

# **Unsettling Suburbia: The New Landscape of Oil and Mortgage Vulnerability in Australian Cities**

**Jago Dodson and Neil Sipe**



**Urban Research Program**

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August 2008

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## Introduction

This paper provides an update of a report we released in 2006 – titled *Shocking the Suburbs* – which examined the distribution of household exposure to higher petrol prices, mortgage interest rate rises and general price inflation due to increases in global oil prices. That paper received wide attention from scholars, policy makers and the media. In that paper we presented a numerical index which we created called the ‘vulnerability assessment for mortgage, petroleum, and inflation risks and expenditure’ (VAMPIRE). This index measures the extent of household exposure to the impacts of higher fuel prices and mortgage interest rates. Versions of the first paper, including the VAMPIRE index, have since been published in various peer-reviewed venues<sup>1</sup>.

The 2006 paper used data from the 2001 ABS Census which was the most recent available at the time. The equivalent data from the 2006 Census became available in early-2008. Thus, we have been able to update the original VAMPIRE analysis to identify changes in the distribution of oil and mortgage vulnerability over time. The present paper therefore offers an opportunity to evaluate the early impacts of higher fuel prices, given that the 2006 Australian Census was undertaken after the global price of oil began its upward march in 2004.

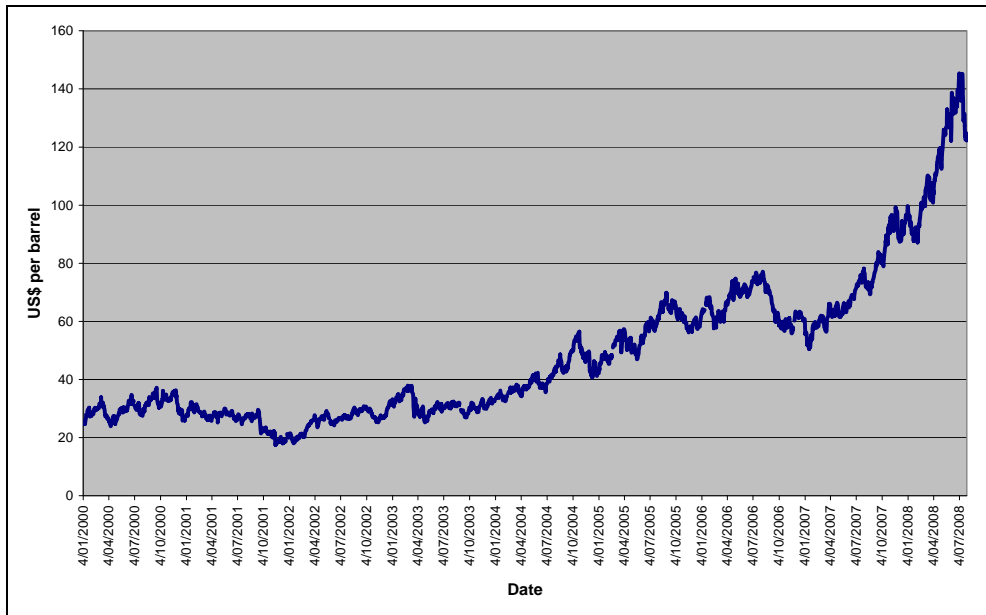
This paper has four aims. First it reviews the basis for the increases in global oil prices seen since 2004. Next the paper considers some of the emerging evidence of socio-economic impacts arising from higher fuel prices and mortgage interest rates. Third, the paper presents the results of the 2006 VAMPIRE and compares them to the 2001 VAMPIRE results. Finally the paper makes observations about the policy implications of the changes in oil and mortgage vulnerability within Australian cities – including advocating for urgent government action to address the oil vulnerability of Australian cities and suburbs and reiterating our earlier call for more indepth research on this increasingly unsettling issue.

### On the up

In 2004 global petroleum prices began to increase sharply from the levels over the previous two decades. The price of oil was barely more than US\$30 per barrel at the start of 2004 but has grown rapidly since then. The ‘psychological barrier’ of US\$50 per barrel [ref] was broken in early 2005 (Agence Presse France 2004). Oil prices have continued to grow apace with increasingly marked volatility, reaching US\$95 per barrel by the end of 2007 and hitting US\$100 per barrel in February 2008. By May 2008 the price of oil had passed US\$130 per barrel and in June 2008 US\$140 was topped for the first time before again dropping to US\$125 per barrel at the time of writing.

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<sup>1</sup> Dodson, J. and Sipe, N. (2007). "Oil vulnerability in the Australian city: Assessing socio-economic risks from higher urban fuel prices." *Urban Studies* 44(1): 37-62; Dodson, J. and Sipe, N. (2008). "Shocking the Suburbs: Urban Location, Homeownership and Oil Vulnerability in the Australian City." *Housing Studies* 23(3): 377-401.



(Source: Energy Information Agency 2008)

**Figure 1: Spot price for crude oil, 2000-2008.**

There are multiple reasons behind the growth in the price of oil. The global economy continues to expand, creating increased demand for petroleum products. Moderate economic growth within the developed nations has been accompanied by strong growth in rapidly industrializing economies, such as China and India, to produce a global growth rate of around 5 per cent by 2006. China's economy has grown by more than 7.5 per cent each year since 1991 and has not slowed below 9 per cent since 2002 (International Monetary Fund 2007). India's GDP growth has not been quite as great, yet has remained above 4 per cent since 1991 and above 7 per cent since 2002 (International Monetary Fund 2007). Economic growth in China and India is producing an expanding middle class that is demanding petroleum consumption profiles similar, although not yet as intensive, to their counterparts in developed nations. The result is massive demands on global petroleum supplies.

In addition to strong global economic growth, concerns about the security and sustainability of global petroleum supplies have heightened since 2004. Capacity constraints in the oil production stream – such as old oil wells, rusting pipelines and ageing refineries – have limited oil producers' abilities to keep production rates ahead of demand. In this context it is not surprising that oil prices have increased. It seems however that this production capacity deficit will persist for some time. The cost of increasing global petroleum production capacity – including refining and distribution infrastructure – to meet the level of demand anticipated by 2030 has been estimated at \$US4.3 trillion (International Energy Agency (IEA) 2006, p. 40). Yet the source of this investment is currently highly uncertain given the investment risks associated with many oil producing regions. The availability of large sums of credit is also in doubt given recent problems in global debt markets. To compound these production problems, a number of major oil producing regions are facing declining

production due to exhaustion of oil fields. North Sea oil production has been in decline since 1999 while Mexican oil production is also declining sharply. Production losses in one oil producing region mean increasing expectations on other zones to maintain production levels.

Another factor stimulating higher oil prices has been geopolitical instability in some of the major oil producing regions. The Middle East is the most significant of such zones – global oil reserves are increasingly concentrated in this region – yet this area is wracked by conflict and political turmoil. The US has waged war in Iraq since 2003 and tensions between the US and Iran have become magnified in recent years. Oil prices jumped by eight dollars overnight in April 2008 after Israel threatened to attack Iran over the latter's nuclear ambitions. At the time of writing Iranian missile tests were adding to the volatility of global oil markets.

On top of these pressures there is growing uncertainty over the long term sustainability of global petroleum supplies. An expanding number of reports and official documents have recognized the possibility of global petroleum production reaching a 'peak' followed by a decline. The theory of 'peak oil' has gained increasing prominence in public and policy debates in recent years. Institutions such as the US Government Accountability Office (Government Accountability Office 2007), the US Army Corps of Engineers (Fournier and Westervelt 2005), the Australian Senate (2007) and the Queensland Government (2007), among others, have all investigated the question of peak oil and the depletion of global petroleum supplies. All have recognised petroleum depletion as a major policy issue that demands urgent attention. In 2007 the Australian Senate's bipartisan report accepted that a global petroleum peak was likely by 2030 and argued that:

[T]he possibility of a peak of conventional oil production before 2030 should be a matter of concern. Exactly when it occurs (which is very uncertain) is not the important point. In view of the enormous changes that will be needed to move to a less oil dependent future, Australia should be planning for it now. (p. 55)

The Queensland Government's 2007 *Oil Vulnerability Taskforce* report identified 2013 as a likely point at which global oil supplies will peak, give or take seven years, thus setting 2020 as its official latest estimate for a peak oil prediction. The current patterns of petroleum supply and oil prices do not unambiguously support the view that peak oil is approaching, however the rapid growth of global oil prices provides little evidence for the contrary view. Regrettably the formal science on petroleum depletion is underdeveloped (in contrast to, for example, climate change science). As urban planners we consider there is sufficient evidence regarding oil depletion and a sufficiently large set of implications arising from a global petroleum peak that the issue must be addressed through further research and analysis.

Even if the world does not experience a peak in production before 2020, the many other petroleum supply factors discussed above suggest that residents of Australian cities will face higher fuel prices during that period. Recent experience has shown that global oil prices can accelerate rapidly. Higher fuel prices also have a number of significant flow-on impacts into other sectors of the economy and upon Australia's urban systems. As we have argued previously (Dodson and Sipe 2008b) and reiterate below, there is now a reasonably established link between the inflationary effects of higher fuel prices and Australian

mortgage interest rates, mediated through the Reserve Bank of Australia's interest rate policy. Such linkages inevitably amplify the impacts of higher fuel prices on our urban economies. As a simple matter of national importance, we need to improve our understanding of the socio-economic impacts of higher fuel prices on our urban systems. Our interest in this paper is the relative socio-spatial distribution of consequences from higher fuel prices, including their intersection with other household socio-economic pressures, such as housing costs. The next sections chart some of the impacts of higher fuel prices

### **The cost of petrol prices**

The main economic effect of costlier oil has been higher petrol prices in Australian cities. In January 2004 the price of petrol fluctuated around 85 cents/L across Australia. By June 2008 the average national petrol price had increased to around 160 cents/L representing almost a one hundred per cent gain in four years. The effect of global petroleum prices on Australian petrol prices might have been even more pronounced had the Australian dollar not appreciated so strongly against the US dollar during this period.

Higher fuel prices have unsettled urban motorists, generating a clamour of complaint. Many households have inevitably found their fuel expenses draining increasingly large proportions from their budgets. It is worth keeping this financial burden in perspective, however. According to the most recent official expenditure survey taken in 2003, transport costs make up around 16 per cent of household expenditure in Australia, while petrol makes up almost a quarter of all household transport costs (Australian Bureau of Statistics 2006). So, *on average*, petrol costs were around four per cent of household expenditure in 2003. However, aggregate averages mask distributional effects. The burden of rising transport and fuel costs is shared unevenly between household income segments. Higher fuel prices affect those on modest or below-average incomes the hardest. In proportional terms, the middle fifth of all households spends the greatest share of their income on fuel, with the next income bracket down the second most burdened (Australian Bureau of Statistics 2006). It should be noted that the data on which these values are based was gathered before oil prices began to grow in 2004. It is reasonable to assume that these costs are now higher than they were at the time of that survey.

### **Depending on cars**

Dependence on private motor vehicles for travel exacerbates the potential impact of higher fuel prices on urban households. Australian cities are highly car dependent – approximately 80 percent of trips are taken by private automobile – and therefore also highly petroleum dependent. But there is a wide spatial variation in automobile dependence for daily travel within our cities. In general, households in the inner zones of Australia's major cities use their cars less than middle suburban households who in turn are less car dependent than outer suburban households. For those in the inner suburbs, public transport, walking and cycling tend to substitute for car use. When the car is used in the inner suburbs, the trips are shorter. Sydney provides a good example of these patterns. Residents of inner eastern

Sydney use a car for only 48.7 per cent of their journeys and travelled on average 10.1 km per day (DIPNR 2003). The average trip distance for households in this zone is only 5.7 km. By comparison, those in Sydney's outer west use their car for 79.1 per cent of their trips while travelling an average 33.1 kilometres daily with an average trip distance of 13.7 km. The Sydney evidence also reveals that those living in inner areas are becoming *less* car dependent over time while those in the middle and outer suburban areas are becoming *more* car dependent. Thus average daily vehicle kilometres travelled (VKTs) of inner eastern Sydney residents declined by 9.9 per cent over the decade to 2001 while VKTs for those in the outer west grew by 22.8 per cent. (DIPNR 2003). Such sharply differentiated travel patterns imply differentiated household socio-economic exposure to higher fuel prices.

Outer suburban households also tend to have higher rates of car ownership which also increase transport expenses. The average weekly running cost for a small car was estimated by the NRMA (2007) at \$144 per week; for a medium car the average was \$237; and for a large SUV the cost was \$323. Petrol costs make up around 18 per cent of the weekly vehicle running expenses behind depreciation, fees and the opportunity cost of vehicle capital value. This means that households in the outer suburbs face heavy additional costs from rising fuel prices. An outer suburban family with one small and one medium sized car, plus a 4WD could already be spending more than \$600 per week in running costs for their three-car fleet, based on NRMA figures.

The urban geographic divergence in travel patterns has significant implications for the distributional effects of higher fuel prices. In the absence of dramatic behavioural shifts on the part of Australia's urban motorists, it will be those in the middle and outer suburban areas of our cities who will face the highest additional costs from higher fuel prices. Even changes in travel behaviour would inevitably cause disruptions to household activity patterns – the main means of reducing the cost of car travel is to either get rid of the car or use it less. Reduced reliance on the car would mean reduced capacity to access activities and services.

### **Housing oil vulnerability**

Australia's urban housing is also implicated in the process of distributing household socio-economic vulnerability to higher fuel prices. Settled home ownership remains a major desire for many Australian households. Around a third of households are currently purchasing their dwelling via a mortgage. The structure of Australia's urban housing markets strongly influences household locational choices. In general, house prices decline as the distance from the CBD increases. Because household income largely determines borrowing capacity, lower income households often find their housing opportunities constrained to outer or fringe suburbs where housing prices are lower. Around half of all first home owners in Australian cities locate in outer suburban zones (Productivity Commission 2004).

The distribution of new housing stock also influences this pattern because the new stock of popularly favoured detached dwellings tends to be found in fringe suburban greenfield sites. Urban geographers and economists have long recognized the effects of this urban socio-spatial arrangement. Maher et al (1992) warned of the 'locational disadvantage' experienced by outer suburban households who are forced to make trade-offs between affordability and

access to infrastructure and services. Dispersed urban form and infrastructure deficits, including poor access to quality public transport, compounds these problems. Burnley et al's (1997) study, for example, showed that households who move to outer suburban areas to attain home ownership become more car dependent as a result of their shift.

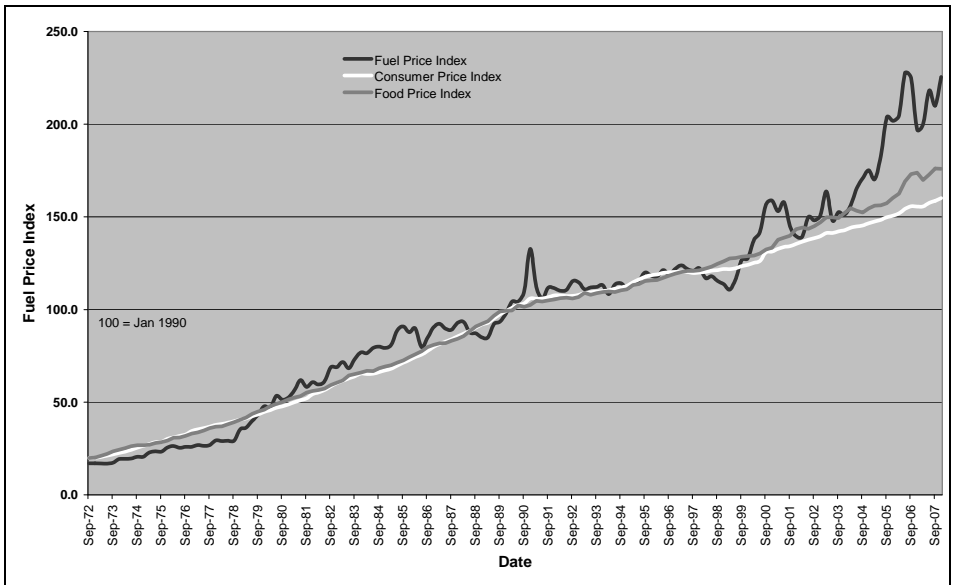
The problems of suburban infrastructure deficits, especially in public transport, reflect the consistent failure of state governments to expand infrastructure to keep pace with the rate and scale of land development, especially during the period of rapid suburbanisation in the decades after World War II. Such spatial supply deficits, in part, lie behind the large variation in travel patterns between inner, middle and outer suburban areas described above. These problems have been exacerbated by the planning of suburban areas around automobile travel, including the dispersion of land-uses. The lack of travel alternatives and the creation of car dependence in large middle and outer suburban areas has been described as 'forced car ownership' (Currie and Senbergs 2007). Such pressures inevitably impose costs on households through petrol expenses and other car ownership costs such as depreciation, insurance, maintenance and registration.

