

CHAPTER 2: THE MACKAY SETTING

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Introduction

Mackay, in Central Queensland, is one of the State's larger regional cities. It lies, roughly mid way between Brisbane and Cairns, being some 800 km in a direct line, or 970 km by road, from Brisbane.

The 2890 km² area administered by Mackay City Council has a resident population of approximately 71 400. The Mackay urban area which is the focus of this study, occupies around 240 km² and is home to around 59 000 people. The city is predominantly a transport, education and service centre for a large sugar and grain growing district, with a major coal export terminal at Dalrymple Bay/Hay Point. Mackay is also the gateway to the tourist resorts on the southern islands of the Whitsunday Group. For the neighbouring council areas of Mirani (about 5100 people) to the west, Sarina (9400 people) to the south, and Whitsunday (18 300 people) to the north, Mackay is the major centre. These jurisdictional boundaries are shown in Figure 2.1.

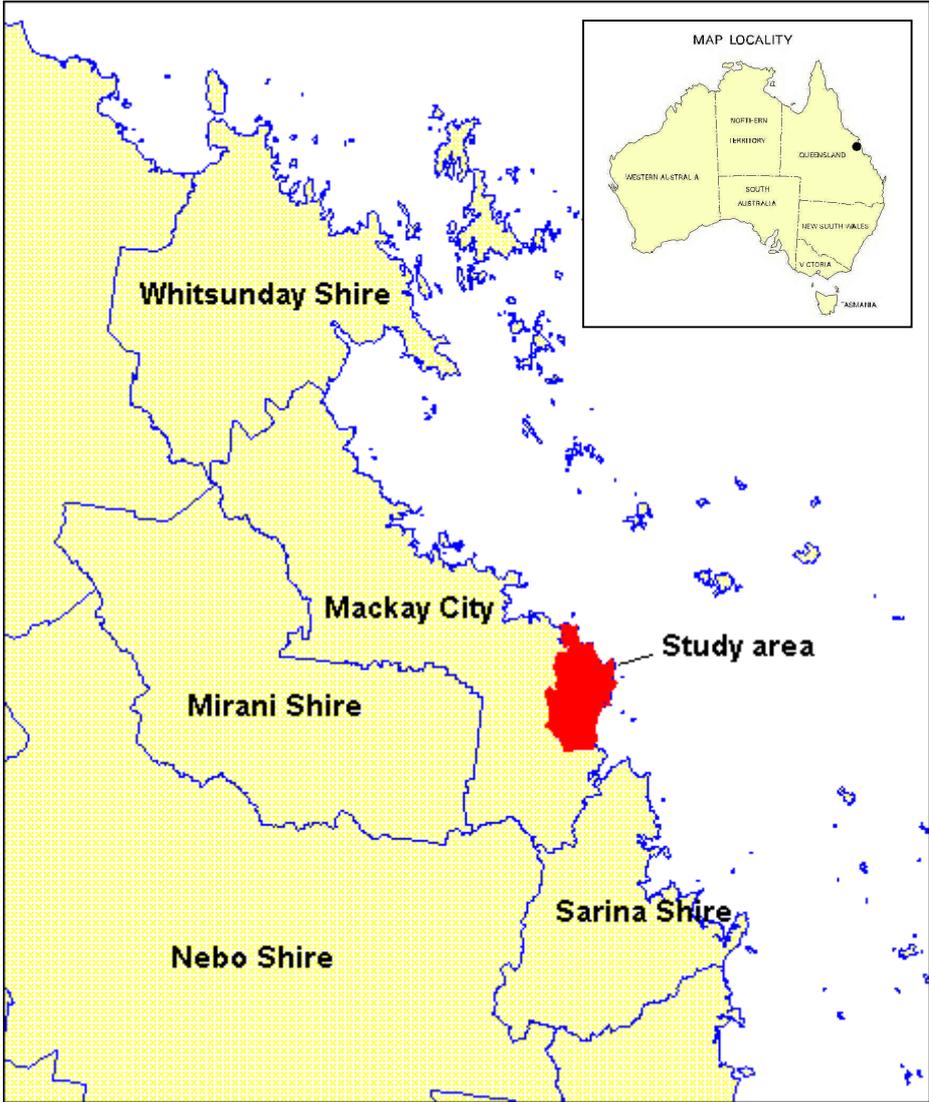


Figure 2.1: Mackay study area location

The Physical Setting

Topography: The entire study area is low-lying, with an average elevation of less than 10 m above the Australian Height Datum (AHD), with the low hills of Mount Bassett (approximately 30 m above AHD) and Mount Pleasant (about 60 m above AHD) as the main features of relief. In the original area of urban development, south of the Pioneer River, the average elevation is around 6 m above AHD and ranges from less than 4 m above AHD at the airport to a little over 11 m above AHD at the Mackay Base Hospital. A high resolution digital elevation model (DEM) of the study area, derived from large scale photogrammetric work completed by Whitsunday Surveys Ltd and enhanced by Andre Zerger as part of his PhD research at the ANU, is available.

The dominant topographic feature of the study area is the estuary of the Pioneer River. The Pioneer River, which has a catchment of about 1500 km², has been described by Gourlay and Hacker (1986) in the following way:

...the Pioneer is a most unusual river, for three main reasons:

- i. its unusually straight course;*
- ii. the rocky nature of so much of its bed, especially in the lower reaches;*
- iii. the irregular nature of its watershed.*

All this is best explained if the Pioneer River is considered to be a vigorous youthful river which is developing along a zone of geological weakness, the Pioneer lineament.

The other drainage features in the study area consist of small short streams, such as McCreadys Creek, which flows into Slade Bay; Goosepond Creek, which joins the tidal Vines Creek before entering Bassett Basin near the mouth of the Pioneer; and Bakers Creek, which enters the sea to the south of the airport (see Figure 2.2).

