UNIVERSITY OF TECHNOLOGY SYDNEY

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

National Environmental Research Program

Institute for Sustainable Futures

IMPLICATIONS OF POPULATION GROWTH IN AUSTRALIAN CITIES: CASE STUDY - MANDURAH, WA

2012

ABOUT THE AUTHORS

The Institute for Sustainable Futures (ISF) was established by the University of Technology, Sydney in 1996 to work with industry, government and the community to develop sustainable futures through research and consultancy. Our mission is to create change toward sustainable futures that protect and enhance the environment, human well-being and social equity. We seek to adopt an inter-disciplinary approach to our work and engage our partner organisations in a collaborative process that emphasises strategic decision-making.

For further information visit: **www.isf.uts.edu.au**

Research team: A/Prof Michael Paddon, Ms Emma Partridge, Dr Samantha Sharpe, Mr Dustin Moore, Ms Jade Herriman and Ms Aleta Lederwasch

CITATION

Cite this report as:
Herriman, J., Partridge, E., Moore, D., Sharpe, S. and Paddon, M. 2012, Research into the Economic, Social and Environmental Implications of Population Growth in Australian Cities: Case study – Mandurah, WA, report prepared by the Institute for Sustainable Futures, University of Technology, Sydney, for the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

ACKNOWLEDGEMENT

The authors would like to acknowledge and thank all stakeholder participants for giving up their time to participate in interviews and providing such rich views and perspectives regarding the Mandurah area.

INSTITUTE FOR SUSTAINABLE FUTURES
University of Technology, Sydney
PO Box 123
Broadway, NSW, 2007
www.isf.edu.au

Case study summary

Mandurah, located 72 kilometres south of Perth, is a coastal town which saw an increase in population of over 600% in the 30 years from 1978 to 2007 (from 10,000 to 61,000) (City of Mandurah, 2009b). Once a small fishing village that boomed during holidays, it now has a population of over 73,000. It is forecast to continue growing by 2.04% per annum, adding another 47,000 residents by 2036.[1] Covering an area of 173.5 square kilometres,[2] Mandurah follows the coast from Madora to the north to the Lake Clifton wetland and Yalgorup National Park 50 kilometres to the south (City of Mandurah, 2012a). Surrounded by rural shires to the east, Mandurah is now decidedly urban, with retail outlets, a shopping centre and a population density of 153 households per square kilometre (City of Mandurah, 2012a).

Mandurah is now home to stretches of high-end canal-side real estate whilst simultaneously experiencing a shortage of affordable housing. Rental stress affects almost a third of all private renters, a higher rate than the WA or Perth average. Mortgage stress affects a smaller proportion of owner-occupiers, but stakeholders spoke of the stress and pressure on relationships experienced by households with high mortgages. Research also suggests that Mandurah is a WA 'bankruptcy hotspot', where many people on low incomes are struggling to meet their financial obligations.

There is some shortfall in social infrastructure, with council and non-governmental organisations (NGOs) reportedly playing 'catch up' to meet the growing need for education, family support, recreation and other social services. Specific examples raised in stakeholder interviews were the need for better public transport, homelessness services, crisis accommodation, childcare and relationship and domestic violence support services. Some public facilities such as libraries, community centres and a recently built arts centre are well appointed and seem to meet current needs, although stakeholders pointed to the need for a new or extended aquatic centre.

Educational attainment is low, and there are concerns that low education levels combined with limited local employment opportunities are entrenching areas of socio-economic disadvantage. Unemployment is higher than the state average, and there appears to be a constricted range of local employment options, although unemployment rates have dropped since the 1990s, possibly due to the mining boom. Mining, construction, manufacturing and retail are important sources of income and employment in the Peel region. The Employment Self Containment rate suggests that there is a need to create a significant number of new jobs in Mandurah in order to increase the number of people who can both live and work within the locality. Tourism, industrial land and agriculture are three priority areas for economic and employment development in the region, and there are large future projects proposed.

Environmentally, Mandurah is a national asset, featuring a wetland system (Peel-Harvey Estuary, Lake Clifton, and Goegrup Lake) listed under the Ramsar Convention[2] as being of international significance (City of Mandurah, 2012h), an array of nationally threatened species and regionally significant ecosystems, and one of the few living communities of thrombolites.[3] The Peel-Harvey Estuary is under threat from nutrients entering the system from upstream agricultural use as well as habitat loss. Physical modifications to the foreshore areas and clearing have also impacted negatively on estuary quality.