The result of these social, housing, transport and planning processes has been to create a complex set of suburban arrangements which, we argue, unevenly distribute the socio-economic impacts of higher fuel prices. In general, households in middle and outer suburbs face higher levels of car dependence and fewer alternative travel options than those in the inner areas – a result that is, in part, due to lower incomes and thus housing purchasing capacity. This means that the costs of higher fuel prices will be borne most heavily by those with the least capacity to pay. The structure of Australia's infrastructure systems and housing markets is compounding the unsettling effects of higher fuel prices. The financial system will further exacerbate this effect.

### **Compounding pressures**

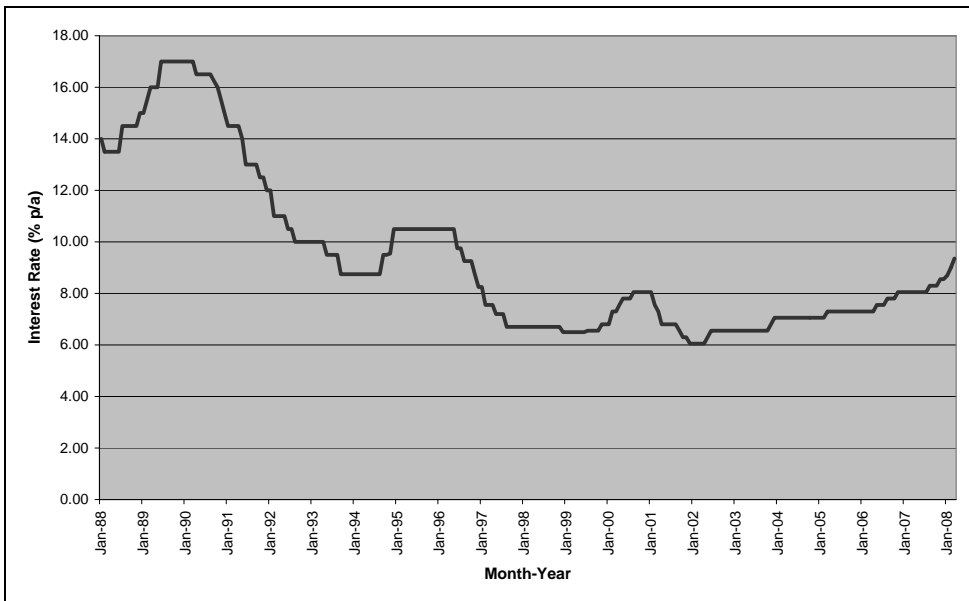
The high concentration of households with mortgages in outer suburban zones complicates the socio-economic impact of higher petrol prices because of the association between higher fuel prices and inflation. As fuel prices increased during 2004-2008 they have contributed to general price inflation in Australia.

Higher inflation in Australia has had broader effects due to government policy responses. Under the Australian government's interest rate policy, the Reserve Bank of Australia is expected to keep inflation in a frame of 2 to 3 per cent by setting interest rates to control the supply of credit. Official interest rates dropped to as low as 4.25 per cent in 2001, but with inflation increasing over the past four years, the Reserve Bank has boosted interest rates twelve times since 2002 to reach 7.25 per cent by early 2008. Oil has been a factor in these interest rate increases – eight of the increases have occurred since oil prices started accelerating in 2004. These gains have resulted in higher mortgage interest rates. Standard variable home mortgage rates have climbed steadily from a thirty-year low of 6.05 per cent as late as February 2005 to 9.35 per cent by March 2008 (Figure 3). While these rate increases amount to just over three percentage points on a standard mortgage, this equates to a 50 per cent increase in interest rates since April 2002.



(Source: ABS Consumer Price Index Series, Cat. No. 6401.0, 2008)

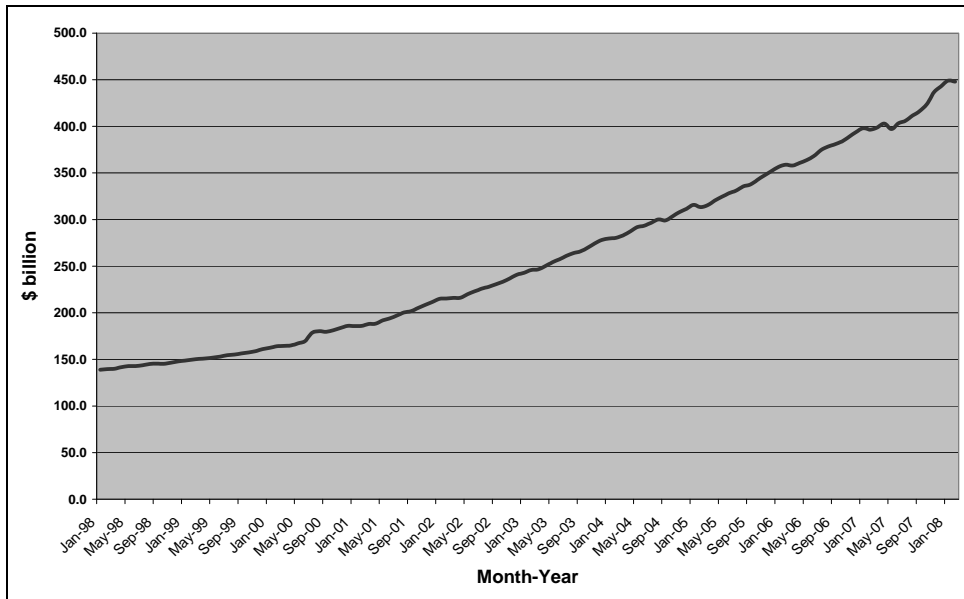
Figure 2: Fuel, Food and Consumer Price Indexes, Australia, 1972-2008.



(Source: Reserve Bank of Australia, Indicator lending Rates, F05 (2008)).

Figure 3: Indicator standard variable housing loan interest rates, Australia, 1988-2008.





(Source: Reserve Bank of Australia, Bank Lending Classified by Sector, D05, (2008))

**Figure 4: Total value of Bank Loans for Owner Occupied Housing, Australia, 1998-2008.**

The effect of mortgage interest rate rises is magnified by the housing boom which saw marked house price inflation across Australian cities during the late-1990s and early-2000s. Part of this housing boom was enabled by the availability of cheap credit signalled by low interest rates. Australia's housing debt was \$139 billion in 1998 but by 2008 had more than tripled, to \$448 billion (Figure 4). This growth was made possible by an unusual combination of historically low, stable interest rates assisted by low unemployment. Many households took advantage of lower interest rates during the late-1990s and early-2000s to seek home ownership.

The period also saw the proportion of Australian mortgagee households increase from 28.1 percent in 1996 to 35.1 per cent by 2004 (Australian Bureau of Statistics 2007, table 1). In New South Wales this gain was particularly pronounced with 33.2 per cent of households holding mortgages in 2004 compared to just 24.7 per cent in 1996 (Australian Bureau of Statistics 2007, table 2). The broader effect of this shift has been that many modest-income households have swelled the ranks of mortgaged home owners and now face much higher interest payments on their mortgages. The ratio of housing debt to disposable income in Australia has gone from less than 50 per cent in the early 1990s to almost 140 per cent by late-2007 (Reserve Bank of Australia 2008a). The housing debts of many urban households far exceed 140 per cent of their incomes.

In March 1998, the average Australian household was spending 4.7 per cent of disposable income on mortgage interest payments. A decade later this figure had more than doubled to 9.5 per cent (Reserve Bank of Australia 2008a). Australia's households are now expending a greater proportion of their income than at any time since measurement began in 1977. The pressure of debt weighs heaviest on those with lower incomes. Mortgagee households in the

lowest income quintile are typically more highly geared and more likely to suffer financial stress from housing debt than those in higher income brackets (La Cava and Simon 2005). Re-financing as a proportion of new loans rose from 18.7 per cent in early 2000 to 30.2 per cent by 2008 (Reserve Bank of Australia 2008b) suggesting that the impacts of higher fuel prices, inflation and interest costs were motivating households to rationalise their financial commitments.

First home buyers have been especially impacted by this process. The average first home mortgage in Australia more than doubled from \$92,000 in 1995 to \$209,600 in 2006 (Australian Bureau of Statistics 2007). For those living in Sydney, the average first home loan grew to \$260,000 by 2006. By 2003 of all Australian households paying more than half of their income on their mortgage, 80 percent were first home buyers. Given that first home buyers tend to be relatively younger and have lower incomes than mortgage holders, the impact of house price inflation and its increased debt demands can only be viewed as regressive. The compounding effect of higher fuel prices driving both general price inflation and higher mortgage interest rates combined with the structure of Australian cities and urban housing markets is amplifying the socio-economic risk from higher fuel prices.

## **The Effects of Recent Fuel Price Increases**

There has been little research which has assessed the impact of higher fuel prices on Australia's urban households – despite our previous calls for such effort. There is still no publicly available dataset that records household transport activity and housing costs within Australian cities. This ongoing deficit makes comprehensive assessment of the impacts of higher fuel prices difficult. However, some insight into the broader socio-economic effects of costlier petrol and higher mortgage interest rates can be discerned from a range of sources. We review some of this evidence in the remainder of this section.

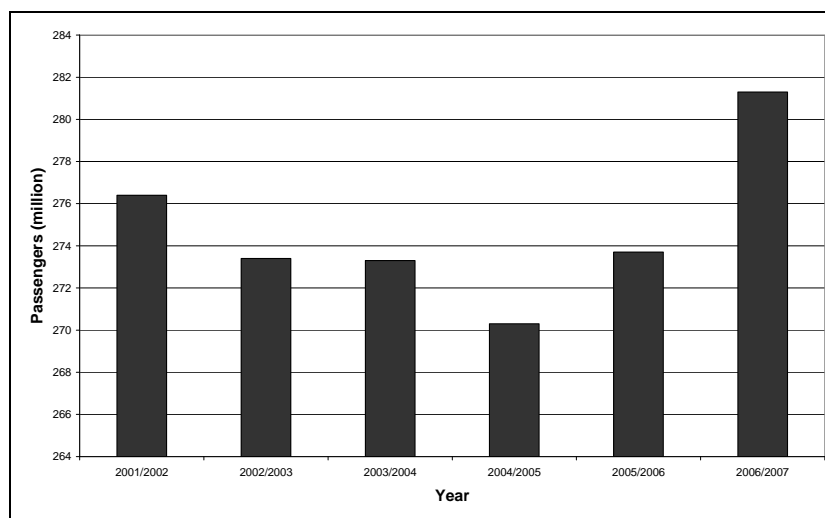
### **Shifting perceptions**

One of the key effects of higher fuel prices has been changing public perceptions of their significance. This shift is demonstrated in regular consumer surveys undertaken by the Sensis over the past few years. After rising oil prices led them to add 'the price of petrol' to its list of consumer concerns in May 2005, households immediately rated this issue as their greatest fear, far above other anxieties such as 'the conflict in Iraq', 'the environment' and 'the workplace relations system' (Sensis 2005). Petrol prices consistently topped consumer concerns between 2005 and 2006. While they yielded to drought and interest rates during a few quarters in 2006 and 2007, by February 2008 petrol prices were again the number one household fear. Terrorism, by comparison, barely rates as an issue of concern. The Sensis surveys also revealed that by September 2006, 45 per cent of households reported having to reduce their budgets to cope with higher fuel prices. Some 30 per cent of surveyed households were cutting back on entertainment and dining out while another 22 per cent were trying to use their car less. A further 19 per cent were forgoing holidays while 11 per cent were cutting down on food. Households on low or modest incomes have faced the

toughest adjustment to higher petrol prices; more than half of those on annual incomes less than \$35,000 reported cutting spending in an effort to cope. By February 2008, petrol pressures were nominated in the Sensis survey as the greatest financial fear of households on annual incomes of up to \$55,000 (Sensis 2008).

### Close to busting

Another indicator of the impact of higher fuel prices has been the dramatic growth in public transport use over the last few years. Brisbane is a good example of this massive patronage boost. In each of the three years since 2004 when fuel prices grew strongly, public transport patronage increased by an average of 9.7 per cent, adding 12.3 million new passengers to the region's system in 2005 followed by another 15.3 million in 2006. This sudden shift took Brisbane's transport planners by surprise given just 3.8 per cent growth in the three years up to 2004. Bus services have struggled to cope under the strain of such massive growth. Overcrowding has become widespread and chronic. In March 2007, a total of 1,749 buses were forced to abandon passengers at stops because they were simply too full. By April 2008 this problem afflicted 1,800 services.



(Source: RailCorp Annual Reports)

**Figure 5: Sydney rail patronage 2001/2002 to 2006/2007.**

Fuel price pressures have put Melbourne's tram and train network under strain. Melbourne's rail patronage has grown by more than 10 per cent annually since 2004 from 137 million boardings to an estimated 200 million in 2008<sup>2</sup>. Overcrowding on trains has caused intense public disquiet. The government and private operators have struggled to organise sufficient services to meet demand, but in March 2008 added another 200 weekly services. Rail

<sup>2</sup> Some of this apparent growth is a result of changes in the way rail patronage is recorded (see Mees Mees, P. (2008). *Does Melbourne Need Another Rail Tunnel?* Melbourne, Environment and Planning Program, RMIT University.).

patronage in Sydney is another indicator of fuel price pressures driving modal shifts (Figure X). In Sydney rail patronage had steady declined during the first part of the decade to a low of 270.3 million passengers during 2005 (RailCorp 2006). After strong fuel price growth, Sydney's rail patronage has grown sharply. An 11 million extra journeys boosted annual patronage to 281.3 million by 2007 (RailCorp 2007). This growth is perhaps all the more notable given the broad perception of poor New South Wales government management of the Sydney rail network.

### **Hitting home**

For a growing number of households the cost of mortgage repayments has exceeded their capacity to pay. Mortgage repossessions in Australian cities have begun tracking upward. This effect is clearest in Sydney where the housing boom was most pronounced. At the peak of the house price boom in 2004, the New South Wales Supreme Court ordered just 1,750 writs of possession. By 2007 this figure had doubled to 3,935 repossessions (Saulwick 2008). A recent study of mortgage delinquency by Fitch Ratings (2008) found repossessions concentrated in a set of suburbs across western Sydney. Guildford was the most affected suburb with 5.7 percent of mortgages in default followed by nearby Granville, Wetherill Park and Belmore.

The effects described above appear to be consistent with what might be expected from the combined socio-economic pressures of higher fuel prices and mortgage interest rates on Australian urban households. Many households on lower incomes are becoming increasingly concerned about higher petrol prices while large numbers are beginning to contemplate changes to their travel behaviour to offset higher fuel costs. In turn, a growing number of households are facing further pressures on their capacity to afford mortgage finance for home ownership.

While the above patterns indicate early responses to higher urban fuel prices we anticipate that more profound effects are likely but that these will take time to develop momentum as higher fuel costs percolate through the urban economy. Australia has luckily benefited from seventeen years of continuous economic expansion which is unlikely to be immediately slowed by higher fuel costs. In this context, the gradual increases in fuel prices are unlikely to instantly flow through to the urban economy; the effects of higher fuel prices are more likely to be gradually realised over a number of years. In mid 2008 Australia's cities have probably only just begun to experience the full effects of the higher fuel prices of the 2004-2006 period. The full impacts of the dramatically higher 2008 fuel prices will probably not be seen until the early years of the next decade. In this context the problem of household socio-economic vulnerability and exposure to the impacts of higher fuel prices and mortgage interest rates remains highly relevant. In the absence of higher quality socio-spatial data our 'vulnerability assessment for mortgage, petroleum, and inflation risks and expenditure' remains a good means of assessing the spatial distribution of the socio-economic pressures from higher fuel prices.

## **The 2006 VAMPIRE: Mapping oil, mortgage and inflation vulnerability.**

To understand household vulnerability to socio-economic stressors we created the 'Vulnerability Assessment for Mortgage, Petrol and Inflation Risks and Expenditure', known as the VAMPIRE. This is an index which calculates the level of household vulnerability at the local level and is based on Australian Census data. It combines information on car dependence, mortgages and incomes at the Collection District (CD) level (about 200 households).

We first presented the VAMPIRE in our 2006 paper *Shocking the Suburbs* which used 2001 Census data to assess oil and mortgage vulnerability across Brisbane, the Gold Coast, Sydney, Melbourne, Adelaide and Perth<sup>3</sup>. With data from the 2006 Census now available we have updated the 2001 VAMPIRE analysis. This allows us to compare patterns in 2006 with those in 2001. The results of this analysis are presented below following a reprisal of the methodology used to analyse the Census data.

The VAMPIRE Index is constructed from four indicator variables obtained from the 2001 and 2006 ABS Censuses that are combined to provide a composite vulnerability index which can be mapped at the CD level. The VAMPIRE Index assesses the average vulnerability of households within the CD rather than the specific vulnerability of individual households. The variables used are:

Car dependence:

- Proportion of those working who undertook a journey to work (JTW) by car (either as a driver or passenger)
- Proportion of households with 2 or more cars

Income level:

- Median weekly household income

Mortgages:

- Proportion of dwelling units that are being purchased (either through a mortgage or a rent/buy scheme)

The first two variables indicate the extent of car dependence for urban travel. The JTW variable provides a basic measure of demand for automobile travel while the proportion of motor vehicles per household indicates the extent of household investment, and thus dependence, on motor vehicle travel. Together these two variables provide an indicator of the extent to which households are exposed to rising costs of motor vehicle travel.