The immediate offshore topography and tidal regime is also highly significant to an understanding of the nature of hazards in Mackay. The sand banks of the Pioneer sediment fan extend offshore almost to Flat Top Island, 2.5 km offshore, south to Bakers Creek, and well to the north in Slade Bay and Sunset Bay.

The tides in the area have the greatest range on the east coast of Australia, being a maximum of 6.7 m at Mackay, and as much as 9 m at the head of Broad Sound, 150 km to the south. High tide also occurs about two and a half hours later than high tide at Bundaberg to the south or Cairns to the north.

Various studies indicate that this phenomenon is caused by a resonant amplification of the semidiurnal lunar tide produced by a combination of the very dense nature of the Great Barrier Reef opposite Mackay, the dimensions and geometry of the lagoon between the mainland and the Reef and the spacing of gaps in the Reef. Put simply, the normal astronomic tide is retarded by the reef and concentrated through the channels including the Capricorn Channel to the south, Hydrographers Passage off Mackay and the Flinders Passage to the north. The delayed tidal flows from north and south combine in the Broad Sound-Mackay area to create the very large tidal range. Key tidal statistics are given in Table 2.1.

Table 2.1: Tidal planes at Mackay outer harbour relative to AHD (Queensland Transport, 1997)

Tidal Plane	AHD (m)
Highest astronomical tide	3.47
Mean high water springs	2.34

Mean high water neaps	1.12
Mean sea level	0.05
Mean low water neaps	-1.00
Mean low water springs	-2.22
Lowest astronomical tide	-2.94

Geology: Mackay is situated in a tectonic province of the northern New England Fold Belt called the Connors Arch. The Connors Arch largely comprises silicic volcanic rocks and granites of a Late Devonian to Early Carboniferous age originating in an Andean-type volcanic arc. The oldest Connors Arch volcanics erupted about 350 million years before present. The Connors Arch is flanked to the east by the Yarrol Province and to the West by the Bowen Basin.

Researchers from the Queensland Department of Mines and Energy (DME) and the Australian National University (ANU) have used new remote sensing technologies and traditional fieldwork to reinterpret the geology of Mackay under the South Connors-Auburn-Gogango (SCAG) Project. Their preliminary interpretations and a 1:250 000 scale preliminary geological map of the Mackay-Saint Lawrence region have been published (Hutton and others, 1999a; Hutton and others, 1999b).

In the Mackay-Saint Lawrence region, major geological units trend northwest, parallel to the coastline. Mapped lineaments and faults, including several in the Mackay study area, follow this trend or, alternatively, trend northeast at right angles to the regional trend. No major fault or lineament is mapped coincident with the Pioneer Lineament. That is, the Pioneer Lineament does not appear to be associated with a major geological or tectonic boundary.

