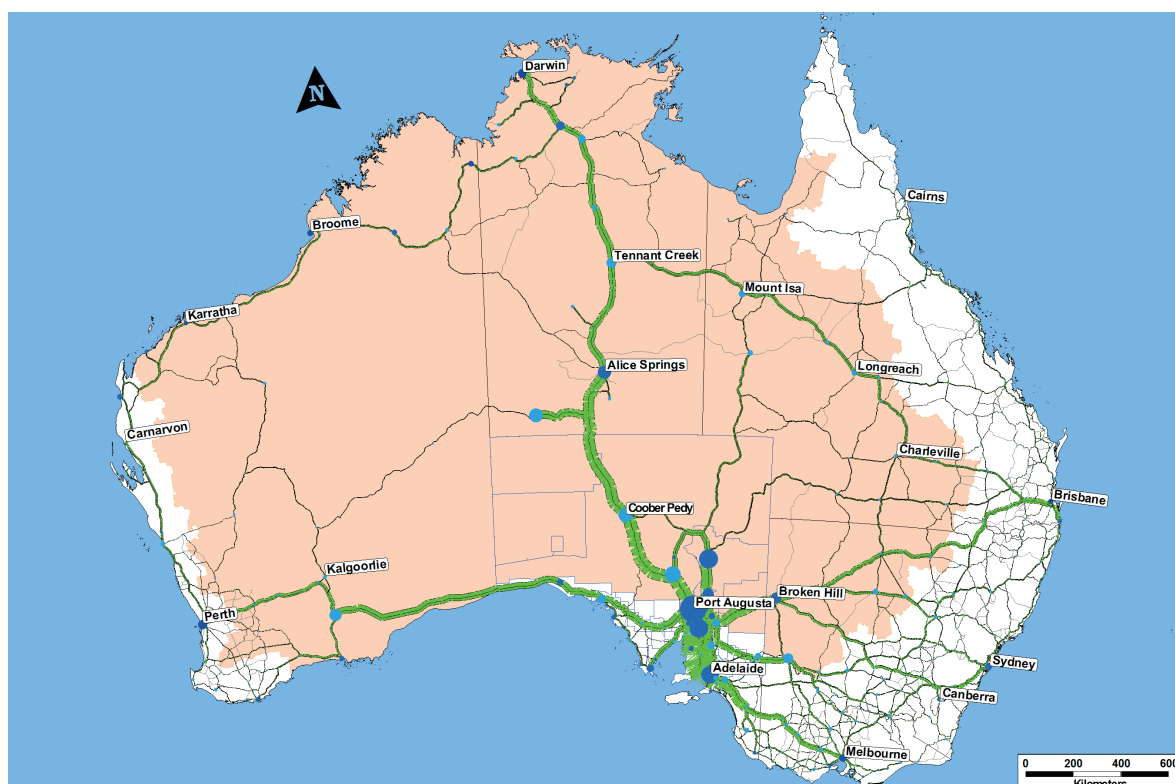


Figure 4: Domestic self-drive visitors who made at least one overnight stop in the Flinders Ranges, 2000–2006

Source: Tourism Research Australia: International Visitor Survey and National Visitor Survey

Description: Figure 4 shows the main visitor flows of self-drive travellers visiting the Flinders Ranges for at least one night. Most visitors entered the Flinders Ranges from the south, coming from Adelaide. Secondary traffic flows led inland up to the Clare Valley and then north, either through Jamestown or

through Gladstone/Laura. The Flinders Ranges link strongly with destinations further north, including central Australia (Alice Springs and Uluru) and Darwin in the NT. The main visitor flows follow this spine in both directions and include transit stopovers in Port Augusta and other places along the Stuart Highway in Outback SA (Woomera and Coober Pedy). Additional strong transit routes are from the east, particularly from south-east Queensland, where travellers enter through Broken Hill, and from the west, where travellers originating from Perth and Kalgoorlie travel on the main highway across Eyre Peninsula to Port Augusta. Two main access routes also emerge from Victoria, the first one leading from Melbourne on the fastest way to Adelaide and further north, the second one leading through rural Victoria and Mildura along the River Murray and entering the Flinders Ranges through Peterborough and Orroroo.