The mortgage variable represents the prevalence of mortgage tenure and accordingly household exposure to interest rate rises. The income variable is used to measure the

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<sup>3</sup> Dodson, J. and Sipe, N. (2006) *Shocking the Suburbs: Urban Location, Housing Debt and Oil Vulnerability in the Australian City*, Research Paper 8; Brisbane, Urban Research Program, Griffith University.

financial capacity of the locality to absorb fuel and general price increases. Together these four variables provide a basic, but comprehensive, spatial representation of household mortgage and oil vulnerability.

The VAMPIRE Index was constructed by combining the four variables as shown in Table 2. High levels of car ownership, JTW by car and mortgage tenure received high index values while low levels of household incomes received lower scores. Thus a CD with high levels of car ownership, JTW by car, income and mortgages would receive a score of 15 (5+5+0+5) as shown in Table 2. The four variables we have selected are not equal in their contribution to the VAMPIRE Index. The variables have been weighted according to their proportional contribution to the overall VAMPIRE Index (Table 3). Thus of a total possible VAMPIRE Index of 30, five points are provided by each of the car ownership and JTW variables while ten points each are provided by the income and mortgage scores.

**Table 1: Value assignment relative to Census District percentile for VAMPIRE.**

Percentile	Value Assigned			
	<i>Car own <math>\geq 2</math></i>	<i>JTW by car</i>	<i>Income</i>	<i>Mortgage</i>
<b>100</b>	5	5	0	5
<b>90</b>	4	4	1	4
<b>75</b>	3	3	2	3
<b>50</b>	2	2	3	2
<b>25</b>	1	1	4	1
<b>10</b>	0	0	5	0

The VAMPIRE Index permits two forms of analysis to be undertaken. First a simple update of the VAMPIRE Index based on the 2006 Census data is possible. We present the results of the 2001 and 2006 VAMPIRE assessments in Part A. Next a comparison of patterns between 2001 and 2006 can be undertaken and the relative increase or decline in oil vulnerability for given areas identified. The results of this analysis are presented in Part B.

### **Part A: The 2006 VAMPIRE: Distributing urban oil and mortgage vulnerability.**

Thematic maps were created for five major Australian cities – Brisbane, Sydney, Melbourne, Adelaide and Perth – based on the ABS definition of the urban area and shaded from minimal to very high vulnerability. The results of this mapping are presented in figures x to XXX. We have placed the 2001 and 2006 VAMPIRE maps side by side so that a visual comparison can be made<sup>4</sup>.

Rather than describe the distribution of oil and mortgage vulnerability suburb by suburb for each city, we consider that the patterns are sufficiently generalised that they can be grouped by VAMPIRE category. We discuss the results of the 2006 VAMPIRE assessment (to p.25)

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<sup>4</sup> We note that there may be some slight differences between the 2001 maps in our earlier paper and those in the present paper. These differences arise because of changes in the compilation of Census data between 2001 and 2006, including changes to a small number of Collectors District boundaries, which necessitated minor adjustments to the method to ensure inter-Censal comparability.

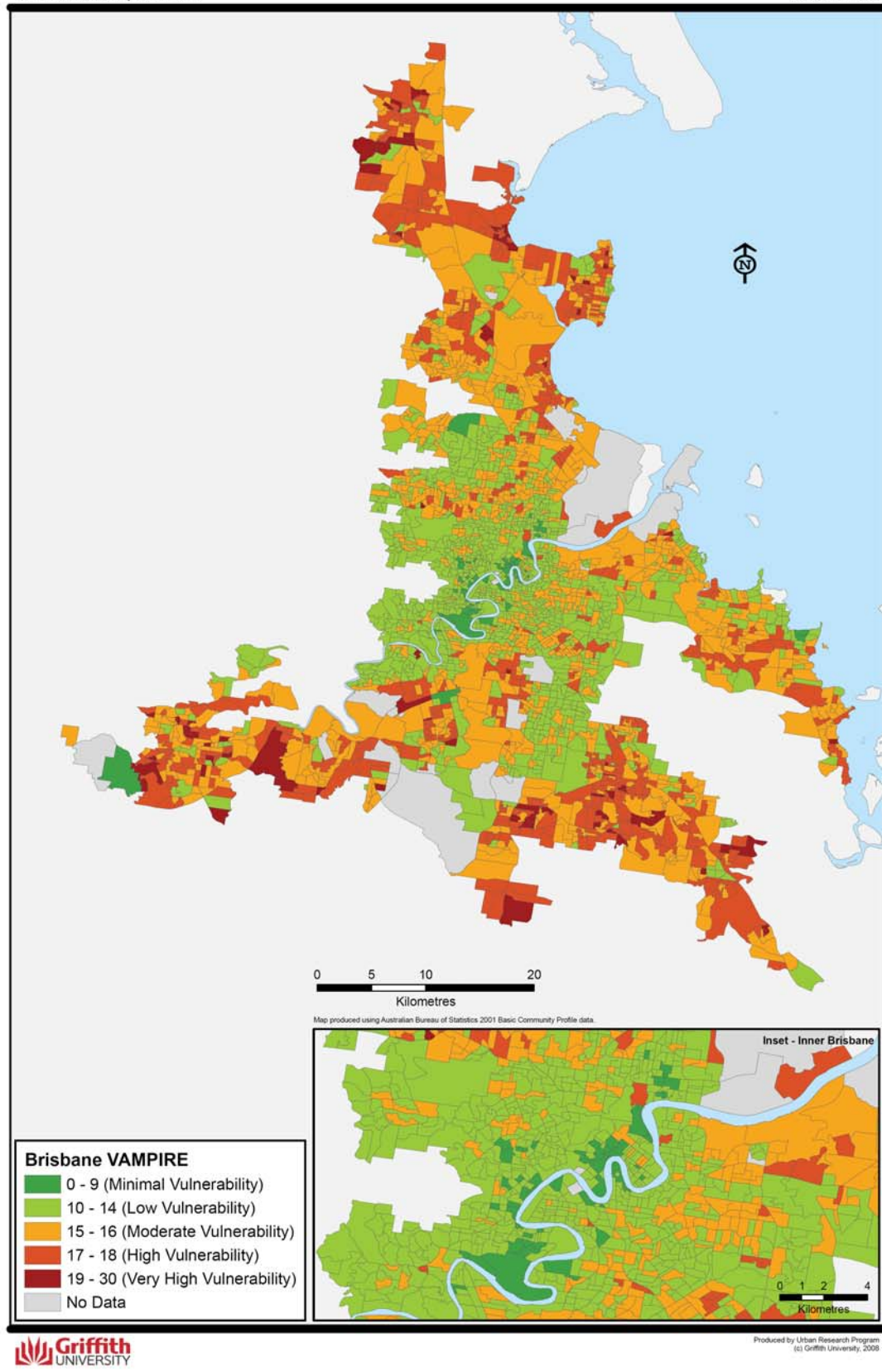


Figure 6: Oil and mortgage vulnerability in Brisbane, 2001.



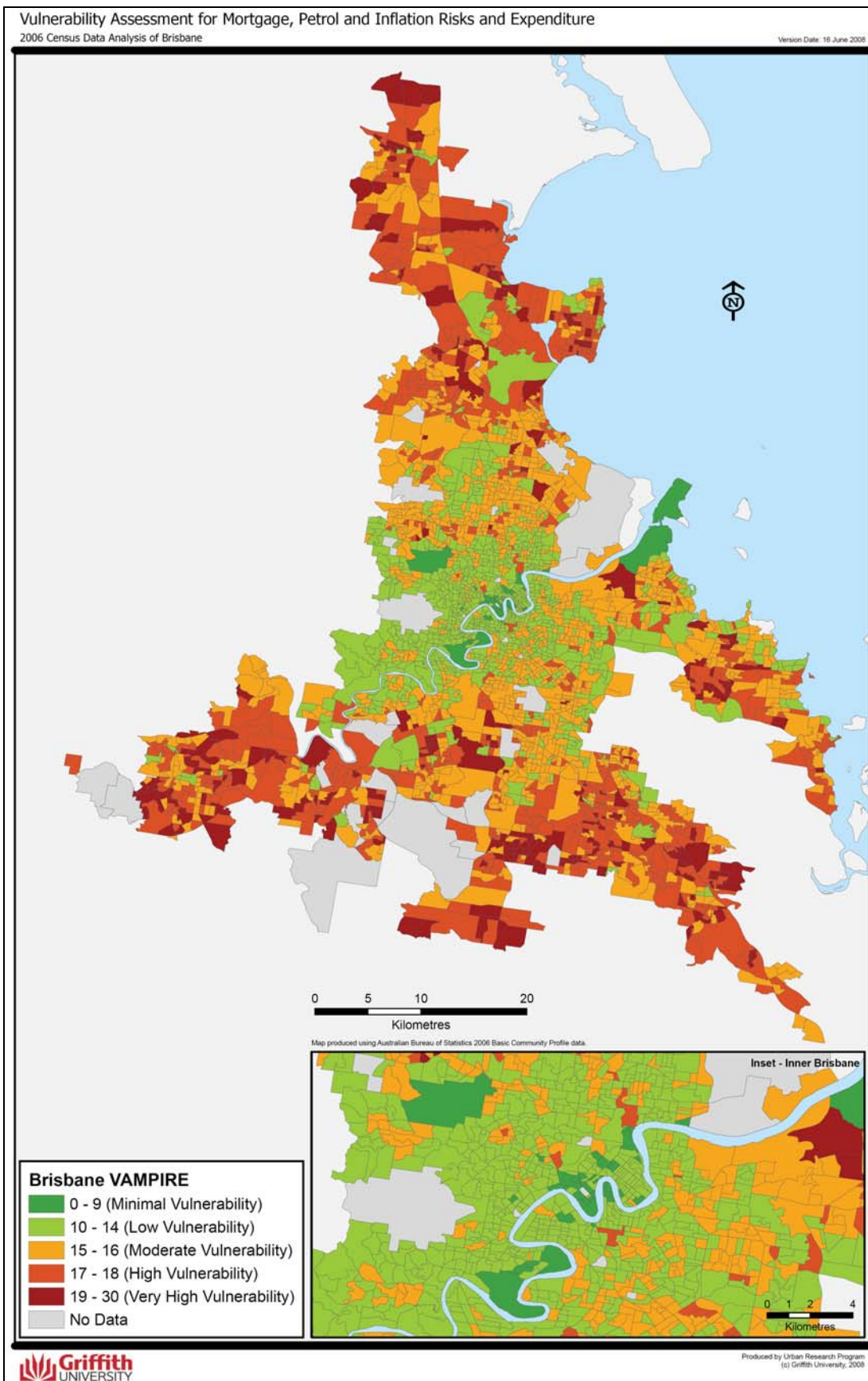


Figure 7: Oil and mortgage vulnerability in Brisbane, 2006.



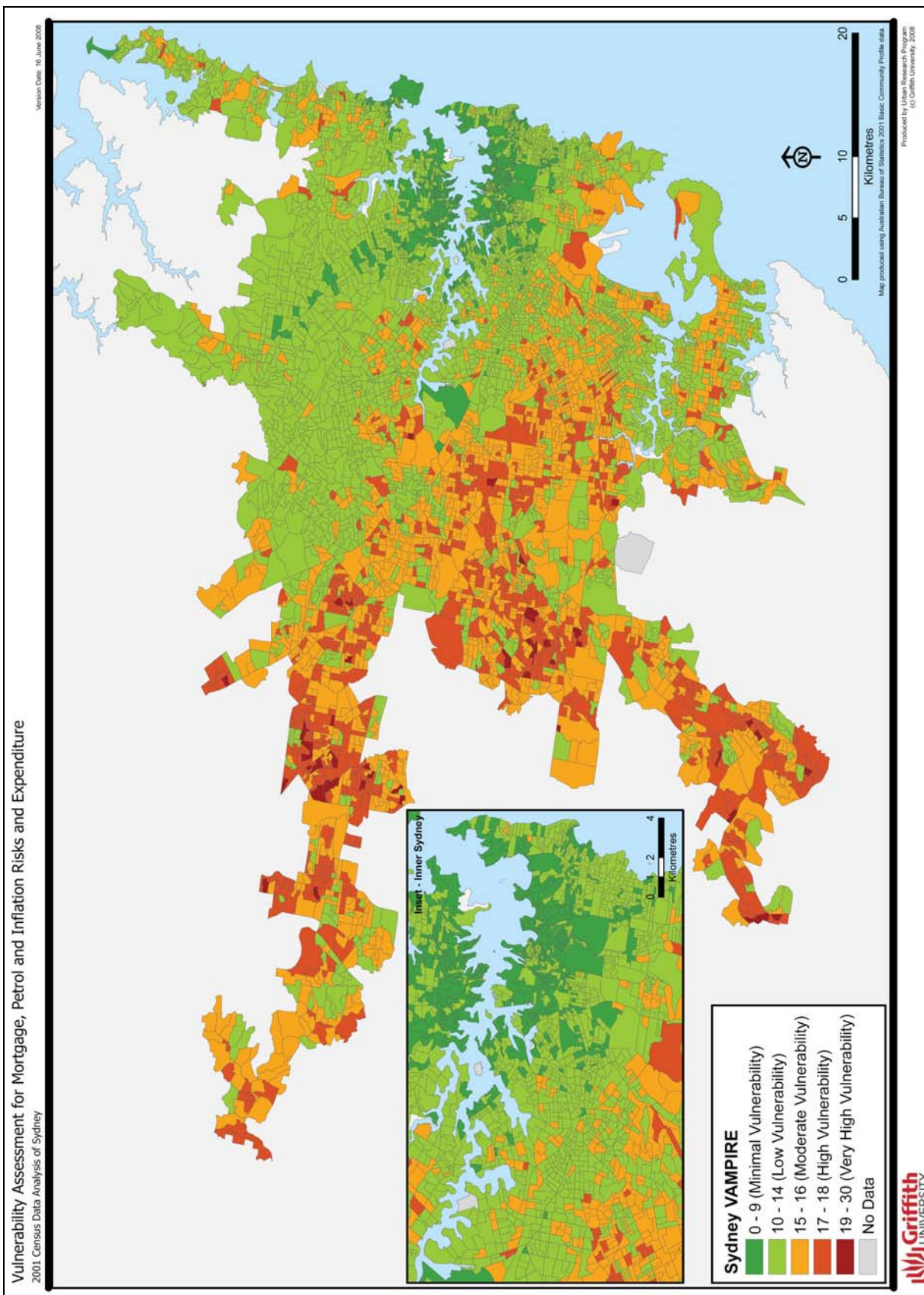


Figure 8: Oil and mortgage vulnerability in Sydney, 2001.

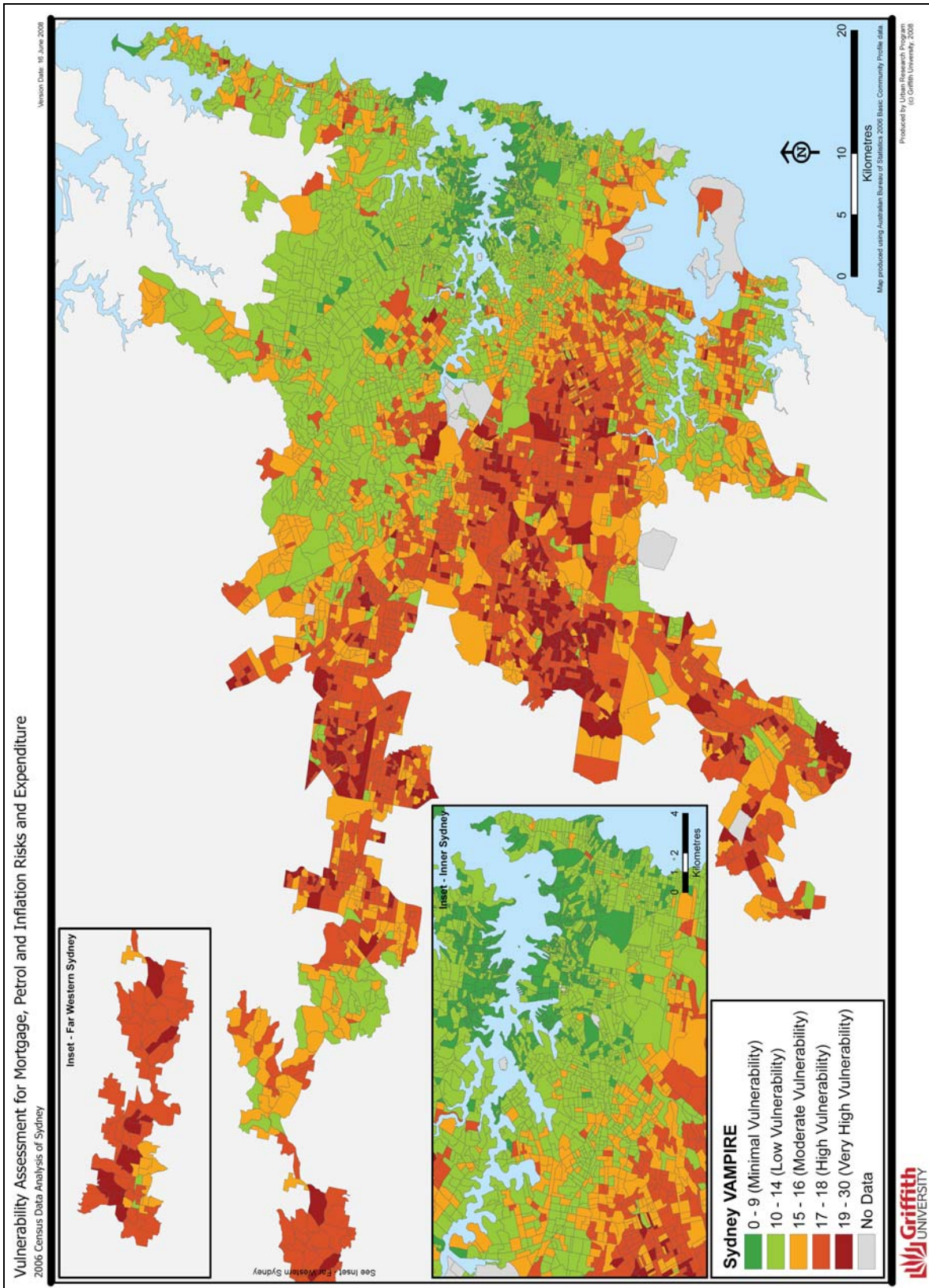


Figure 9: Oil and mortgage vulnerability in Sydney, 2006.