Faults oriented ‘favourably’ (i.e., at right angles) to the maximum principal stress in the rocks are candidates for possible re-activation by a future earthquake. However, for Mackay, as for almost everywhere else in Australia, we have no evidence that any particular fault can be considered seismically active, nor that any one will be seismically active in the foreseeable future. Therefore, we largely discount the importance of mapped geological faults as indicators of the sites of future earthquakes affecting Mackay, and have not included them on the geological map (Figure 2.3).

The Mackay study area features several geological units. The Permian (age about 290 million years before present) Carmila Beds underlie parts of several northern suburbs including North Mackay, Nindaroo and Beaconsfield. They contain volcanic rocks at the base (up to 30 m thick), overlain by conglomerates (up to 40 m thick), sandstones, siltstones, mudstones and shales.

Rocks of the Yarrol Province are the oldest in the study area. Late Devonian to Early Carboniferous volcanic rocks of the Campwyn Beds (age about 350 million years before present) crop out in coastal headlands in northern parts of the study area such as Slade Point and Shoal Point.

Cretaceous diorite (Cretaceous Period: 65 to 141 million years before present) occurs in the western part of the study area in the largely rural suburbs of Farleigh, Richmond and Glenella.

Of more importance to earthquake hazard in Mackay are the extensive alluvial, estuarine and beach Quaternary sediments, deposited in the past 1.8 million years, that cover more than half the study area, especially in the southern and eastern suburbs. The vast Quaternary floodplain of alluvial sands, silts and clays from the Pioneer River extends under all southern suburbs. Broad sequences of Holocene (geologically recent; the past 10 000 years including the present) beach sands, fore-dune deposits, estuarine sediments and Pleistocene dunes (age between 10 000 years and 1.8 million years) are also found in the coastal suburbs. Sediment thicknesses reach 40 m South of the Pioneer River and probably about 30 m North of the Pioneer. Von Gnielinski has prepared a preliminary 1:100 000 scale geological

map of Mackay, part of which is reproduced in [Figure 2.3](#). We are grateful for permission to use this unpublished material.

Climate: Mackay lies on the coast of Queensland at approximately 21° south latitude and consequently has a moist tropical climate. Rainfall is seasonal, with the heaviest rain occurring during the summer months. Extreme rainfall events are associated with tropical cyclones. Mackay comes under the influence of tropical cyclones on average at least once every two years, though ‘direct hits’ by severe tropical cyclones are less common.

Temperatures rarely exceed 35.0°C or go below 10.0°C for extended periods.

The main climatic statistics are summarised in [Table 2.2](#).

Table 2.2: Selected climatic statistics for Mackay for the period 1950 to 1999
(Bureau of Meteorology 1999a)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
Mean max temp (°C)	30.0	29.5	28.5	26.6	24.1	21.9	21.2	22.4	25.1	27.3	29.1	29.9	26.3
Mean min temp (°C)	23.5	23.3	22.2	20.0	17.2	13.7	12.8	14.0	16.5	19.5	21.7	22.9	18.9
Highest daily temp (°C)	37.2	38.7	34.7	33.8	29.2	29.1	29.7	29.3	32.3	34.9	34.9	39.4	39.4
Lowest daily temp (°C)	17.2	17.8	13.1	12.0	7.1	4.6	3.8	5.0	7.9	10.6	14.9	15.3	3.8
Av. rainfall (mm)	285	306	281	148	111	60	42	36	16	37	85	192	1598
Highest 24hr rain (mm)	286	303	389	125	178	110	170	99	32	103	165	314	389
Av. daily sunshine (hrs)	8.5	7.7	7.5	7.2	6.9	7.6	7.8	8.7	9.5	9.4	9.5	8.9	8.3

Vegetation: Within the study area there is very little natural vegetation left, other than mangroves and coastal saline marsh vegetation in the tidal creeks and flats, and pockets of *Melaleuca*-dominated wetland vegetation. The study area was originally covered by an open forest of eucalypts, palm thickets and grassland, however, this has long since been cleared for agriculture (predominantly sugar cane cultivation) and urban development.