The coastal amenity and rural character that appeal to many may be under threat from development, yet further population growth may also trigger or enable investment in the social infrastructure that the current population requires. Ongoing questions remain about how to balance these two concerns, as

[1] http://forecast2.id.com.au/default.aspx?id=260&pg=5000

[2] The Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands. See http://www.ramsar.org/.

[3] Thrombolites are an ancient life form made of single celled bacteria that deposit sediment and calcium to create 'living' rock like structures.

well as create new employment opportunities that match the existing skills of residents and future residents without eroding natural assets.

Glossary

ABS	Australian Bureau of Statistics
AEDI	Australian Early Development Index
BFV	Barmah Forest virus
CALD	Culturally and linguistically diverse
CAMBA	China-Australia Migratory Bird Agreement
CBD	Central Business District
CCP	Cities for Climate Protection Program
CD	Collection District
CEO	Chief Executive Officer
CR	Critically Endangered
DCP	Development Control Plan
DEC	Department of Environment and Conservation
DOW	Department of Water
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EPA	Environmental Protection Agency
ESC	Employment Self Containment
ESS	Employment Self Sufficiency
EPBC Act	Environmental Protection and Biodiversity Conservation Act
FIFO	Fly in fly out
GDP	Gross Domestic Product
GFC	Global financial crisis
GP	General Practitioner
GRP	Gross Regional Product
ha	Hectare
ICLEI	International Council for Local Environmental Initiatives
ISF	Institute for Sustainable Futures
JAMBA	Japan-Australia Migratory Bird Agreement
kl	Kilolitre
km	Kilometre
LGA	Local Government Area
MAR	Managed Aquifer Recharge
MBO	Monosifatic black ooze
ML	Megalitre
NAPLAN	National Assessment Program Literacy and Numeracy
NEPM	National Environment Protection Measures
NGO	Non-governmental organisation
pa	Per annum
PNP	Peron Naturaliste Partnership
NIEIR	National Institute of Economic and Industry Research
RDA	Regional Development Australia
RDC	Regional Development Commission
RRV	Ross River virus
SD	Statistical District
SEIFA	Socio-Economic Indexes of Areas
SoE	State of the Environment report
SoR	State of the Regions report
SPP	Statement of Planning Policy
UDP	Urban Development Program
WA	Western Australia
WACOSS	WA Council of Social Services
WAPC	WA Planning Commission

WHO	World Health Organisation
WSUD	Water sensitive urban design

Contents

Background and context

Geography and features

Mandurah sits within the Peel region, one of nine regions of Western Australia, and encompasses the five local government areas of Boddington, Murray, Serpentine-Jarrahdale and Waroona and the City of Mandurah (Peel Development Commission, 2012). Located 75 kilometres south of Perth, it is Western Australia's smallest region geographically, covering 5,648 square kilometres. Figure 1 provides geographical context, showing where Mandurah is located in relation to the rest of Western Australia.

Figure 1: Geographical context map of Mandurah

The City of Mandurah covers an area of 173.5 square kilometres and is situated approximately 75 kilometres south of Perth between the Indian Ocean and the Peel-Harvey Estuary (City of Mandurah, 2012b). Mandurah is within commuting distance of Perth, with the local government area (LGA) extending down a strip of the coastline south of Perth, from Madora and Lakeland in the north to the wetlands of Lake Clifton and the Yalgorup National Park in the south.

The Peel-Harvey Estuary has three tributaries – the Murray, Serpentine and Harvey Rivers, which between them contribute significant amounts of phosphorous and nitrogen to the catchment.

Development and growth within Mandurah has centered on its marine environments, particularly the Peel-Harvey Estuary and wetlands. The Peel-Harvey Estuary includes the Peel Inlet and the Harvey Estuary, the latter being an elongated body of water that runs north to south. The Harvey River flows into the southern end of the estuary and the northern end is open to both the (constructed) Dawesville channel and the Peel Inlet through the Grey Channel. The wetlands are of world significance and were listed under the Ramsar Convention in 1990.[4]

Mandurah is connected to the wider metropolitan area of Perth, and to the Bunbury area to the south via the Kwinana Freeway. A direct railway connection links Mandurah to the Perth central business district (CBD). Suburbs with Mandurah LGA include Barragup, Bouvard, Clifton, Dawesville, Erskine, Halls Head, Lakelands, Madora Bay, Meadow Springs, Parklands, San Remo, Silver Sands, Stake Hill and Wannanup.

Table 1: Contextual indicators - summary of Mandurah physical characteristics (Source: City of Mandurah, 2012a)

Physical characteristics	
Land area in square kilometres	173.5km
Land area in hectares	17,350ha
Coastline	50km
Population	73,605 (June 2011)
Number of Households	26,458 (2011 Census)
Population per square kilometre	424/sq km (June 2011)
Households per square kilometre	153/sq km (2011 Census)
Length of total roads	652km
Length of total canal waterways	22km approx.