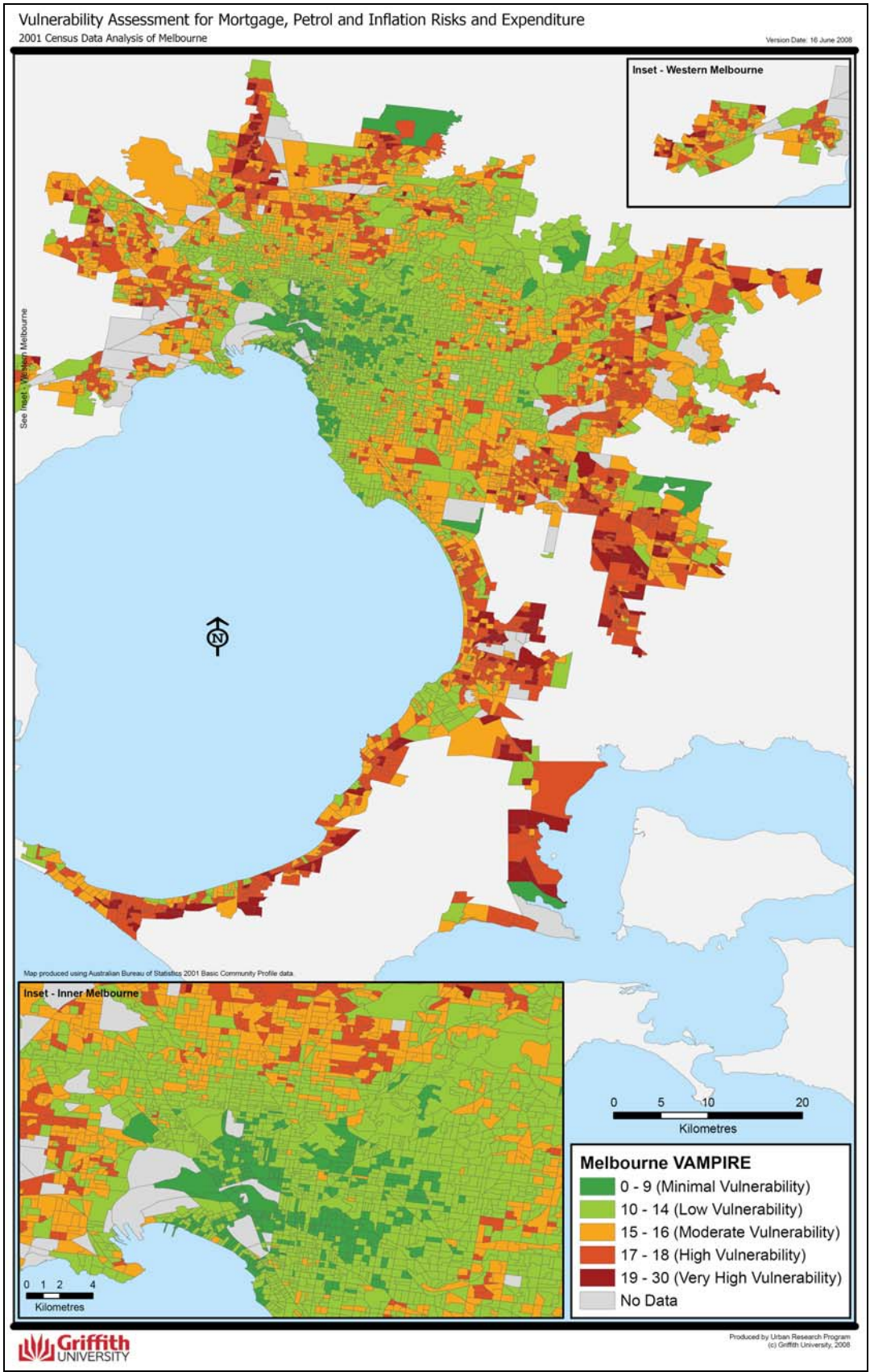


Figure 10: Oil and mortgage vulnerability in Melbourne, 2001.

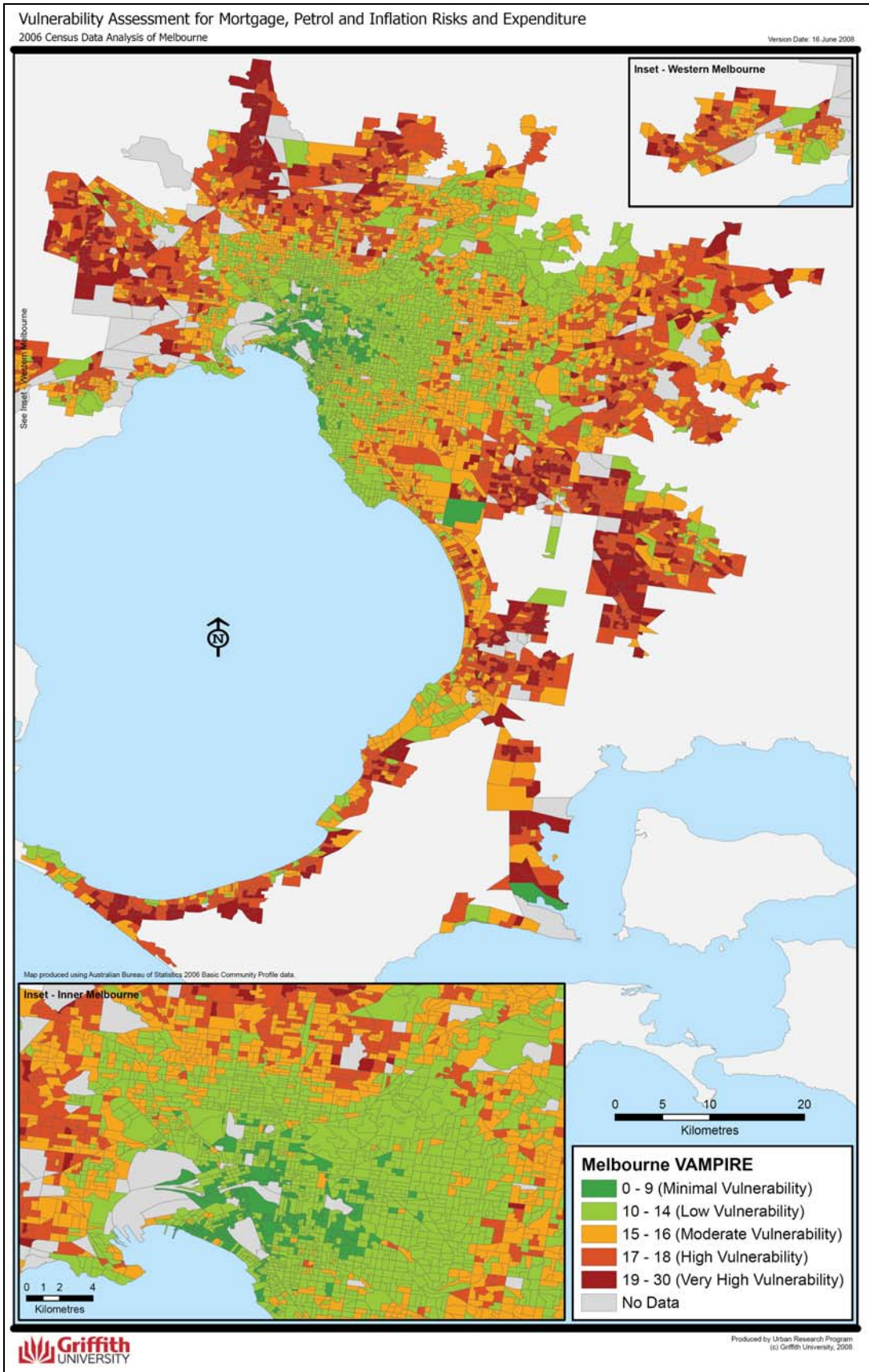


Figure 11: Oil and mortgage vulnerability in Melbourne, 2006.



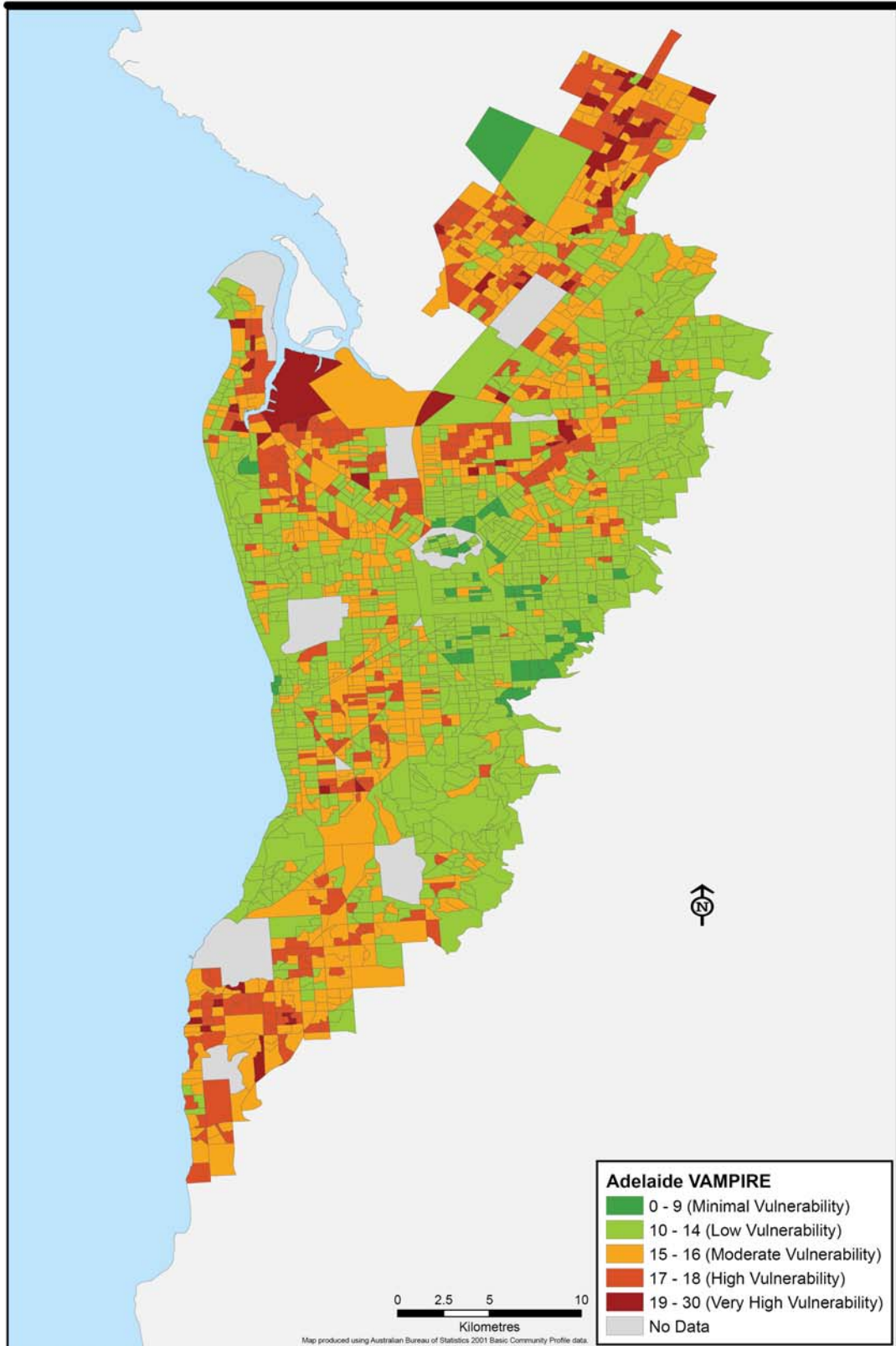


Figure 12: Oil and mortgage vulnerability in Adelaide, 2001.

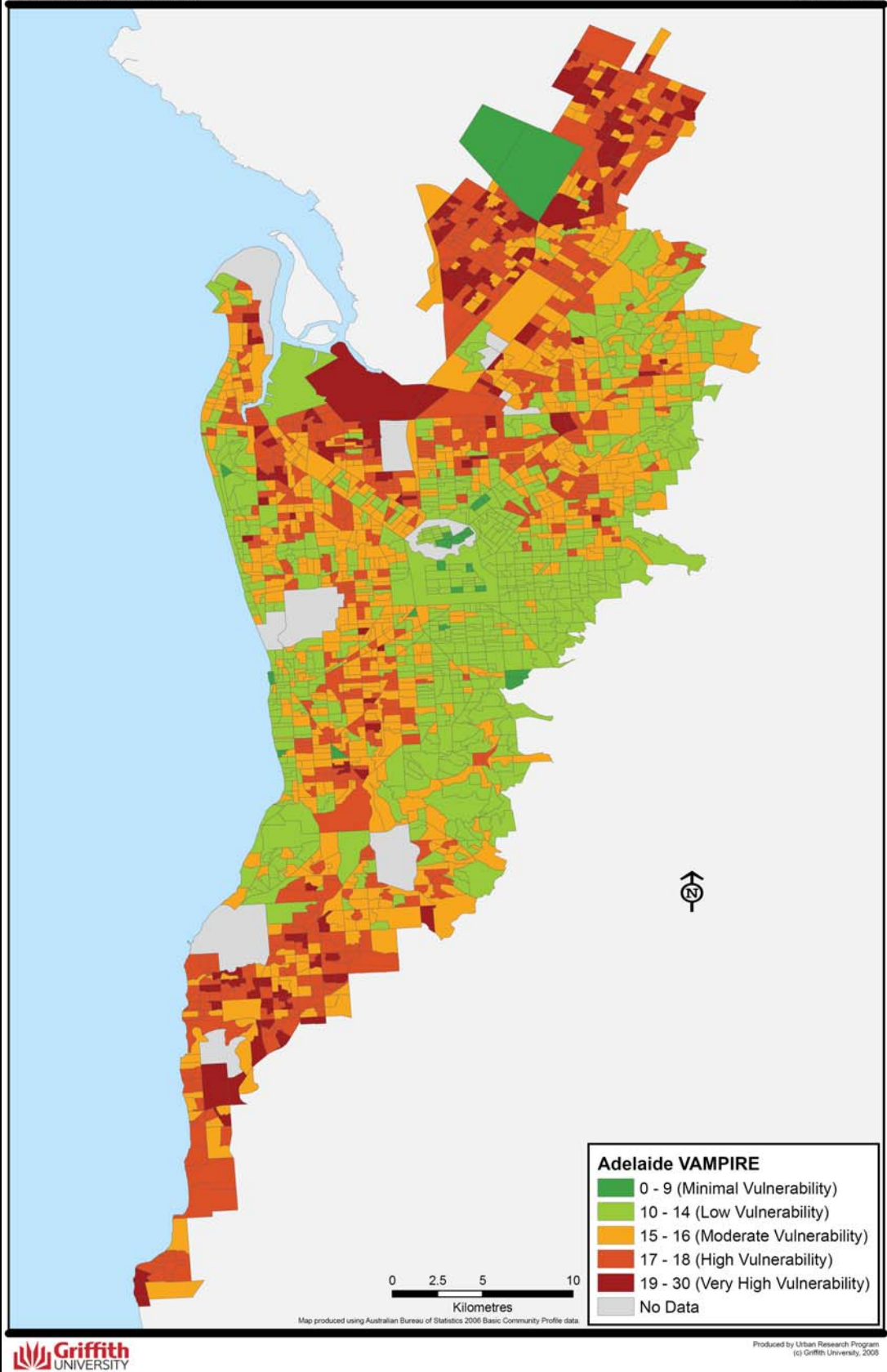


Figure 13: Oil and mortgage vulnerability in Adelaide, 2006.