In addition to these main interstate transit links, there appears to be considerable intraregional tourism traffic in the Flinders Ranges, especially in the central and northern parts of the region that cluster around the main attractions and national parks. Visitor flows are primarily from the south to the north and the most prominent stopover locations include Quorn, Hawker and the collective of small settlements and tourist spots around the Flinders Ranges National Park. A smaller proportion of visitors completes a 'loop' through Maree, Roxby Downs and Woomera, or continues on the Oodnadatta Track to Coober Pedy. These routes are mainly on unsealed roads, which may explain the lower visitor traffic. Port Augusta is clearly the most common overnight stopover in the Flinders Ranges, mainly because of its geographic location at the intersection of the south–north and east–west highways. Most stopover locations in the Flinders Ranges (including Port Augusta, Quorn, Hawker and smaller locations in the northern and southern Flinders Ranges) had considerably longer lengths of stay than destinations on the classic transit routes (such as Coober Pedy, Woomera, Renmark or Ceduna).

Commentary: The bigger circle in the northern Flinders Ranges represents the collective of small towns and communities located around the Flinders Ranges National Park, rather than one specific place. While the data may not show exactly where visitors stopped on their way through the central and northern Flinders Ranges, they can give very useful information about visitors' length of stay. The consistently longer lengths of stay in locations along the intraregional Flinders Ranges 'loop' indicate that visitors are likely to use overnight stopover locations as hubs for day trips. Rather than transiting through the region (and having multiple one-night overnight stops in different locations), visitors seem to be more likely to use one location as a base camp from which to explore the surrounding attractions and towns.

Another important observation (which is, however, not displayed in the example map above) is that some transit links have undergone considerable changes in the time period 2000–2006. For example, traffic on the major transit route from south-east Queensland has diminished significantly since 2000. In turn, traffic from Melbourne, as well as to and from Coober Pedy, has increased tremendously. Similarly, a new link between the Flinders Ranges and Port Lincoln (along the coast line of Eyre Peninsula) has emerged in the period 2000–2006.

Significance: This exercise identified the main links between the Flinders Ranges and other destinations on people's drive itineraries, the main gateway locations, the main directions of visitor flows, the main stopover locations in the region and whether they were simply used for transit stopovers or for longer stays. Understanding such visitor flows and travel patterns is critical for a self-drive destination such as the Flinders Ranges. For example, the dominant travel pattern from the south to the north means that businesses would have to place their brochures and promotional material in locations further south so that travellers can access this information *before* they enter the Flinders Ranges. Similarly, visitors travelling on the main transit routes may be less likely to tour the Flinders Ranges. Joint marketing efforts with classic transit locations (such as Coober Pedy, Woomera, Ceduna and Broken Hill) might have limited benefits for operators based in regions other than Port Augusta. On the other hand, the

longer length of stay in places along the recently emerged link to the Eyre Peninsula coast (e.g. Port Lincoln) indicates that travellers using this route may be less likely to be just transiting and therefore more interested in joint product packages and marketing efforts.

1.8.1.2 Length of stay

The Figure 4 VRUM™ example includes information about the location of overnight stops (UCL) and the length of stay. Size of the point indicates proportion of travellers who spent a night in the location, and intensity of the colour of the point indicates the length of stay in the location, with darker points indicating longer mean lengths of stay). This information has not been included in the more detailed examples above (with the exception of some representation in the Flinders Ranges example) because of the poor data quality of the IVS and NVS records in this regard. However, it is important to note that VRUM™ has the capacity to represent this data, and if data quality issues can be addressed, or new data sources are included, then this becomes a very powerful tool.

1.8.2 Temporal analysis: change in travel patterns 2000–2002 against 2004–2006

Aim: To examine how trip patterns for self-drive visitors to desert Australia have changed between 2000–2002 and 2004–2006.

Data preparation: Data from the IVS and NVS were combined for this analysis. Trip matrices were customised into two time cohorts: travellers who returned from their trips between 2000 and 2002, and travellers who returned from their trips between 2004 and 2006. Both IVS and NVS are rolling surveys, and the selection of these cohorts enabled more records to be included in the analysis.

Visualisation: Data were visualised using a difference plot. The output shows the difference between the proportion of all trips in the 2004–2006 cohort and the proportion of all trips in the 2000–2002 cohort. Green lines indicate an increase in the proportion of travellers using the road segment, and red lines indicate a decrease. Direction is represented by the thickness of the line on the left hand side (A–B direction) of the road centre line. While it is possible to similarly visualise changing proportion of overnight stops at locations, these data have been left off this map for ease of interpretation.