Population summary

The City of Mandurah is one of the fastest growing LGAs in Western Australia (WA) and over the longer term is expected to become one of the fastest growing regional areas in Australia. Over a 30-year period from 1978 to 2007 Mandurah's growth averaged approximately 6.5% per annum, with its population increasing from 10,000 in 1978 to 61,000 by 2007 (City of Mandurah, 2009b).

The pace of population growth has slowed in recent years as a result of both the rapid increase in property prices in the area in the past five years and the recent economic downturn (City of Mandurah, 2009c). Nevertheless, Mandurah's population is forecast to continue growing by a further 2.04% per annum, reaching nearly 100,000 by 2021 and 120,000 by 2036.

Table 2: Context indicator – population (Source: ABS, 2012b)

	Mandurah 2001	**Mandurah 2011**	**Perth 2011**	**WA 2011**
Population (persons)	48,877	73,605	1,832,114	2,352,215
Rate of growth 2001-2011 pa		4.2%	2.4%	2.2%
Population density (people/km^2)	280.6	422.5	285.5	0.9

[4] The Ramsar Convention is an international treaty for the conservation and sustainable utilization of wetlands. See http://www.ramsar.org/.

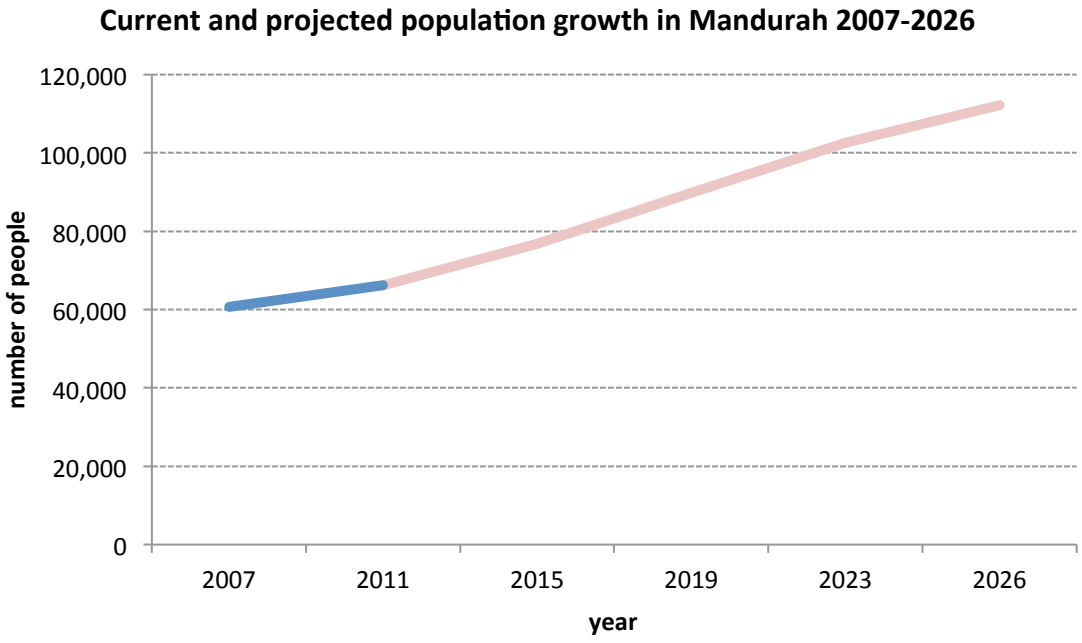

Figure 2: Current and projected growth in Mandurah (Source: WA Planning Commission, 2012b) (Note: population projections are shown in red.)

Social characteristics

Demographic changes in Mandurah

For much of the twentieth century Mandurah was a small coastal tourist town with a local fishing industry. Mandurah's local government was formed in 1949 when it seceded from the Murray Roads Board. Mandurah Shire Council was formed in 1961. It was replaced by the Town of Mandurah in 1987 and upgraded to city status in 1990.

The drivers for the recent growth in Mandurah include the development of mining and industrial projects in the Peel region (now the third-largest mining region in WA) and a 'sea-change' phenomenon of people moving to the area for a coastal, outer Perth lifestyle. This 'sea-change' movement has accelerated with the opening of the Kwinana Freeway extension, bringing the region to within an hour's car journey of Perth CBD. Mandurah also has a direct rail link to the Perth CBD. These transport links put Mandurah within commuting distance of both Perth CBD and Bunbury in the south-west of the state.