Settlement

The present-day boundaries of Mackay City Council were established in 1995 following the amalgamation of the former local governments of Pioneer Shire and Mackay City. The area covered by this study includes all of the significant urban areas extending from the suburb of Shoal Point in the north to the settlement of Bakers Creek in the south. This area, and the suburban boundaries used throughout this report, are shown in [Figure 2.4](#).

An excellent history of the Mackay district is provided by Kerr (1980). The following highlights are worth noting. European settlement of Mackay was established in 1862 by pastoralist John Mackay who had ‘discovered’ the Pioneer River in 1860 during an expedition to find good pasture land. He named the river after himself, however, it was subsequently found that Commodore Burnett of HMS *Pioneer* had already used that name on a stream near Rockhampton, so he suggested that the name be changed to ‘Pioneer’, even though his vessel had never entered the river. Mackay overlanded 1200 head of cattle from Rockhampton to the first property in the district at Greenmount, some 19 km from the present day city that bears his name. Mackay’s cattle property was subsequently supplied by sea, using the banks of the Pioneer River estuary as the port.

The settlement grew rapidly in its early years. The first post office was opened in 1863; the first land sales were also in 1863; and sugar was introduced from Java in 1865. By 1883 there were at least 25 sugar mills operating in the district and by 1902 most of the sugar lands had already been settled.

Until the post-World War II era, urban development was largely confined to the south bank of the Pioneer River and on Slade Point. Since then, growth has steadily increased to the north of the river, especially in the Andergrove-Beaconsfield area.

Population

According to the National Census taken in September 1996, the population of the Mackay Statistical Local Area (SLA – i.e. the full local government area) was 71 894 (35 935 males and 35 959 females). Of this total, 5708 were recorded as ‘visitors’, of whom only 412 (7%) were from overseas. The study area contained 58 850 people (29 174 male and 29 678 female, including 4381 visitors).

Population density varies across the study area with the most densely populated neighbourhood (as represented by the census collectors districts - CCD - used in the 1996 census), with 3280 persons per square kilometre, in the centre of Slade Point. The lowest densities are in the rural and urban fringe areas, with the lowest density being nine persons per square kilometre in the rural neighbourhood that separates Bakers Creek from the main urban area of the city. Figure 2.5 shows the relative population densities across the study area.

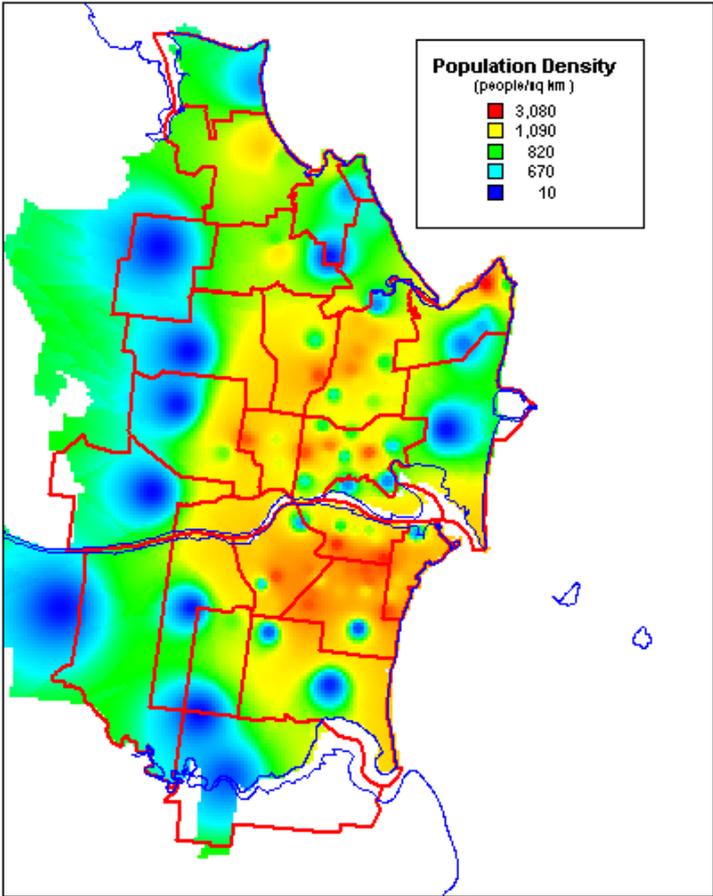


Figure 2.5: Mackay population density (people/sq km)