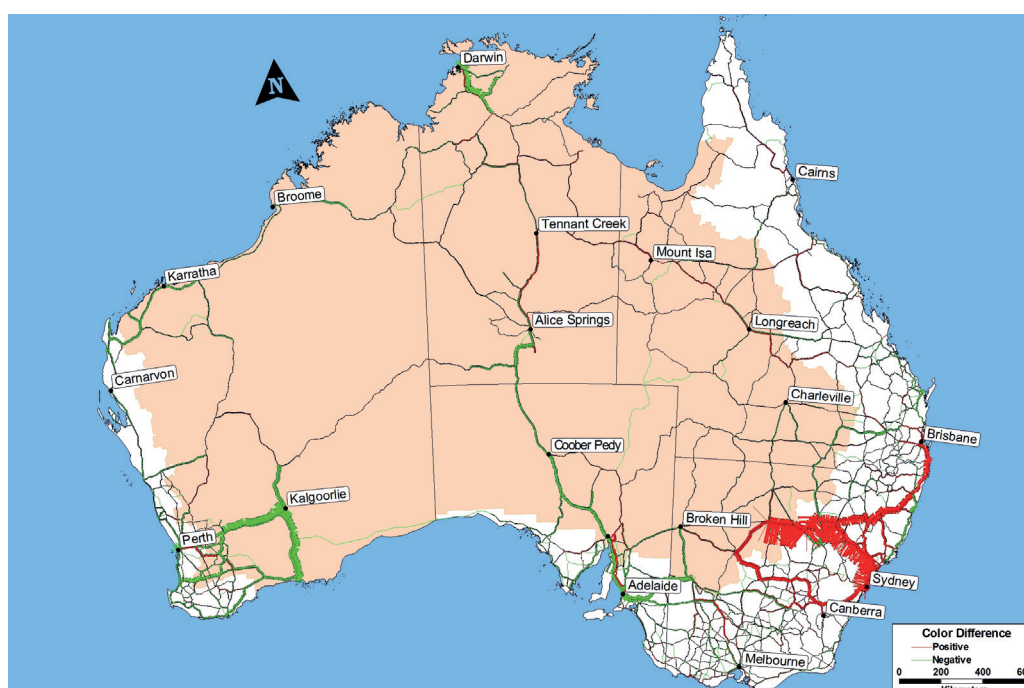


Figure 5: International and domestic self-drive trips to desert Australia, 2000–2002 compared with 2004–2006

Source: Tourism Research Australia: International Visitor Survey and National Visitor Survey

Description: The outstanding feature of Figure 5 is the dramatic reduction in the proportion of desert trips that included travel on road segments in New South Wales. In particular, the inland corridors between Brisbane and Sydney, and Brisbane/Sydney and Broken Hill experienced major declines in market share. The decline also affected travel from east to west (i.e. from the coast to inland) more than from west to east. Smaller declines occurred on the extension of these corridors through to Adelaide, Canberra and Melbourne. Declines also occurred right across the north: the inland road networks of Queensland, the route between Alice Springs and Katherine, and the routes west from the Stuart Highway (NT) approaching Broome.

In contrast, there were substantial increases in the proportion of traffic in the south-west corner of Western Australia, around Adelaide and the Adelaide to Alice Springs routes, and immediately around Darwin. Smaller increases were experienced right along the west coast of Western Australia, and along the New South Wales/Victoria border.

Commentary: Holyoak et al. (2009: 244) proposed explanations for the observed changes in travel patterns.

The increase in low-cost air traffic between the cities within the densely populated south east corner, [which] may have its corollary in decrease in road traffic in that part of the country. The increase around Perth may reflect rapid population growth there attributed to the current resources boom, and consequent increase in local market. The increase around Darwin may reflect an increase in fly-drive visitors, which could also explain why the routes into Darwin (particularly north from Alice Springs and west from Charleville) have experienced decline. That Adelaide has not been isolated from Alice Springs/ Uluru to such an extent as has Darwin is an interesting outcome that warrants further investigation. Future research will have to address the issue of how to integrate additional data that can help interpret and explain changing consumer behaviour.