Mandurah is facing twin demographic challenges. While a quarter of its population is aged 15 years and under, Mandurah is also one of Western Australia's most rapidly ageing communities (City of Mandurah, 2009c). At the 1991 census Mandurah's median age was 35 years, in 2006 it was 43 years and in 2011 it was 42 years. One in five (20.3%) of Mandurah's residents is aged 65 years or older which is a much higher proportion than in Western Australia (12.3%) or Australia as a whole (14%). This older age group is also fast growing, and by 2021 is forecast to make up 30% of the population (WAPC, 2005). Older residents are more likely to be on fixed and lower incomes, making them more vulnerable to rising housing costs and other costs of living. This age group also has greater needs for health and age related support services.

Table 3: Context indicator - culture and migration (Source: ABS, 2012a)

	Mandurah 2001	Mandurah 2011	Perth 2011	WA 2011
% Born overseas	19.4%	25.4%	34.6%	30.6%
% Do not speak English well	0.2%	0.5%	2.5%	2.1%
Indigenous	1.7%	1.9%	1.6%	3.1%

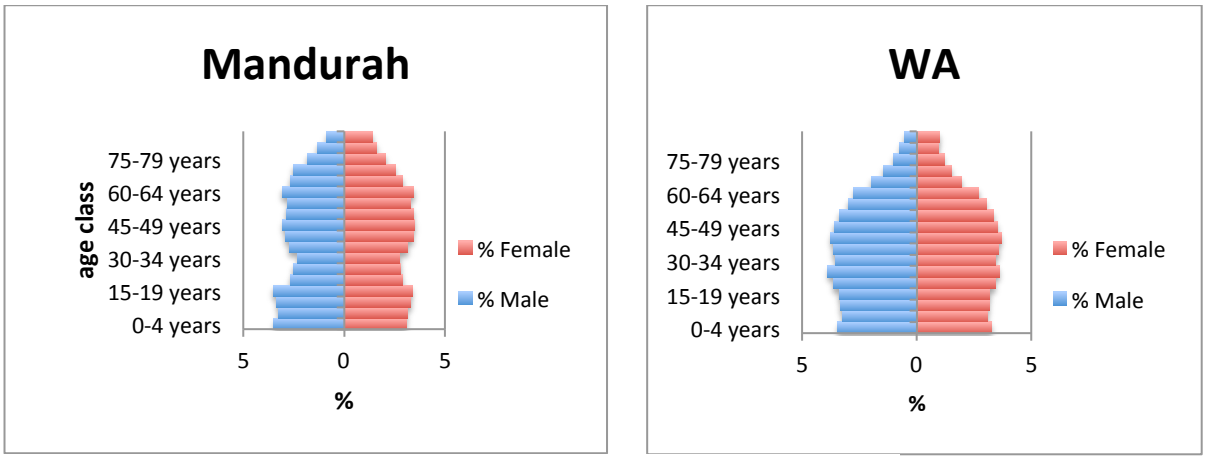

Figure 3: Age profile of Mandurah and WA (2011) (Source: ABS, 2012a)

Economic characteristics

The metric referred to as Employment Self Sufficiency[5] (ESS) for this sub-region is currently 71%, meaning that there are potentially local jobs available for 71% of the labour force living in that sub-region.

The Employment Self Containment rate (ESC) measures the percentage of residents of a local government area that actually works within that same area. The ESC rates for the local government areas in the Peel region at the 2006 ABS Census were: Mandurah 53%, Murray 39% and Serpentine Jarrahdale 25%. To increase these ESC levels to a 'more acceptable' 66% will require the creation of an additional 43,000 local jobs by 2031 (WA Planning Commission, 2009).

Planning and governance

Influence of the WA State Government

The state government sets the overall planning parameters for development through the State Planning Strategy (which sets a broad strategic direction for Western Australia), the Statement of Planning Policy (SPP) (which includes the State Planning Framework (SPP No.1) and key sectoral policies (SPP. Nos. 2-6), which further detail the broad themes set out in the State Planning Strategy (WAPC, 2010: 13).

[5] ESS measures the quantity of jobs available in a given area as a proportion of that area's labour force.

The Western Australian Government's Economic and Employment Lands strategy *Directions 2031 and Beyond* (WA Planning Commission, 2012a) is a regional-level strategy that provides the strategic and spatial framework for the metropolitan area of Perth and the sub-region of Peel. Sitting beneath this document are further metropolitan sub-strategies for Perth and the Peel sub-region, which include details of housing and employment targets, and plans for reaching these targets, including zoning of land as rural, urban or industrial. Sub-regional structure plans are informed by these sub-regional strategies and provide guidance for sub-regional planning in the short, medium and long term.