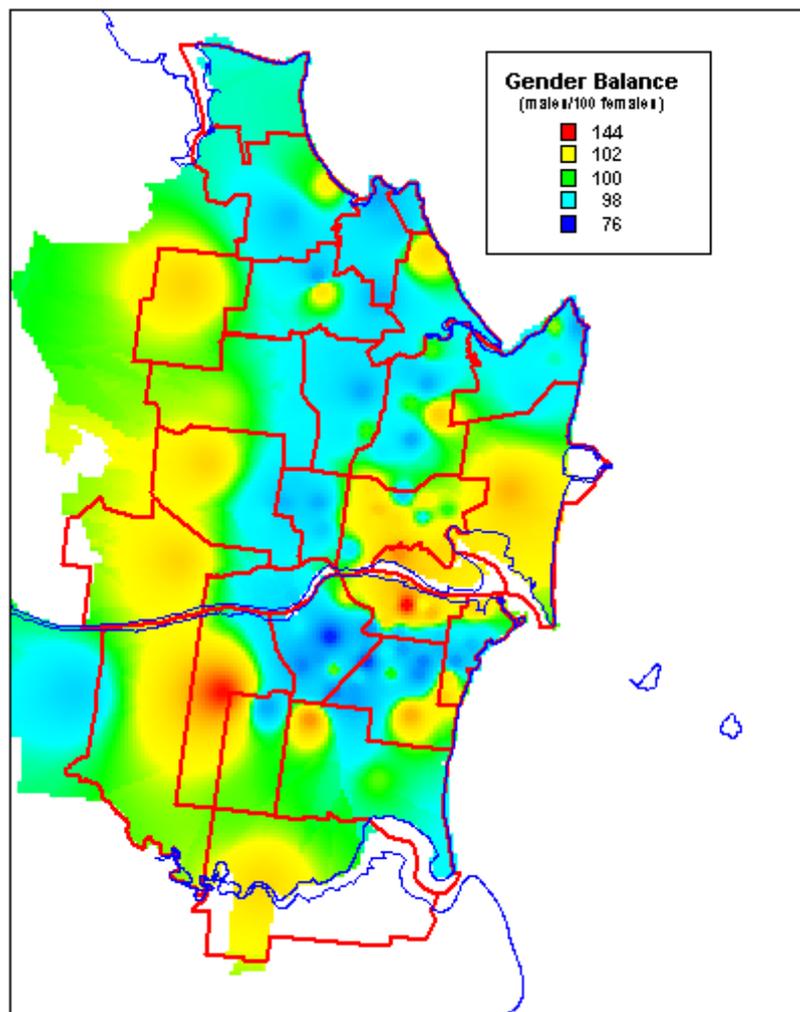
The gender balance also varies greatly across the study area, ranging from 73 males to every 100 females in one neighbourhood in West Mackay (dominated by a nursing home), to 156 males to every 100 females in a neighbourhood in Central Mackay (dominated by a Catholic boarding school for boys). The distribution of gender ratio is illustrated in Figure 2.6.

The age/sex structure of the Mackay City resident population is shown in [Figure 2.7](#) compared to the makeup of the Queensland population as a whole. The similarity between the two structures indicates that Mackay is an ‘average’ Queensland community in terms of age structure.

Growth of the Mackay population is shown in [Figure 2.8](#).

It is evident from the population data that the old Mackay City area had effectively reached its capacity by 1975 and that subsequent growth is accounted for by the redevelopment and densification of older areas. The urban area to the north of the Pioneer River (in the former Pioneer Shire area) is now the centre of growth.

Mackay is not a self sufficient community. It depends very heavily on outside sources of supply for its energy, material requirements and much of its food. Such dependence clearly imposes limits to the community’s resilience to recovery from hazards.