The authors are describing a move away from transit travel, where desert locations are coincidentally visited on trips where the real purpose is to move between non-desert urban or holiday destinations, and a shift to the west resulting from increases in resident population there and its closer proximity to desert. There is also some evidence of increased traffic around the major air terminals (Darwin, Alice Springs, Adelaide, Perth, Broome) which could be explained by increases in fly/drive travel.

Significance: The significance of the observed changes in travel patterns includes both that ‘incidental’ travellers have become less common, and that a higher proportion of travellers in the desert are now likely to have intended to go there. This transition is a threat to some enterprises and destinations whose business models have been to exploit ‘churn through’ of transit visitors (short lengths of stay, relatively low-level demands for product quality, etc). It also provides opportunities for enterprises and destinations to target higher yield outcomes.

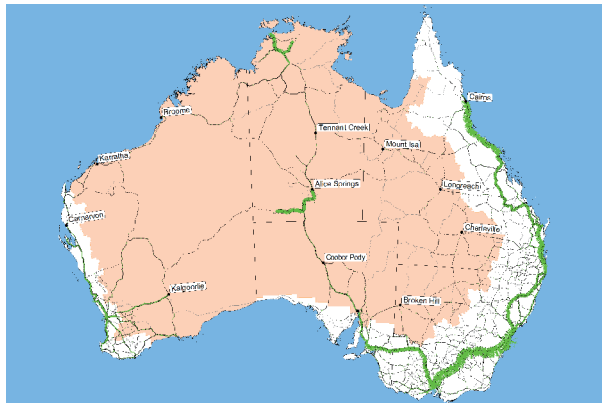
1.8.3 Traveller characteristic analysis: comparison of domestic and international visitor trip patterns 2002–2006

Aim: To examine the differences in trip patterns between international and domestic self-drive visitors to desert Australia for the period 2002–2006.

Data preparation: Data from the IVS and NVS were analysed separately. Trip matrices were constructed which included all respondents to the IVS 2002–2006, and separately for all respondents to the NVS 2002–2006. Both IVS and NVS are rolling surveys, and the selection of this cohort enabled more records to be included in the analysis.

Visualisation: Data were visualised using green lines to represent road segments used (Figure 6). The thicker the line, the higher proportion of travellers who used that road segment. Direction is represented by the thickness of the line on the left hand side (A–B direction) of the road centre line. Comparison is made by visually comparing two maps, rather than consolidating to a single map.

International



Domestic

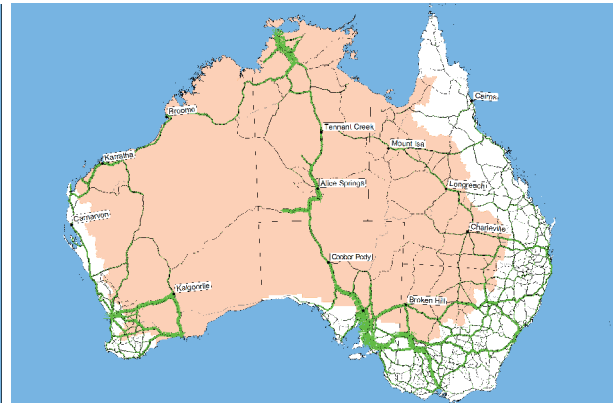


Figure 6: International and domestic self-drive trip patterns, desert Australia 2002–2006

Source: Tourism Research Australia, International Visitor Survey and National Visitor Survey

Description: International trip patterns are dominated by travel along the east coast of Australia, and then small pockets of travel in the desert near Alice Springs, Perth and Darwin. Domestic travel is much more dispersed, but has its concentration around Adelaide, Perth and Darwin.

Commentary: The international trip patterns are likely to reflect preference for fly/drive travel in desert destinations. International travellers who use self-drive modes of transport (about 50% of all international visitors to Australia in 2008) tend to do so as fly/drive combinations. Points of dispersal therefore tend to be around the major airports, particularly in Alice Springs and Darwin. The international map also shows that many visits to desert Australia occur during trips that have a much wider itinerary, particularly to the well-established east-coast destinations (far north Queensland, south-east Queensland, Sydney–Melbourne corridor). In contrast, domestic trips are concentrated around large population centres (Adelaide, Perth, Darwin) and the corridors between these and the desert. There is very little non-desert travel associated with desert travel.