Directions 2031 and Beyond (WA Planning Commission, 2012a) identifies an ESS target of 80 per cent for the Peel sub-region[6], which is the equivalent of 36,000 to 56,000 additional jobs in this sub-region over the next 25 years (WA Planning Commission, 2012). The strategy also aims to achieve an increase in dwellings in the Peel sub-region from 38,000 in 2008 to 64,000 by 2031. *Directions 2031 and Beyond* identifies Mandurah as the primary strategic metropolitan centre for Peel, and as such it is expected to be the main focus for commercial activity within this sub-region into the future.

The state government's Urban Development Program sits alongside the metropolitan and sub-regional strategies and is a continuous program detailing new residential land and infrastructure requirements. This program will serve as a means of measuring and evaluating the delivery of the *Directions 2031* objectives.

Influence of Local Government

At the local level there are local planning strategies, schemes and local structure, precinct and activity centre plans. Subdivision-level planning is informed by these.[7]

An 'environmental scan' completed as part of council's four-year strategic planning process highlighted the following issues associated with population growth in the area (City of Mandurah, 2009b):

- high growth not accompanied by required levels of community infrastructure
- limitations on employment growth due to the lack of available industrial land
- potential impacts of climate change
- need for connected and planned transport infrastructure
- changing role of local government and higher levels of community expectation in regards to service delivery.

The WA State Government recently reviewed the *State Coastal Planning Policy* (SPP 2.6), and council is currently developing a Local Planning Policy (subject to council endorsement), which will complement the updated SPP 2.6 (City of Mandurah, 2012e).

How infrastructure is funded in new development areas

WA councils are not subject to state government-imposed 'rate pegging' as they are in some other states (such as NSW), and so are able to set their own rate revenue, although of course this is subject to normal political constraints as ratepayers continue to exert pressure on councillors to keep rates within tolerable limits.

The broad principles for developer contribution plans in WA are made at the state level through State Planning Policy 3.6 – *Development Contributions for Infrastructure* (2009) made under the *Planning and Development Act 2005* (WA) (State of Western Australia, 2009). Developer contributions to community infrastructure (such as sporting and recreational facilities, community centres, child care and after school centres) can be sought for a new item of infrastructure, land for infrastructure, an upgrade in the

[6] Defined by the WA Planning Commission as the City of Mandurah, and the Shires of Murray and Waroona
[7] See Council's planning Services webpage for more details: http://www.mandurah.wa.gov.au/planning.htm

standard of provision of an existing item of infrastructure or an extension or replacement of infrastructure at the end of its life.

Contributions are calculated by determining the cost of infrastructure required and the percentage of this infrastructure requirement that is a consequence of new development. The resulting dollar amount is then included in the Development Control Plan (DCP) for the new development.

Federal Government Regional Planning Initiative

Under the federal government's Regional Development Australia (RDA) initiative, which is a partnership between the three tiers of government, 55 RDA committees across the country have prepared regional plans. Mandurah is one of the three councils in the Peel Region RDA committee. The Peel Regional Plan 2011-2016 (RDA Peel, 2010) identifies five priority areas for the region:

1. **Industry diversification and workforce development** – including extending the industry base beyond mining and retail; and building capacity in the workforce for new directions such as science and technology
2. **Educational attainment** – increasing educational attainment as indicated by Australian Early Development Index (AEDI) testing, National Assessment Program Literacy and Numeracy (NAPLAN) testing and post-compulsory schooling educational attainment levels
3. **Caring for the environment** – the Plan notes that high population growth, development and low rainfall have had impacts on coastal wetland systems and that climate change and sea level rise may compound these environmental pressures
4. **Addressing social issues** – referring to the range of social issues identified in the report Peel Away the Mask (Mayes, 2012)
5. **Infrastructure development and coordination** – the Plan notes that infrastructure has 'failed to keep up' with consistently high population growth in the area (RDA Peel, 2010: 4), and proposes to develop an investment plan outlining a range of priority infrastructure projects for the area, in order to deliver a more coordinated approach to infrastructure planning and funding.

Regional Development Australia has now produced Peel 2032, a draft strategic plan for the Peel region 'to overcome its challenges and achieve economic, social and environmental sustainability by 2032' *(RDA Peel, 2011)*. This will replace *The Peel Regional Plan 2011-2016.*

Peel 2032 states that priorities for the region focus on three key themes:

- Productivity – The need to produce more output with proportionately fewer workers, which is key to achieving increased living standards;
- Sustainability – Conserving our biodiversity and heritage, and protecting our natural and built environments; and
- Liveability – Ensuring communities are connected and provide a high quality of life, including easy access to employment and services.