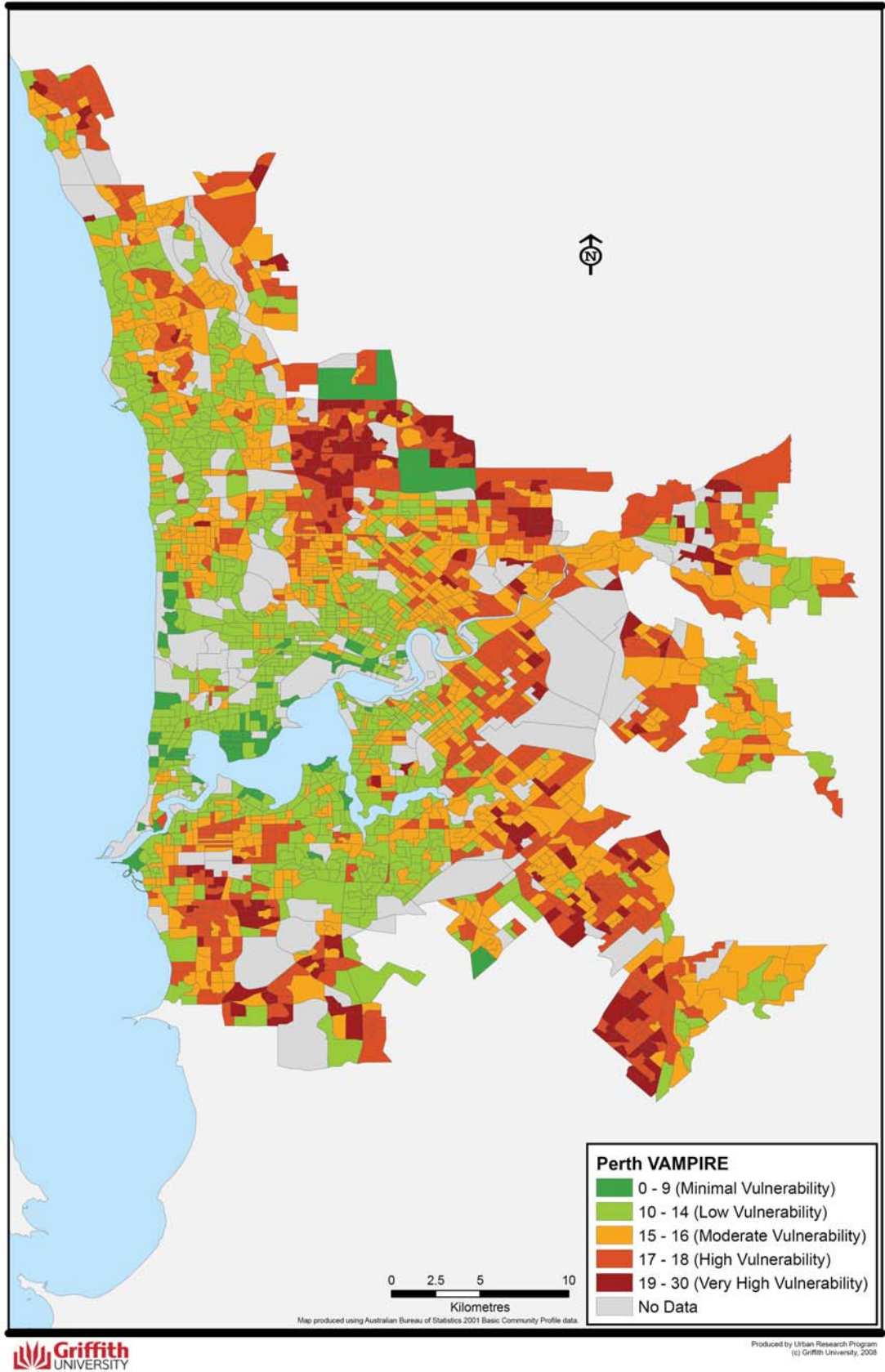


Figure 14: Oil and mortgage vulnerability in Perth, 2001.



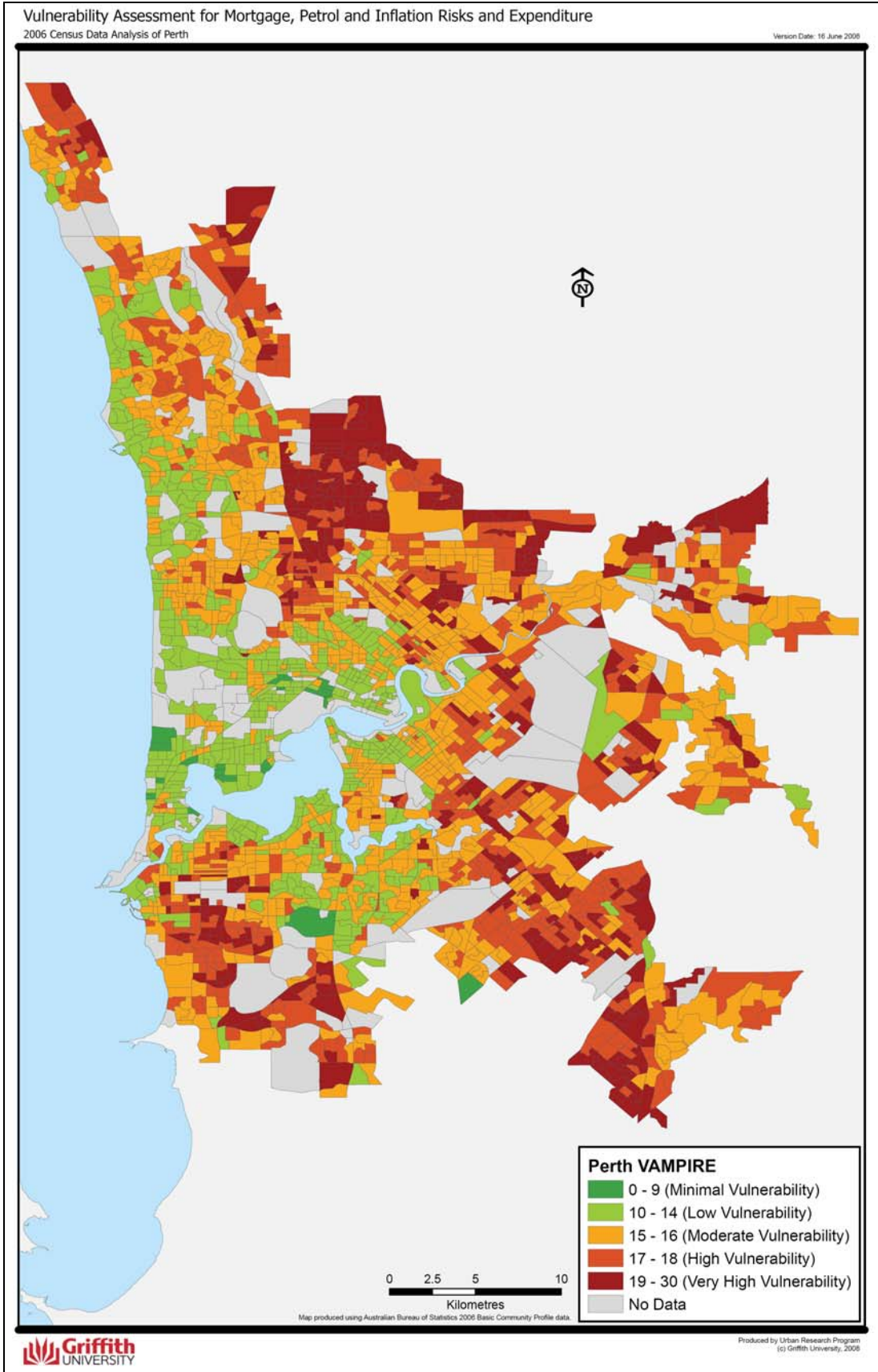


Figure 15: Oil and mortgage vulnerability in Perth, 2006.



(from p. 13) according to four categories of vulnerability, ranging from low vulnerability to high vulnerability<sup>5</sup>. Rather than an exhaustive recounting of the specifics of each category by city we encourage the reader to use our discussion to guide their own perusal of the maps.

#### *Minimal and Low Vulnerability Areas*

Inner city areas of these five Australian cities almost universally fall into low or moderate vulnerability categories. Places like New Farm and Indooroopilly in Brisbane, Crows Nest, Surry Hills and Bondi in Sydney, Fitzroy and Collingwood and St Kilda in Melbourne, central, inner north and inner eastern Adelaide with Crawley, Claremont and central Perth all rating as having low oil and mortgage vulnerability. The residents of these areas are typically wealthier than average and are far more likely to use public transport, walk or cycle than those more distant from the city centre, in part because these areas have some of the best public transport services. Some minimal or low oil vulnerability areas are found in locations distant from the CBD. For example in Brisbane areas such as Chapel Hill and Kenmore exhibit low oil vulnerability while most of Sydney's northern suburbs (east of Epping) fall within low oil vulnerability categories. Comparable patterns apply to Melbourne and Adelaide's eastern suburbs. Low oil vulnerability areas are found as far east as Box Hill in Melbourne and as far south east as Blackwood in Adelaide. Low oil and mortgage vulnerability areas are found along Perth's western shorefront including Mulaloo and Scarborough.

#### *Moderate Vulnerability Areas*

The suburbs beyond the immediate core of Australian cities are more oil vulnerable than those at the centre but only moderately so. These include suburbs such as Hamilton, Kenmore, Stafford and Holland Park in Brisbane. In Sydney the lower oil vulnerability zones are much more extensive and include southern suburbs adjacent to Parramatta Road and south of the CBD plus almost all of northern Sydney east of Macquarie Park. Melbourne's moderate oil and mortgage vulnerability suburbs include, among a large swathe, most of Essendon, Brunswick and Northcote, and extend as far east as Doncaster, Surry Hills, Chadstone and Brighton. In Adelaide a band of moderate oil vulnerability localities west of the central city extends south from Marion to Mitchell Park while a further zone is apparent to the north west of the Adelaide CBD. In Perth moderate vulnerability areas are found to the south, east and north of the CBD in places like Bull Creek, Cloverdale and Duncraig.

#### *High Vulnerability Areas*

In general, the VAMPIRE index shows that the further from the centre of the city a suburb is situated, the more likely it is to fall into the higher vulnerability categories. In Australian cities large areas of moderate-high oil and mortgage vulnerability are found in the middle and outer suburbs. In Brisbane these areas include suburbs like Narangba, Beenleigh, Karalee and Drewvale, all in outer suburban areas. Sydney's areas of moderate-high oil and mortgage vulnerability include outer suburbs such as Campbelltown, Regents Park, Penrith and Camden. In Melbourne a large swathe of high oil vulnerability suburbs cover Sunshine, Lilydale, Werribee and South Morang. Adelaide's high oil vulnerability zones include suburbs such as Northfield, Paralowie, Craigmore and Campbelltown. In Perth, high vulnerability areas are found among

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<sup>5</sup> Minimal vulnerability categories are combined with the Low vulnerability categories for this discussion.

outer suburban zones such as Coogee in the south, Bassendean and Kenwick in the east, plus Innaloo, and Karaloo in the north.

**Table 2: Selected examples of suburban vulnerability based on the 2006 VAMPIRE Index**

City	Vulnerability Category (VAMPIRE Index Range)			
	<i>Minimal/Low (0-14)</i>	<i>Moderate (15-16)</i>	<i>High (17-18)</i>	<i>Very High (19-30)</i>
<b>Brisbane</b>	Indooroopilly	Stafford	Narangba	Browns Plains
	New Farm	Holland Park	Beenleigh	Caboolture
	Coorparoo	Hamilton	Karalee	Redcliffe
	Bulimba	Kenmore	Drewvale	Capalaba
<b>Sydney</b>	North Sydney	Baulkham Hills	Campbelltown	Cabramatta
	Mosman	East Hills	Regents Park	Parramatta
	Potts Point	Kellyville	Camden	Hebersham
	Pymble	Phillip Bay	Penrith	Fairfield East
<b>Melbourne</b>	Port Melbourne	Essendon	Sunshine	Deer Park
	Brunswick	Glen Waverley	Lilydale	Beaconsfield
	Camberwell	Oakleigh	Werribee	Roxburgh Park
	Bentleigh	Nunawading	South Morang	Knoxfield
<b>Adelaide</b>	Central Adelaide	Newton	Campbelltown	Wingfield
	North Adelaide	Reynella East	Northfield	Seaford
	Hyde Park	Allenby Gardens	Paralowie	Parafield Gardens
	Beaumont	Pennington	Craigmore	Elizabeth
<b>Perth</b>	Central Perth	Bull Creek	Bassandean	Banksia Grove
	Crawley	Cloverdale	Karaloo	Marangaroo
	Claremont	Duncraig	Innaloo	Huntingdale
	Carine	Lesmurdie	Kenwick	Armadale

#### *Very High Vulnerability Areas*

Very high vulnerability is distributed across large tracts of the outer areas of Australia's cities. These include places such as Caboolture, Redcliffe, Capalaba, Logan, Beenleigh and Browns Plains in Brisbane. In Sydney high oil and mortgage vulnerability is distributed across much of the city's western suburbs including Hebersham, Green Valley, Cabramatta and Canterbury in the mid and outer west. Even parts of Sydney's inner west show high levels of oil vulnerability with many areas around Bankstown exhibiting high VAMPIRE scores. In Melbourne the pattern of outer suburban oil vulnerability is particularly pronounced. Melbourne is ringed by a number of high vulnerability zones, including many outer suburban growth corridors such as Frankston, Cranbourne, Berwick and Knox Park in the south-east plus Epping, Roxburgh Park and Cragieburn in the north and Kings Park, Deer Park plus Hoppers Crossing in the west. In Adelaide the most vulnerable suburbs include Queenstown, Burton, Holden Hill and Elizabeth in the north plus Christies Beach and Hackham West, Morphett Vale and Sturt in the south. Perth's most vulnerable localities include Banksia Grove, Girrawheen, Balga, Marangaroo, Alexander Heights, Ballajura, Beechboro and Morely in the north, Gooseberry Hill in the east and Langford, Huntingdale, Seville Grove, Armadale, Hamilton Hill and Success in the south.

## Part B: Changes in urban oil and mortgage vulnerability 2001-2006

The mapping of 2001 and 2006 VAMPIRE levels permits assessment of changes in the spatial oil and mortgage vulnerability of households over time. This section examines how the VAMPIRE patterns have changed between 2001-2006 and identifies the areas of increased or reduced exposure to higher fuel costs and rising mortgage interest rates at the Census Collection District (CD) level.

The degree of change in VAMPIRE category has been calculated and mapped for each Australian city at the CD (Figures X to XX). In addition we have charted the number of CDs according to their degree of change in order to estimate the aggregate balance of change in spatial oil vulnerability within each city. We discuss trends for each of the five major cities below.

### *Brisbane*

In Brisbane, a majority of CDs experienced minimal change in their level of vulnerability during the 2001-2006 period (Figure 16). The number of areas in which oil and mortgage vulnerability increased were almost exactly offset by the number of areas where oil and mortgage vulnerability declined. Slightly more than a quarter of Brisbane's CDs became more vulnerable to oil and mortgage risks during the 2001-2006 period while a similar proportion saw their oil and mortgage vulnerability improve. While there were few areas which saw their VAMPIRE score increase by more than four, these increases were largely offset by similar numbers of areas where oil and mortgage vulnerability declined. As a whole Brisbane's oil vulnerability remained largely static over the most recent inter-Censal period.

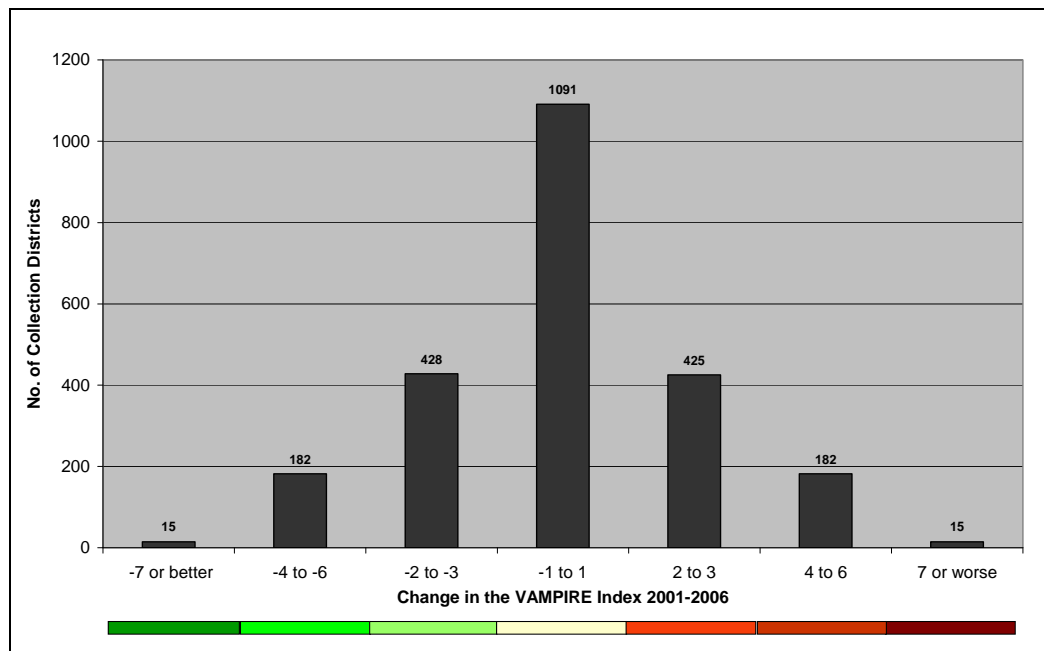


Figure 16: Change in oil and mortgage vulnerability at the Census Collectors District level, Brisbane, 2001-2006.