Significance: The significance of the differences in patterns between domestic and international visitors is largely to do with expectations of dispersal. Just because an increasing proportion of international visitors use self-drive forms of transport does not mean that they disperse more widely than those who continue to use fly and coach/rail transport combinations. This is particularly the case in desert regions, where the apparent dispersal of international visitors is very low. This emphasises, for example, as argued by Jacobsen (forthcoming) that desert Aboriginal tourism development needs to focus more on domestic market potential. The analysis also emphasises the importance of air travel to international market dispersal, even where self-drive modes of transport are used. Marketing opportunities may exist for desert destinations to target international visitors already in Australia and driving the east coast, whereas domestic travel appears far more centred on the desert rather than combined with wider trips.

1.9 Conclusions

The examples above show some of the power of VRUM™ to shed insights into the implications of travel patterns for destination and enterprise management in desert Australia. The most significant limitation of the system currently (IVS and NVS data) is its selection of locations to one UCL per statistical local area (SLA). This is because SLA is the finest level of geography that is coded to the data sets by Tourism Research Australia. Data at the level of location name are held by Tourism Research Australia, but have not been made available to this project. The lack of fine geographic detail for locations flows on to imperfections in allocation of road route. In the Flinders Ranges analysis, for example, the extension of the Oodnadatta Track (William Creek to Marla) is not shown as attracting

traffic because that area has just one SLA, and UCL allocations do not account for multiple locations within the SLA. This issue is most pronounced at local-level analysis of the output, and only for SLAs that have more than one UCL (less than 20% of all desert SLAs).

The geographic fineness issue is largely a function of the limited range, and limitations, of data currently in the system. Better quality data (which may be available from local level surveys, for example) would address this issue, as in practice we can allocate locations at any points on the map. In the absence of finer geographic detail, the data validation process becomes more important, and further work is required on that process.

The other key limitation with VRUM™ is the level of expertise required to operate the system. The system continues to exist as several stand-alone components that are integrated by an expert user. Much more could be done to bring the system within the usage capabilities of a 'standard user' through creating more direct software links between the components, creating a user interface, making the system accessible via the Internet and so on.

Limitations notwithstanding, the project has delivered a working visitor flows GIS, and has populated it with data covering the period 2000–2006 inclusive. The system serves both as a proof of concept and as a source of real intelligence, as reflected in the analysis examples above. The invitations to publish and present VRUM™ in a variety of forums (see list following References) demonstrate a perceived academic and industry value.

The VRUM™ research team is strongly of the view that dispersal is the key to more sustainable and profitable tourism development in desert Australia. Tourism has the potential to provide economic development opportunities for desert communities, but the nature and extent of these opportunities are constrained by the physical contact between hosts and guests. Understanding dispersal provides understanding of where opportunities currently exist in situ (where physical presence of hosts and guests coincide) and insight into how the market would need to change to provide additional opportunities. It also raises the issue of whether there might be alternative approaches to desert tourism development, wherein products created in one area may be transported to other areas where contact with tourists is more likely to occur and be profitable.

Continued development of VRUM™ and making it accessible to enterprises and destinations would help build industry and community understanding of both the potentials and limitations of tourism for desert Australia. Trends over the past ten years indicate fewer visitors, but there is some evidence, at least in the self-drive markets, that desert visitors have become less 'incidental' in many places (particularly in the east) and that there has been substantial growth in other places (the west, and around the major population and transport hubs). Continuing to track these spatial patterns is important for decisions about development, infrastructure and marketing.

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2.1 VRUM™ Invited presentations

- The Spatial Science Institute Biennial International Conference (SSC2007), Hobart, Australia, 14–18 May, 2007.
- Tourism Futures Sixth National Conference, Gold Coast, Australia, June 2–4, 2008.
- Desert Knowledge Symposium and Business Showcase, Alice Springs, Australia, 3–6 November, 2008.
- International Map Traders Association, Darwin, Australia, 5–7 August, 2009.
- Spatial@Gov, Canberra, Australia, 15–16 June, 2009.
- 16th ENTER Conference on Information and Communications Technologies in Travel and Tourism, Amsterdam, 28–30 January, 2009.

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