The plan also notes that *'it is important to recognise that each of these themes is inextricably linked to the others'.*

Environmental, social and economic indicators

Summary

The first component of the case study research was investigating themes and indicators presented in the indicator framework. Each theme and group of indicators is explored here using the indicators as headings and they are discussed across each of the three sustainability domains (environmental, social and economic). Each domain draws on different data sources at the local level, the availability of which varies across the indicators. The analysis presented shows that population growth is impacting on all three sustainability domains in a range of ways.

In the environmental domain, environmental quality, particularly with regard to water quality and vulnerable and endangered species, is being impacted by land use changes. There is no locally generated air quality data and CO_2 emissions are reported to be lower than the state average. The impacts of climate change are seen to be of local significance for development and ecosystem protection. There appears to be a trend toward reduced water use per household, however total water consumption has increased since 2002 as a direct result of population growth. Wastewater treatment is nearing capacity.

The social indicators show that Mandurah has some significant issues related to social disadvantage and has a great deal of diversity in its socio-economic structure. The area demonstrates lower tertiary educational attainment than Perth or the WA average although it has seen some recent rises in vocational education. Employment levels are lower than the WA average and social security take-up has risen in the past five years. Rental stress affects almost a third of Mandurah's private renters, more than the state average, and mortgage stress is also slightly higher than the state average at 9.1%.

Health remains a concern. Compared to the Perth and WA averages, the population of Mandurah has a higher proportion of people rating their own health as poor to fair, and a higher proportion of people who are overweight or obese. Mandurah has recorded higher crime rates than the South West average with the exception of illicit drug offence rates. The city's crime rates have been increasing over the period for offences against the person and, until 2007-08, for crimes related to property damage.

On measures of wealth, Mandurah has undergone rapid recent change. Disposable income grew by a total of 49% in the period from 2006 to 2011, or an average of 7.6% annually, which is far greater than the national average. However the Socio-Economic Indexes for Areas (SEIFA) score reveals that there are pockets of high disadvantage, and unemployment remains several per cent higher than WA and regional averages, and participation rates in Mandurah are lower.

Environmental indicators

Climate and atmosphere

The Department of Environment and Conservation (DEC) considers Mandurah as a separate region for the purposes of the Ambient Air Quality National Environment Protection Measures (NEPM) and is committed to installing a monitoring station in the area, but as of July 2012 there was no monitoring station in Mandurah, and therefore there is no publicly available data regarding air quality in the city (DEC, 2012). However a media release by the City of Mandurah (2009a) comments on the contribution of wood heaters to reduced air quality in the city. It is possible that this problem is worsening with population growth as the number of dwellings (and therefore potentially the number of wood heaters) increases.

Mandurah Council has been a member of the International Council for Local Environmental Initiatives (ICLEI) Local Governments for Sustainability Cities for Climate Protection (CPP) Program for over ten years. Council has a climate change strategy, with emissions reduction targets, and has developed a *Coastal Zone Climate Change Risk Assessment and Adaptation Action Plan* and a *Climate Change Response Plan*.

Council prepared the *Coastal Zone Climate Change Risk Assessment and Adaptation Plan* in 2009 with financial assistance from the Commonwealth Government. The plan highlighted the highest priority risks for Mandurah on both a strategic and site-specific level. The strategic issues for the coastal zone in Mandurah include the uncertainty in long-term land use planning and infrastructure design, and the impacts on infrastructure (public and privately owned) from coastal erosion and inundation. Specific sites classified as being at extreme risk from climate change impacts were the coastal zones of Halls Head Beach and Falcon Beach (CZM, 2009).

Through the Cities for Climate Protection Program (CCP), the City of Mandurah City has encouraged the Mandurah community to reduce its greenhouse gas emissions from waste, transport and energy use through a wide variety of projects that are estimated to have saved more than 128,000 tonnes of CO_2 from entering the atmosphere since 1999 (City of Mandurah, 2012f). According to Mandurah Council's 2011 State of the Environment report (SoE), Mandurah's CO_2 emissions per capita are lower than both the state and national averages (see Figure 4).