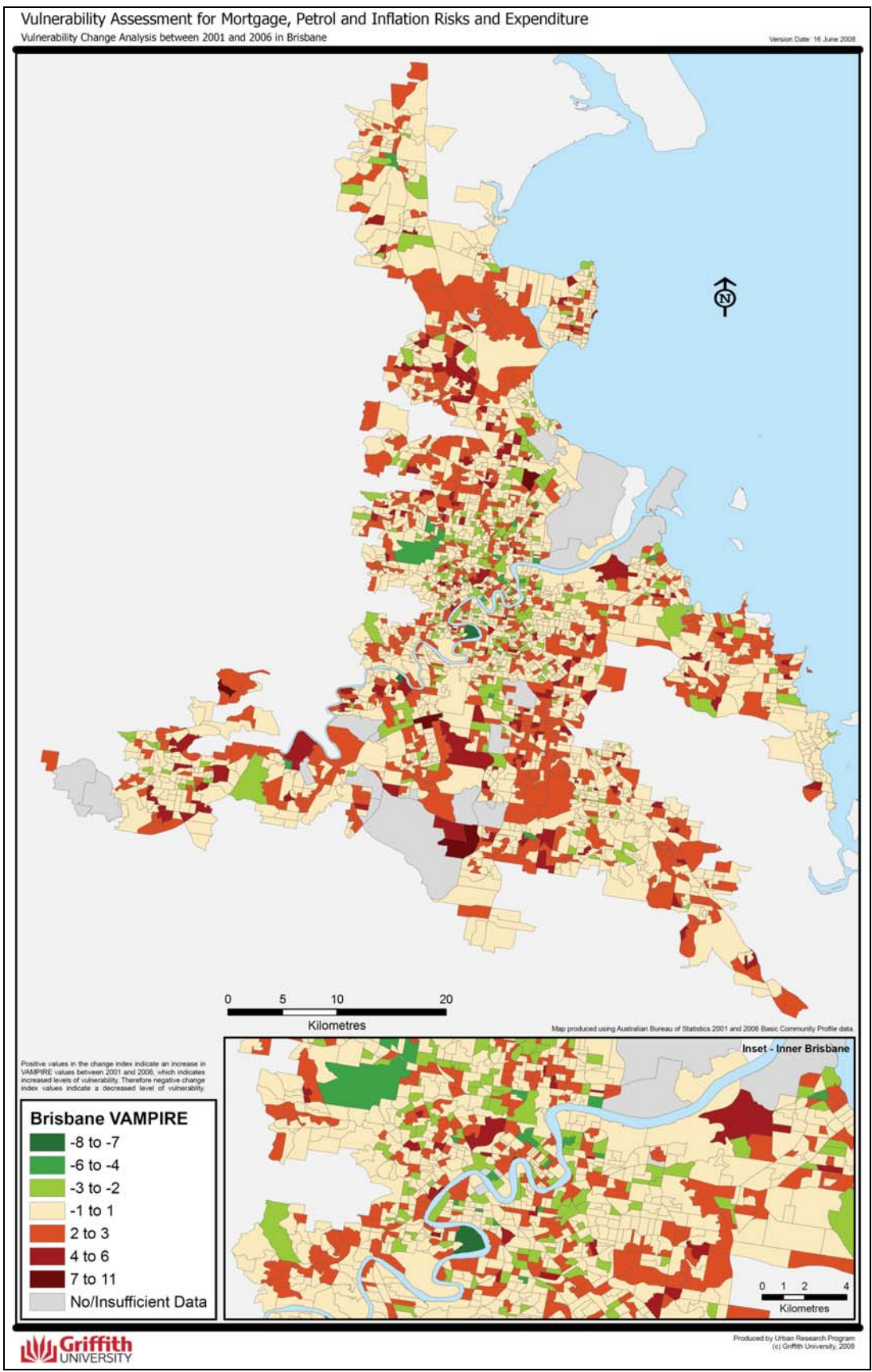


Figure 17: Spatial change in oil and mortgage vulnerability at the Census Collectors District level, Brisbane, 2001-2006.

The spatial distribution of vulnerability is presented in Figure 17. This figure reflects the patterns presented in Figure 16 above and shows that areas that became more vulnerable (shaded red) clearly outweigh those where vulnerability declined (shaded green). While the distribution of increased oil and mortgage vulnerability within in Brisbane is quite dispersed, some unevenness within these patterns can be discerned. Some clustering of increased oil and mortgage vulnerability is apparent in areas such as Wellington Point, Cleveland and Capalaba in the east and from Carindale through Sunnybank Hills to Browns Plains in the inner south east. Some clustering of vulnerability gains is apparent in some north western areas like Aspley and Strathpine and in some near Beenleigh. However the extent of clustering is limited and almost every sub-region of Brisbane includes areas that became more oil and mortgage vulnerable during 2001-2006.

*Sydney*

In Sydney a majority of CDs experienced minimal change in their level of oil and mortgage vulnerability during the 2001-2006 period – equivalent to approximately 36 per cent of the city’s CDs (Figure 18). The number of areas in which vulnerability declined was far outweighed by the number of areas where vulnerability increased over the 2001-2006 period. Approximately 18 per cent of Sydney CDs became less vulnerable to oil and mortgage risks during the 2001-2006 period, whereas 41 percent saw their oil and mortgage vulnerability worsen during between 2001-2006. This shift in the oil and mortgage vulnerability balance in Sydney was most pronounced among areas where the VAMPIRE index worsened by two or three – with 20 per cent of CDs experiencing this level of change. At the extremes of the VAMPIRE index, the numbers of Sydney CDs which saw their VAMPIRE index worsen by at least seven (2.9 per cent) far outweighed those who saw their fortunes improve by a similar scale (0.3 per cent). In summary Sydney as a whole became much more oil and mortgage vulnerable over the 2001-2006 period.

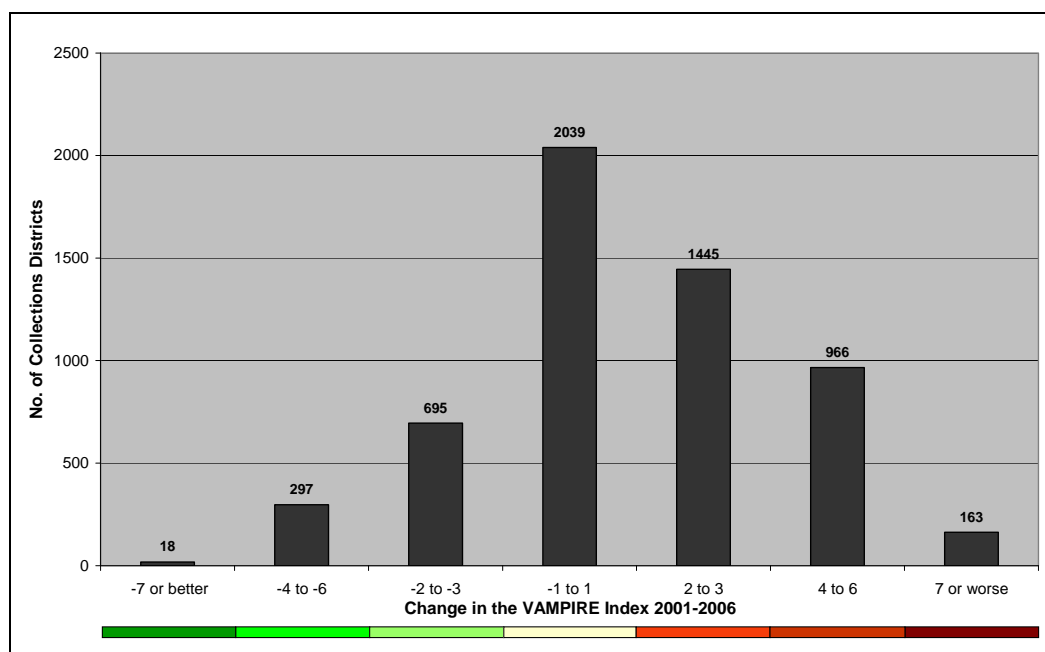


Figure 18: Change in oil and mortgage vulnerability at the Census Collectors District level, Sydney, 2001-2006.



Vulnerability Assessment for Mortgage, Petrol and Inflation Risks and Expenditure  
 Vulnerability Change Analysis between 2001 and 2006 in Sydney

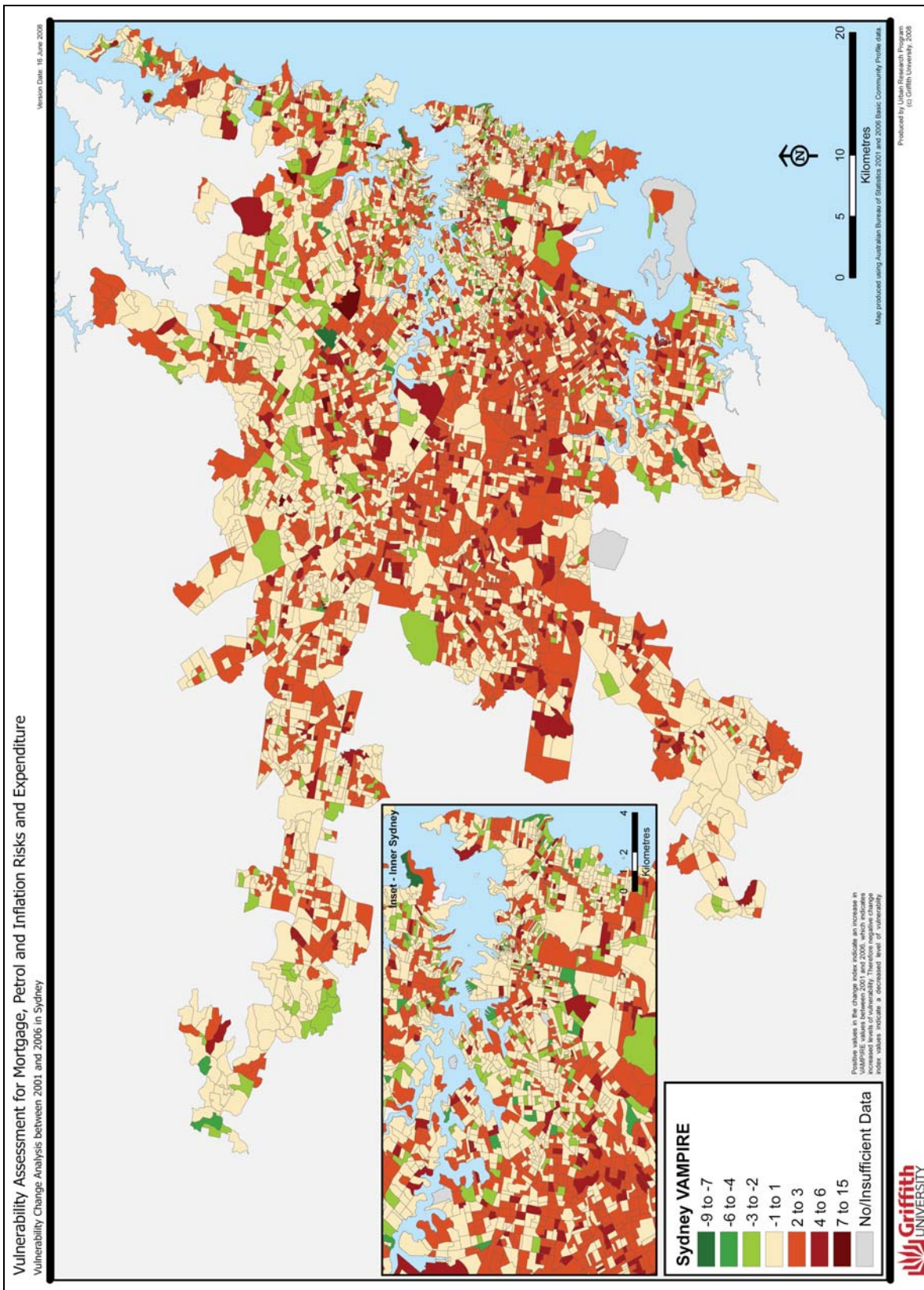


Figure 19: Spatial change in oil and mortgage vulnerability at the Census Collectors District level, Sydney, 2001-2006.

Sydney's changing oil and mortgage vulnerability is presented in Figure 19. Sydney appears to display a more defined spatial patterning of change in vulnerability than is found in Brisbane. The few areas where vulnerability declined are largely restricted to particular sub-regions such as the band of mid-northern suburbs between North Rocks and Pymble. Some other weak clusters of reduced oil and mortgage vulnerability are apparent in the Sutherland Shire, around Petersham and Waverly in the inner west and east and in far western Blaxland. By comparison broad areas of Sydney saw marked increases in vulnerability over the 2001-2006 period. One major sub-region covering an area from Liverpool to Parramatta and Hurstville contains a large number of CDs that became more vulnerable. Some further clustering of marked increases in oil and mortgage vulnerability are also found on the in the northern suburbs between Carlingford and North Ryde. Other notable such areas include Blacktown, Penrith, Hornsby, Mona Vale, Sylvania and La Perouse. Perhaps the most obvious feature of increasing oil and mortgage vulnerability in Sydney is the wide spread nature of the phenomenon.

### Melbourne

A majority of Melbourne's CDs saw minimal change in the extent of their oil and mortgage vulnerability over the 2001-2006 period (Figure 20) - some 33.1 per cent increased or decreased their VAMPIRE Index by no more than one. The number of areas in which oil and mortgage vulnerability improved however, was substantially outweighed by the number of areas where vulnerability increased over the 2001-2006 period. Just under a quarter (24.6 per cent) of Melbourne CDs became less vulnerable to oil and mortgage risks during the 2001-2006 period whereas 42.3 per cent saw their vulnerability worsen during the 2001-2006 period. This shift in the vulnerability balance was most pronounced among areas whose VAMPIRE Index worsened by two to three or four to six, with 36.7 per cent of areas falling into these two categories. At the extremes of the VAMPIRE Index, the numbers of Melbourne CDs which saw their oil vulnerability worsen by at least seven (5.4 per cent) were more than double those which saw their fortunes improve by a similar scale (2.4 per cent). Melbourne therefore saw a marked rise in local oil and mortgage vulnerable during the 2001-2006 period.

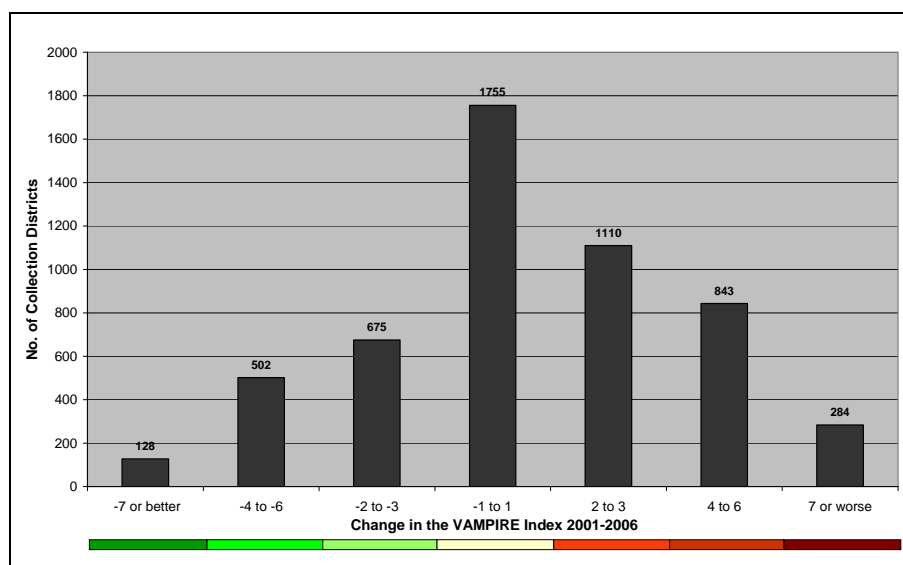


Figure 20: Change in oil and mortgage vulnerability at the Census Collectors District level, Melbourne, 2001-2006.