[Figure 2.6](#): Mackay gender balance (m/f)

Mackay is heavily reliant on its transportation links to the rest of the world. They are:

- the main road links which include: to the south, the Bruce Highway to Brisbane (971 km) and beyond; north to Cairns (735 km) and beyond; and to the southwest, the Peak Downs Highway, to Clermont (274 km) and beyond;

- the main-line rail link south to Brisbane and north to Cairns provides regular passenger and freight services. The freight yards and railway station are located in Paget. A short spur line also links Mackay with the sugar centre of Marian in the lower Pioneer Valley. An extensive network of cane tram lines also exists throughout the district. A high-capacity line also links the coal fields as far west as Blair Athol (north of Clermont) with the major coal terminals at Dalrymple Bay/Hay Point (30 km south of Mackay and outside the study area);
- the airport, located just north of the mouth of Bakers Creek in South Mackay, has around 4600 domestic services per annum, making it the fifth busiest airport in Queensland after Brisbane, Cairns, Coolangatta and Townsville (ABS, 1999); and,
- the Port of Mackay provides berths for general cargo, containers, bulk grain, tankers discharging both oil and LPG and a bulk sugar terminal (Plate 2.1). A commercial fishing base and a marina catering for charter vessels and other small craft are also located within the harbour. Some fishing vessels and pleasure craft use moorings in the Pioneer River below the Forgan Bridge. In 1996-97 the Port of Mackay loaded 1.7 million mass tonnes of cargo (mainly sugar, grain and molasses) and discharged 0.6 million tonnes (dominated by petroleum products and bulk fertilisers). The Dalrymple Bay/Hay Point coal loading complex is the largest in Queensland and loaded 46.6 million tonnes in 1996-97, the greatest throughput of all Queensland ports (ABS, 1999).

Power supply for the Mackay area is drawn from the State grid. The closest base-load power stations are at Stanwell (near Rockhampton) and Gladstone, each situated around 450 km to the south of Mackay. Stanwell power station is operated by Stanwell Corporation Limited (a state-owned enterprise), whilst Gladstone power station is operated by the private company, NRG. The major transmission lines of the State grid are operated by Powerlink Queensland, whilst power distribution within the Mackay region is managed by the Mackay Division of Ergon Energy - both are state-owned enterprises.

Water supply is drawn largely from the Dumbleton Weir which was completed in 1983. This low concrete weir is located at Dumbleton Rocks and marks the limit of tidal influence on the Pioneer River, about 16 km upstream of the city.

The key terminal facilities that provide an interface between the study area and the rest of the world are shown in Table 2.3.

Table 2.3: Terminal facilities

Facility	Suburb	Direction
Ampol fuel depot	Mackay Harbour	import
Boral gas depot	Mackay Harbour	import
BP fuel depot	Mackay Harbour	import
Bulk grain terminal and loaders	Mackay Harbour	export
Bulk sugar terminal and loaders	Mackay Harbour	export
Container wharf	Mackay Harbour	import & export
Mackay airfield	South Mackay	import & export
Mackay airport terminal facilities	South Mackay	import & export
Mackay radio telephone station	Mount Pleasant	import & export
Mackay substation	West Mackay	import
Mackay telephone exchange	Mackay Central	import & export
Mobil fuel depot	Mackay Harbour	import

Rail-freight yard	Paget	import & export
Railway station	Paget	import & export
Shell fuel depot	Mackay Harbour	import
Tourist jetty	Mackay Harbour	import & export
Water treatment plant	West Mackay	import

Suburbs and Names

Suburb and locality boundaries throughout the Mackay City council area have recently been formalised. Whilst these boundaries and the suburb names are based on agreed perceptions of ‘community interest’, there is significant potential for confusion with historical or general place names. For example, the name ‘Mackay’ is used in many contexts including the urban centre, a suburb, the district, the former and present local government area.

To reduce the potential for confusion in this study, the following conventions will be followed:

- the former (pre 1995) ‘Mackay City Council area’, namely the urban area south of the Pioneer River, will be referred to as ‘Old Mackay City’;
- the urban area north of the Pioneer River that was within the former ‘Pioneer Shire Council area’ will be referred to as ‘Old Pioneer’;
- the current council area will be referred to as ‘Mackay City’;
- the suburb which has been gazetted as ‘Mackay’ will be referred to as ‘Central Mackay’; and,
- the study area covered by this report will be referred to as the ‘Mackay study area’.

Because of the significant mismatch between the CCD and suburb boundaries in the study area, it has not been possible to develop comparative statistics at the suburb level. In this study, the statistics used to measure community vulnerability in [Chapter 3](#) have been developed at the CCD level and displayed with the suburb boundaries overlain to provide the more widely understood spatial reference. Aggregated vulnerability profiles have, however, been developed at the suburb level.