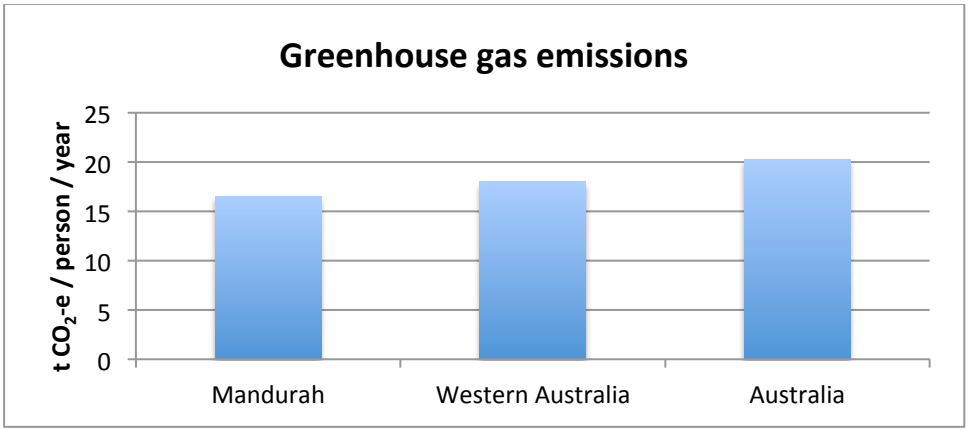

Figure 4: Natural capital - climate and atmosphere (Source: City of Mandurah, 2012g)

Table 4: Natural capital - climate and atmosphere (Source: City of Mandurah, 2012f & 2012g)

	Mandurah	Western Australia	Australia
Tonnes CO_2 saved from entering the atmosphere since 1999	estimated >128,000		
Tonnes CO_2-e per person per year	16.5	18	20.3

Ecosystems and biodiversity

Mandurah is located in the Peel-Harvey Estuary and immediately north of the Peel-Yalgorup Ramsar site. The Peel-Yalgorup System is made up of the Peel Inlet, Harvey Estuary and the Yalgorup Lakes, with Lake Clifton listed under the *Convention on Wetlands of International Importance especially as Waterfowl Habitat 1975* (Ramsar Treaty) (DCLM, 2004).

The Peel-Yalgorup Ramsar site includes the largest and most diverse estuarine complex in south-western Australia and is home to tens of thousands of waterbirds, including large numbers of migrant shorebirds from the northern hemisphere, which use the estuary and lakes each year. A total of 35 bird species in the estuary are listed under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA) and are specially protected by the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Within the site there is also a particularly unusual occurrence of thrombolites[8], a primitive life form that grows in waterways and resembles 'living rocks' (described in more detail below).

These qualities make the estuary and foreshore areas particularly valuable from an environmental perspective, yet many of these areas are facing increasing pressures from the effects of residential development associated with population growth. Loss of other foreshore vegetation, such as salt marshes, is associated with the development of foreshore areas for canal estates, private foreshores and public recreation areas (Peel-Harvey Catchment Council, 2011). The Environmental Protection Agency (EPA) has released the *Swan Bio Plan* which maps areas with significant vegetation, but this is not a statutory plan.

Development and land use change often create significant environmental impacts, and this is true in Mandurah where the natural environment has been significantly modified to support population growth and development. As described by Elrick et al. (2008) these environmental changes include:

- large-scale clearing of vegetation – originally for agriculture, timber and mining industries, and in more recent years, for urban development
- engineering works to alter the natural hydrology – reducing water levels with an extensive network of drains, construction of dams, diversion of rivers and streams, dredging of sandbars and modification of river mouths
- construction of the Dawesville Channel to alleviate eutrophication[9] within the estuary
- construction of canal estates – including North Port and Port Mandurah, among others.

In 1994 the Peel-Harvey Estuary was opened up to the Indian Ocean through the construction of the Dawesville Channel. The reasoning for the construction of the channel was to address the intense eutrophication of the estuary (and resulting complaints of residents), caused by excessive discharge of nutrients through the river systems and the compounding effect of a lack of summer rainfall (Hale and Butcher, 2007). While the opening of the channel has alleviated symptoms of eutrophication, there have been resulting complications. In addition, there is still evidence that high levels of nutrients continue to be delivered to the estuary (Hale and Butcher, 2007). Water quality is discussed further below.

One complication arising from the opening of the Dawesville Channel has been higher and more frequent tides within the estuary. This has led to significant changes in the estuarine ecology, and particularly the littoral vegetation, including a loss of freshwater paperbarks on the lower Harvey River and a decline in swamp sheoaks (*Casuarina obesa*) at the river mouth (1994-1998) (Peel-Harvey Catchment Council, 2011). Further bank erosion, and loss of fringing vegetation, is caused by larger recreational watercraft, which can now access the estuary through the channel.