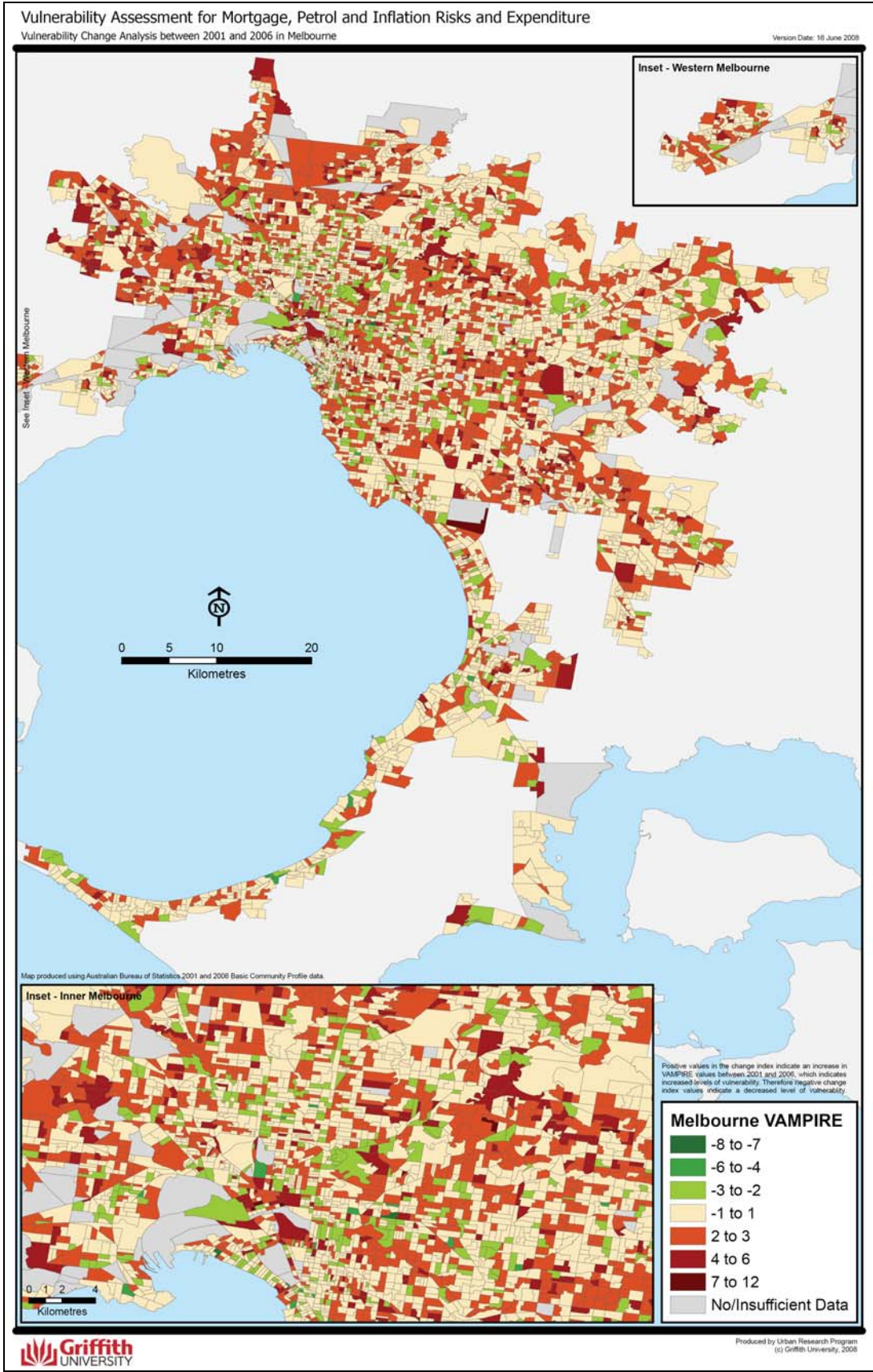


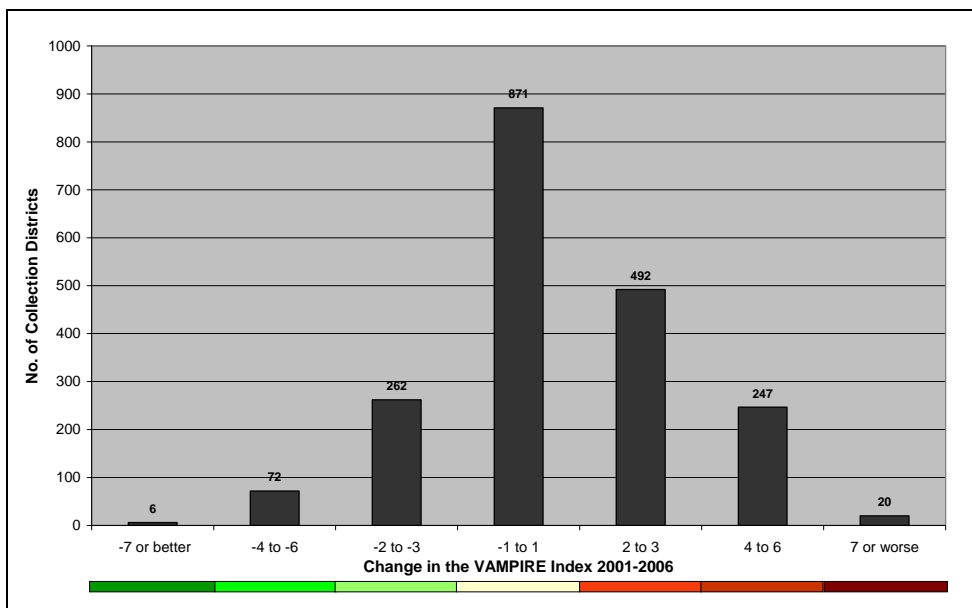
Figure 21: Spatial change in oil and mortgage vulnerability at the Census Collectors District level, Melbourne, 2001-2006.



Spatial patterns of change in oil and mortgage vulnerability in Melbourne are very difficult to discern (Figure 21). Like Sydney and Brisbane, there is only minimal sub-regional clustering of either improvements or declines in vulnerability at the CD level. However some general patterns may be observed. Areas where oil and mortgage vulnerability improved are located within Melbourne’s inner eastern suburbs with some very small clusters apparent in Hawthorn, Toorak and North Fitzroy. By comparison increased vulnerability is widely spread throughout the metropolitan region. Some weak clustering is apparent in some outer suburban zones, such as in Deer Park, Sunshine and Sydenham in the west, Broadmeadows and Thomastown in the north and Glen Waverley, Dandenong and Narre Warren in the south east.

*Adelaide*

As with the other cities considered above, the largest single category of change in Adelaide was that of minimal change into which 44.2 per cent of Adelaide’s CDs fell between 2001 and 2006 (Figure 22). A small minority (17.3 per cent) of CDs in Adelaide improved their oil and mortgage vulnerability during the 2001 to 2006. This limited number was dwarfed by the 38.5 per cent of CDs which saw their vulnerability worsen during the period. Of these more vulnerable regions, most fell into the slightly more vulnerable category with a VAMPIRE Index gain of between two and three and comprised 25 per cent of all Adelaide CDs. In the categories of extreme oil and mortgage vulnerability change in Adelaide the number of CDs which saw their VAMPIRE Index value improve by more than four (4.0 per cent) was outweighed by the number of CDs whose VAMPIRE Index worsened (13.5 per cent). In Adelaide, as with Melbourne and Sydney, the overall pattern between 2001 and 2006 was for a worsening of oil and mortgage vulnerability.



**Figure 22: Change in oil and mortgage vulnerability at the Census Collectors District level, Adelaide, 2001-2006.**

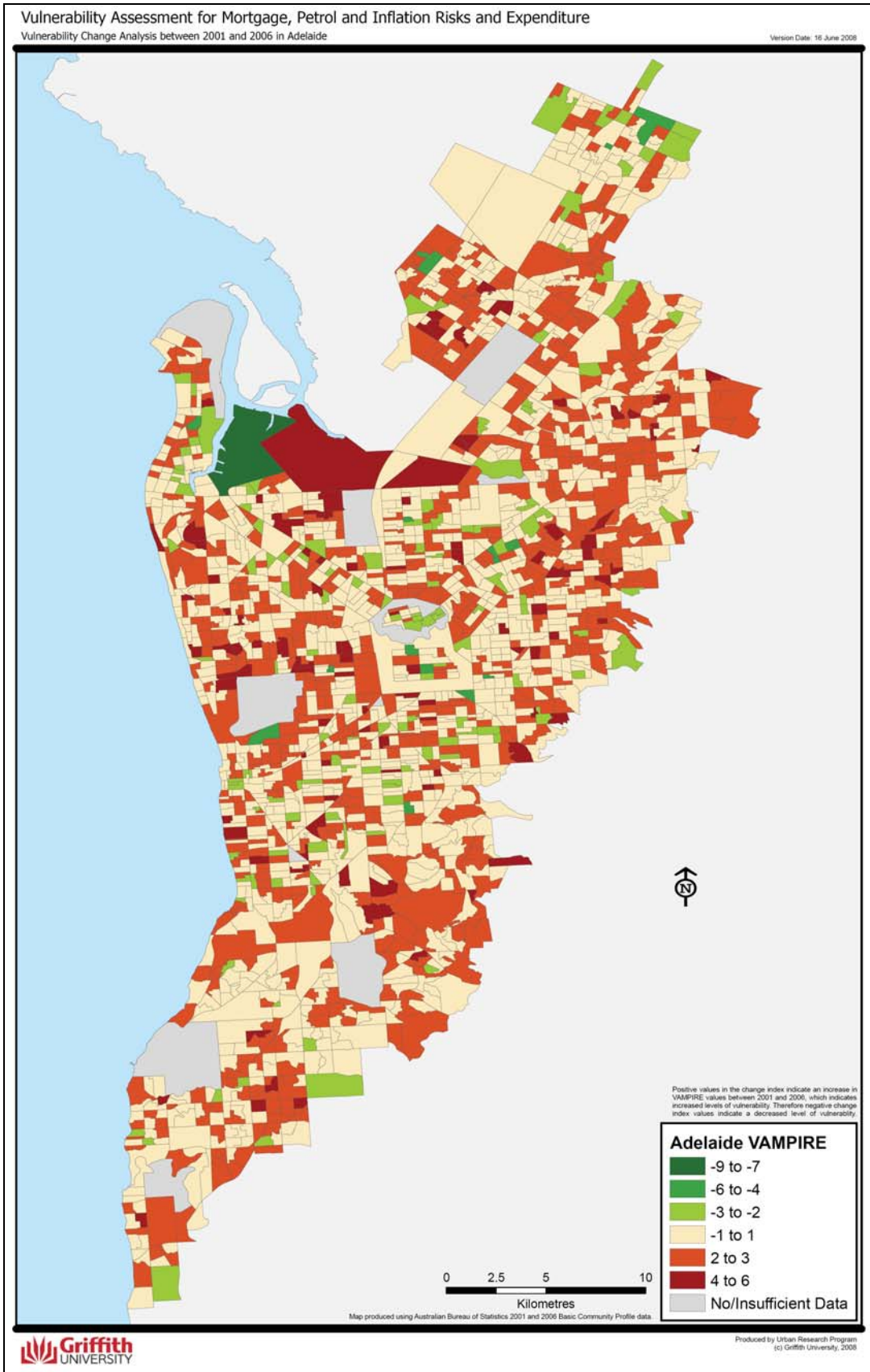
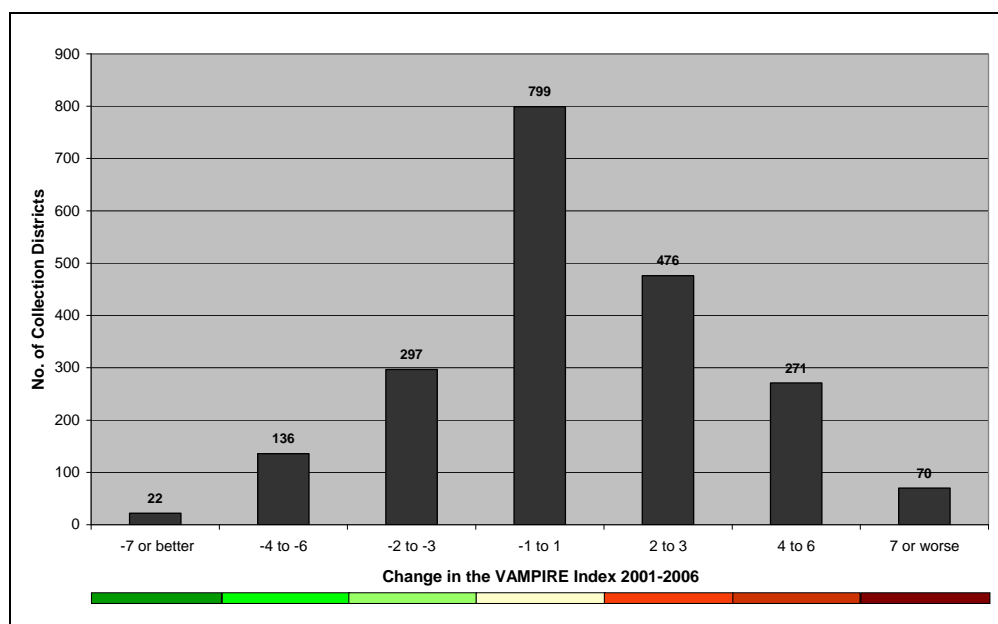


Figure 23: Spatial change in oil and mortgage vulnerability at the Census Collectors District level, Adelaide, 2001-2006.

Changes in spatial oil and mortgage vulnerability within Adelaide are dispersed across the city in a pattern similar to those found in Australia's other major cities (Figure 23). As with the other cities there are very few clusters in which vulnerability declined over the period 2001-2006. Most areas of reducing vulnerability are found within ten kilometres of the Adelaide CBD -- although these are rarely contiguous. Some additional clusters can be found at Port Adelaide and around Smithfield in the far north of the city. By contrast, a number of better defined clusters of markedly increased vulnerability can be found within Adelaide, although again these are generally dispersed. Thus noticeable clusters of increasing vulnerability are found in the areas immediately encircling Adelaide airport, in Morphett Vale and Woodcroft in the south west, around Windsor Gardens and Dernancourt in the north east and at Parafield Gardens in the north. These clusters are accompanied by many other very dispersed and highly localised sub-zones where vulnerability increased markedly during the 2001-2006 period. As with the other Australian cities which we examined, growth in oil and mortgage vulnerability does not appear to be strongly spatially concentrated.

*Perth*

The dominant category of VAMPIRE change in Perth between 2001 and 2006 was the minimal change of no more than one VAMPIRE Index score (Figure 24). Some 38.6 per cent of Perth CDs were found within this category. As with Sydney, Melbourne and Adelaide a larger number (39.5 per cent) of Perth CDs experienced a worsening in their VAMPIRE Index by more than one between 2001 and 2006 than saw their vulnerability improve by more than one (22 per cent). And like Sydney Melbourne and Adelaide, a smaller number of CDs in Perth saw their VAMPIRE index lose more than four (7.7 per cent) than saw their VAMPIRE index gain more than four (16.5 per cent). The more extreme VAMPIRE 2001-2006 shifts among Perth CDs are clearly dominated by worsening oil and mortgage vulnerability rather than improvements in this condition. Overall, Perth, like Sydney, Melbourne and Adelaide became more oil and mortgage vulnerable between 2001 and 2006.



**Figure 24: Change in oil and mortgage vulnerability at the Census Collectors District level, Perth, 2001-2006.**

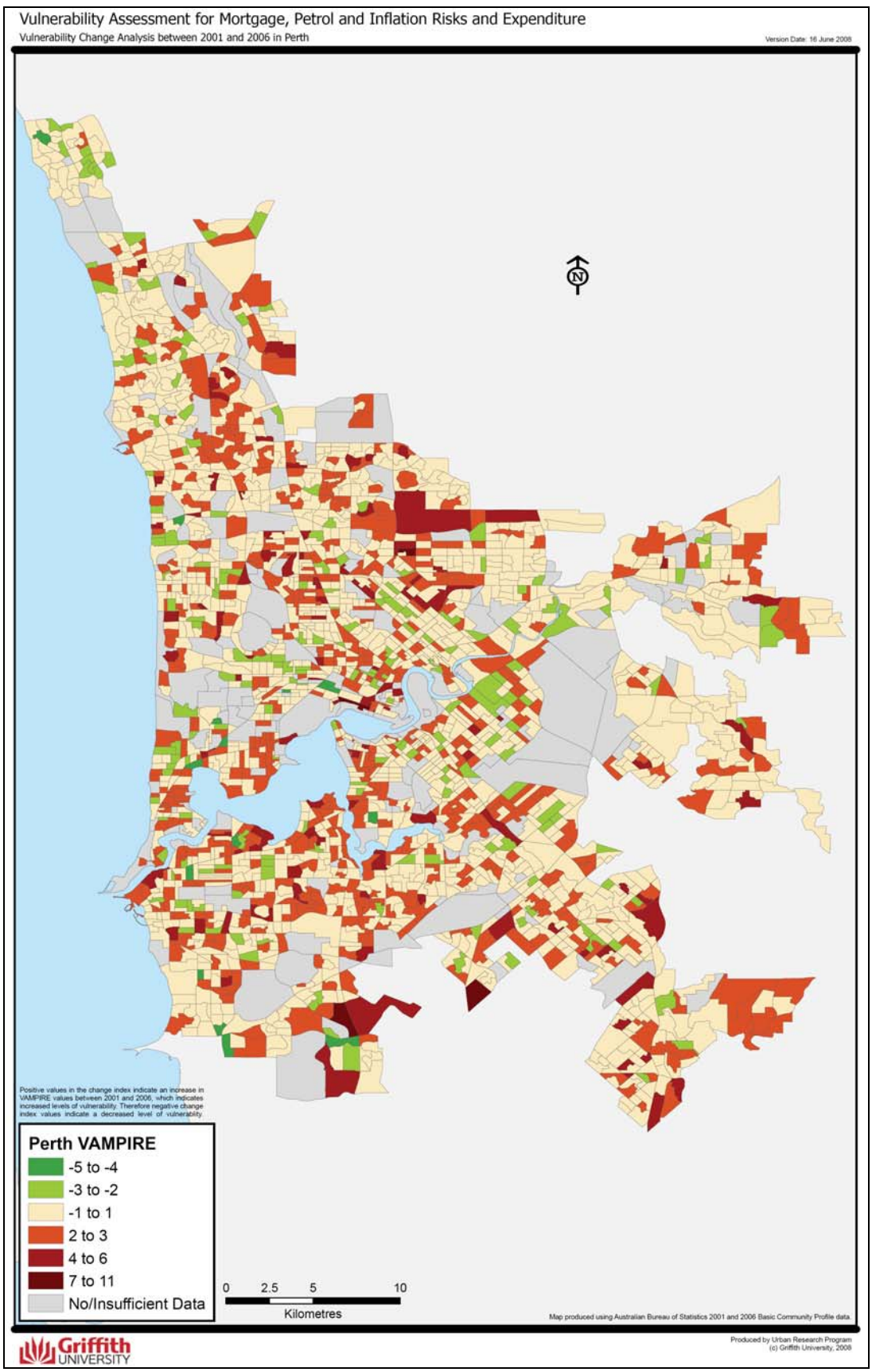


Figure 25: Spatial change in oil and mortgage vulnerability at the Census Collectors District level, Perth, 2001-2006.

Patterns of changing vulnerability are very dispersed in Perth with only limited spatial clustering apparent (Figure 25). Although the majority of CDs saw at most minimal change to their oil and mortgage vulnerability almost all sub-regions of Perth contain areas which saw a strong gain in vulnerability over the 2001-2006 period. Some clustering of gains in vulnerability are apparent in suburbs such as Morley, Noranda and Mirrabooka as well as Kingsley and Woodvale in the north plus Andross, Winthrop, Bull Creek and Cannington in the south. There is no clear inner, middle or outer differentiation in Perth with high and minimal gains in oil and mortgage vulnerability found interspersed at the local scale.

## Discussion

Both the snapshot view of urban oil vulnerability presented in Part A and the dynamic perspective presented in Part B show that there are major overall differences in the spatial distribution of oil and mortgage vulnerability within Australia's major cities. The consistent pattern revealed in the 2001 and 2006 VAMPIRE maps is for inner areas tend to be less vulnerable to higher oil and mortgage costs than middle suburban zones with these middle areas in turn facing less exposure to such pressures than outer and fringe suburban areas. This differentiation in exposure to the socio-economic impacts of higher fuel costs and the mortgage stress appears to be a structural feature of Australia's cities for the reasons we have described earlier in this report, and in previous studies.

The analysis we have presented demonstrates that the number of areas in which oil and mortgage vulnerability increased over the 2001 to 2006 period far outweighed those in which oil and mortgage vulnerability declined. This weakening of urban oil and mortgage resilience within Australian cities was however unevenly distributed between cities. Brisbane appears to have remained relatively balanced in terms of areas of increased or reduced oil and mortgage vulnerability. Despite some areas becoming less oil and mortgage vulnerable over the 2001-2006 period the remaining major cities all displayed a shift towards greater oil vulnerability at the local scale.

Spatial patterns of change in oil and mortgage vulnerability are however less starkly differentiated than the underlying structural distribution of oil and mortgage vulnerability would suggest. Some outer suburban zones (such as Sydney's north and south west growth corridors) saw a lower level of increase in their oil vulnerability over the 2001-2006 period than middle or inner suburban zones. While this may be cause for some relief such a pattern may reflect the fact that many outer suburban suburbs were already among the most vulnerable zones in 2001 and have simply been joined by increasingly vulnerable neighbouring middle suburban areas. Such patterns of change therefore reflect the inward encroachment of increasing oil and mortgage vulnerability inwards – a pattern that is borne out by a visual comparison of the 2001 and 2006 VAMPIRE patterns.

Much more analysis and evaluation of urban oil and mortgage vulnerability is needed to better understand the dynamic patterns and processes that contribute to spatial change in household fuel and housing purchase stress. As far as we are aware this paper represents the first attempt to evaluate longitudinal spatial changes in urban oil vulnerability in Australian cities. Given that the question of oil vulnerability is quite recent and that there is only a very limited preceding literature on socio-spatial methods for oil vulnerability assessment it was not possible to make serious predictions about the potential results of the basic longitudinal analysis we have presented. Further effort is needed drawing on this present study to improve the evaluative capacity of the VAMPIRE index and to expand the measures within the index to incorporate a

wider set of transport and social variables and data. We hope to undertake this work in the near future.

## **Conclusions: the policy challenge of urban oil and mortgage vulnerability**

The research we have undertaken demonstrates that there is a broad distribution of socio-economic exposure to higher fuel prices and rising mortgage interest rates within Australian cities. In general higher and lower vulnerability are concentrated in different sub-regions of our cities. Despite some local variation, higher vulnerability tends to be found in outer suburban areas where cheaper housing attracts modest-income home purchasers and where transport systems are highly dependent on automobile travel. By comparison, households in inner suburban locations typically experience the advantages, from an oil vulnerability perspective, of higher incomes and lower reliance on automobiles for transport than those in outer suburban zones. These patterns are not transitory but a durable structural feature of the Australian metropolis. Urban structure and the local conditions of resilience and adaptability that urban structure engenders will be a critical factor that shapes household socio-economic circumstances under conditions of higher petroleum prices or mortgage interest rates. Because our study measures vulnerability to these pressures, rather than direct impacts, the patterns we have described remain relevant whether oil is at US\$80 per barrel or US\$160.

### *The regressive city*

The distribution of oil and mortgage vulnerability is highly inequitable because the impacts of higher fuel and home purchase costs are borne most greatly by those in outer suburban tracts. As a result the households that will face the greatest adaptive task in coping with higher transport and housing costs are among those with the least resources and weakest access to local infrastructure that could assist them through the adjustment process. Under current conditions in which largely unhindered fuel and housing markets intersect with highly differentiated local infrastructure deficits higher fuel prices and higher mortgage interest rates are a highly regressive phenomenon within Australian cities. Maher et al (1992) and Burnley et al (1997) have shown that active individual household choice plays only a partial role in shaping household locational decisions. Additional factors, such as the structure of housing and labour markets strongly limit where households are able to afford to purchase housing. These factors allocate less wealthy households to parts of the city where they face grossly constrained travel choices resulting in higher car dependence and thus higher exposure to the socio-economic impacts of higher fuel prices. Higher fuel prices and mortgage interest costs are therefore deeply regressive features of Australian urbanisation processes. Because the impacts of higher fuel prices are inequitably distributed within cities, any policies to address the socio-economic stress of higher petrol costs must account for these structural factors. Governments have a responsibility to redress spatial failures on features of the suburban landscape over which they exert the greatest control, such as the distribution of high quality public transport infrastructure and services.

### *Fuelling futility*

To date proposals to provide Australian urban households with respite from the effects of higher fuel costs have focused on attempts to reduce the up-front cost of petrol. Such policy proposals



include the Fuelwatch scheme put forward by the Australian Government and reductions to fuel excise duty suggested by the Federal Opposition. Neither of these approaches is likely to achieve any measurable impact on the exposure to higher fuel costs faced by suburban households. The evidence in favour of Fuelwatch as a method of stabilising petrol prices is weak. The Australian Consumer and Competition (ACCC) considered that it might effect a 1.9 cents per litre reduction in petrol prices (ACCC 2007). Even if this constraint was realised – which is doubtful – such a price reduction would be insignificant relative to weekly variations in fuel prices due to global fluctuations in oil price irrespective of the \$28 million annual cost of the scheme. Fuel excise cuts of 5 cents per litre would have similar modest effect over the medium and longer term but would be achieved at far higher cost to government – approximately \$1.75 billion based on current domestic fuel consumption levels. Given the multiple structural pressures on oil prices described in this paper such attempts to modulate directly the price of petrol are likely to be highly frustrated if not simply ineffectual.

### *The planning imperative*

The evidence in support of the view that global oil prices will continue to increase has strengthened in the past two years. Official bodies such as the International Energy Agency have become increasingly pessimistic about the long term trajectory of oil prices. Since WWII Australia's cities have been planned on the presumption that automobiles running on low-priced fuel would be the dominant means of transportation. That dominance is now looking less secure. If Australian cities are to remain socio-economically resilient in the coming decades, our urban planning will need to give much greater emphasis to less oil dependent modes of travel, such as public transport, walking and cycling.

There are many reasons why governments should begin to take the problem of petroleum security and the oil dependence of Australia's urban transport systems more seriously. Shifting away from the 'business as usual' approach to transport planning to a less petroleum dependent approach will not be easy for either elected representatives or government officials. Some of the predicted scenarios for petroleum prices over the medium term are quite pessimistic. Even the Australian Senate expects 'peak oil' to occur by 2030. A broad and comprehensive plan to reconstruct Australian suburbs to reduce their petroleum reliance is urgently needed. As the Senate has observed, this policy and investment planning must begin now.

In a previous paper (Dodson and Sipe 2008a) we used the 2001 VAMPIRE to investigate the role of metropolitan planning strategies in alleviating or, conversely, exacerbating the problems of suburban oil and mortgage vulnerability. That study concluded that current Australian metropolitan plans are failing to address declining petroleum security and increasing suburban oil and mortgage vulnerability. In some cases these problems are exacerbated by current metropolitan plans, especially those which continue to promote car-based suburbanisation. This worsening comes despite many rhetorical commitments within Australian metropolitan plans to reduce car reliance and promote travel by alternative modes. Unfortunately such commitments have often been at odds with transport investment programs. The evidence we have presented suggests that current metropolitan planning is failing to produce cities which are less car reliant. This failure demands a searching reconsideration of the basis for Australian metropolitan plans and the forms of suburbanisation that have prevailed over recent decades. The insecure petroleum future faced by Australian cities suggest that a major recalibration of planning is required to reduce suburban oil and mortgage vulnerability.

### *Missing the train*

Some government planning responses risk misallocating resources in addressing the effects of oil and mortgage vulnerability. There has been considerable discussion over the past year concerning the pressures on public transport systems – in part due to the pressure of higher fuel prices – and the appropriate measures to address these pressures. In Brisbane, feasibility studies have begun into the viability of an underground CBD rail loop. A metro rail line has been proposed for Sydney while a similar plan has been mooted for Melbourne by the ‘Eddington’ Report. These schemes share some worrying similarities from an oil vulnerability perspective. Such infrastructure may perversely perpetuate the oil vulnerability of Australia’s outer suburban regions, at great cost. First, such schemes will largely direct new investment to central and middle suburban areas, yet these are the zones that are already well served by high quality public transport infrastructure – as reflected in the high use of these services by residents. For example, residents of Sydney’s inner north-western suburbs are already among the least oil vulnerable in the city but they are to receive a new metro line whereas those in such places as Green Valley or Horningssea will miss out. By comparison many of the highly oil and mortgage vulnerable parts of Australian cities identified by VAMPIRE would miss out on such investment – yet their present vulnerability is in part due to the lack of infrastructure. Second, the scale of finance that these schemes would require is extraordinary. Brisbane’s rail tunnel has been costed at \$7 billion, Sydney’s metro at \$12 billion and Melbourne’s east-west tunnel at \$8.5 billion. Funding such schemes would inevitably crowd out investment in new rail infrastructure to oil and mortgage vulnerable outer suburban zones. An oil vulnerability perspective suggests that rather than using the \$27.5 billion in funds available for public transport improvements across these three cities to replicate existing inner city infrastructure it ought to be directed to ameliorating the exposure of suburban households to higher transport costs. This could be done via new outer suburban rail extensions and through improvements to interconnecting local bus services. Such a view appears to be shared by Peter Newman, the only public transport expert appointed the new board of Infrastructure Australia. Professor Newman has cautioned about the risk of ‘suburban abandonment’ of oil dependent suburbs and has argued in favour of new rail lines to outer suburban areas (Newman, cited in Campion 2008).

Perth, which is Australia’s most car dependent city, appears to be an exception to the metro rail tunnel rush found elsewhere. The Western Australian government has recently completed a \$1 billion suburban rail line from Perth to Mandurah which is already exceeding patronage expectations and, along with interconnecting bus improvements, is reducing the oil vulnerability of Perth’s southern suburbs. Flushed with the success of this program, the WA government is considering further rail investments which will help in reducing the oil vulnerability of other outer suburban areas of Perth. Other Australian states should consider the Perth experience when considering transport planning responses to oil vulnerability.

### *Housing vulnerability*

The other dimension to the planning question is housing. The main policy that has been promoted to address energy issues in Australian cities is that of urban consolidation. This policy was initially conceived to help reduce urban transport energy demand in response to the petroleum shocks of the 1970s, but has subsequently been promoted as a greenhouse emissions reduction strategy. One of the objectives of urban consolidation policy has been to concentrate development within existing urban footprints with the expectation that this would result in



development that is better located relative to services, such as public transport, while also concentrating demand for public transport services. The main effect of urban consolidation has been to promote increased urban densities within existing metropolitan areas. This approach has been followed for over two decades, with mixed success; there is little evidence that this policy has had much effect on urban transport petroleum dependence.

More worryingly, urban consolidation, as currently practiced, is unlikely to address the problems of suburban oil vulnerability which we have described in this paper. As Dodson (2008) has recently argued, the structure of Australian housing markets will prevent urban consolidation policies from reducing the oil vulnerability of outer suburban households in Australian cities because these policies are overly reliant on private housing markets. Two factors underpin this problem. First, development timeframes are too slow and unresponsive to provide rapid and comprehensive re-development of outer suburban areas. Second, residential land markets in Australian cities are heavily centrally concentrated. Higher density development therefore tends to also be centralised because higher value inner-urban land provides greater opportunity for profit than lower valued middle and outer suburban residential land. This means that urban consolidation is unlikely to result in sufficient densification of suburban areas to either reduce demand for automobiles by concentrating housing near employment and services or, conversely, by concentrating demand for public transport.

A further challenge for housing is the question of inter-generational security and equity. Home ownership remains an aspiration of many Australian households, yet the problem of mortgage vulnerability in the face of mounting stressors means that the 'dream' could turn into a nightmare for many. Yet there are few alternatives to private home ownership that offer a reasonable level of security. Australia lacks a major alternative to private home ownership that could offset the risk of mortgage lending for those threatened by suburban oil vulnerability. A longer term solution to the suburban oil and mortgage vulnerability challenge must reconsider the tenure structure of Australian cities and seek a wider set of stable and secure housing choices for suburban households.

### *Public planning, public transport*

A more effective response to suburban oil vulnerability than current planning approaches would be to improve public transport services to match the quality found in inner and middle suburban areas. Such services are already providing a good level of resilience these zones. There is a clear equity imperative to ensure that this level of public benefit is shared by those in the outer areas of Australian cities. This does not require large expenditures. Significant gains could be achieved through better management of suburban public transport including more efficient institutions and improved integration of bus and rail services. In areas where new public transport infrastructure and services are required these need not be grossly expensive. Modest extensions to existing suburban rail networks combined with comprehensively planned and high quality local suburban bus services would be a cheaper and more sustainable option for redressing suburban oil vulnerability than costly underground inner city services. The VAMPIRE maps we have provided can assist in the planning of new suburban public transport services by identifying where vulnerability is greatest.

Australian cities remain highly oil vulnerable in a changing and insecure global petroleum environment. If our cities are to remain resilient in the face of declining global petroleum security – and its diabolical cousin climate change – we will need comprehensive government planning of our suburban public transport networks. The legacy of the past half-century of

suburban infrastructure neglect and weakened institutional capacity in service provision means that the task of planning for oil resilient suburbs has been made much more difficult. The historical personal and community security provided by Australia's suburbs is too great an achievement to let fail under the threat of declining petroleum security. We must begin planning now so that the challenges we face do not end up unsettling suburbia.

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