Unfortunately there are no long-term data sets on bird populations in the area that might provide information about any change in waterbird numbers as a result of the changes to habitat in the area. Research has been undertaken to investigate possible changes in bird numbers in the past two decades as a result of habitat loss, however the results are inconclusive (Peel-Harvey Catchment Council, 2011).

[8] See footnote 3.

[9] The term 'eutrophic' means well-nourished; thus, 'eutrophication' refers to natural or artificial addition of nutrients to bodies of water and to the effects of the added nutrients. When the effects are undesirable, eutrophication may be considered a form of pollution.

Mandurah is part of the South-West biodiversity 'hotspot' – one of 25 internationally identified areas of unique endemic biodiversity in which significant habitat has been lost, and this is the only one in Australia (DSEWPaC 2009).

Lake Clifton supports a thrombolite community which is the largest known example of living non-marine microbialites[10] in the southern hemisphere (CALM, nd). The thrombolite community of Lake Clifton was initially assessed as 'Endangered' in 1996 (DCLM, 2004: 3). Due to the increase in nutrient concentrations it was then reassessed on the 18 February 2000 as 'Critically Endangered'. It currently meets the criteria for Critically Endangered, namely *'*a highly restricted distribution with very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes which are likely to result in total destruction throughout its range in the immediate future' (DCLM, 2004: 3). It is reported that the growth of the community is probably dependent upon the microbes having a continuing supply of fresh water rich in calcium, bicarbonate and carbonate.[11] The source of the calcium in the waters of Lake Clifton is probably groundwater that has passed through sand dunes that surround the lake (DCLM, 2004: 3).

In addition to the thrombolite community, Mandurah contains 11 threatened animals, two rare plants, 12 priority-listed plants, five priority-listed animals and one priority-listed ecological community (DEC, 2006 cited in City of Mandurah, 2012g). The area also has 47 migratory species (DSEWPaC, 2012). For example, the following animals in Mandurah are listed as Endangered under the EPBC Act: Australasian Bittern *(Botaurus poiciloptilus*), Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris),* the Southern Giant-Petrel (*Macronectes giganteus*), the Graceful Sun Moth *(Synemon gratiosa),* the Woylie *(Bettongia penicillata ogilbyi*), the Red-tailed Phascogale *(Phascogale calura).* There are many more endangered marine and migratory marine animals as well as plants (DSEWPaC, 20120).

Table 5: Natural capital - ecosystems & biodiversity (Source: DEC, 2006 *in* City of Mandurah, 2012g)

	Mandurah
Number of threatened animals	11
Number of threatened ecological communities	1
Number of rare plants	2
Number of priority-listed plants	12
Number of priority-listed animals	5
Number of priority-listed ecological communities	1

Community concern about iconic species is reflected in local media, with headlines from earlier this year stating *'Black cockies extinct in 50 years'* (Mandurah Coastal Times, 2012).

Serious concerns about the broader impact of population growth on the estuarine[12] and coastal environments remain. The major finding of the Peel Economic Development and Recreation Management Plan for the Peel Waterways is that:

> without corrective action, the Peel Waterways will not be able to sustain the increased recreational demands of expected population growth. Under such stress, the environment will decline further unless resources are found for action in the catchment to improve water quality throughout the system, and affirmative action to restore the environment and habitats of the

[10] A sedimentary body formed on the bed of a lake from the remains of benthic (bottom dwelling) communities of algae and cyanobacteria.
[11] These microbes include cyanobacteria dominated by Scytonema, and other photosynthetic bacteria that depend on light for growth and survival.
[12] An estuary is a 'semienclosed and coastal body of water, with free communication to the ocean, and within which ocean water is diluted by freshwater derived from land' (Valle-Levinson, 2010).

rivers, particularly the Murray and Serpentine (Everall Consulting Biologist, 2002: viii).

Water

According to the Peel-Harvey Catchment Council (2011), the prominent issue for the estuary has been nutrient management and the reduction of nutrients entering the estuary. The soils in the catchment are nutrient deficient and have been artificially drained to move water off the land quickly and allow development. Results from water quality monitoring over the past two decades indicate that nutrient loads are still excessively high and beyond what the estuary can sustainably tolerate. Priorities for catchment management, in regards to population growth in particular, are for new residential developments to maintain pre-development hydrology, adopt water sensitive urban design (WSUD) best practices, connect to deep sewerage or zero discharge systems and adapt certain low or no fertiliser practices (Peel-Harvey Catchment Council, 2011: 21).

Water consumption per household has declined over the last seven years from an average of 372 kL per household in 2000-01 to 270 kL per household in 2005-06. This represents a reduction of 27.4%. However, since 2005 there has been a slightly increasing trend (City of Mandurah, 2012g). Interestingly, most probably due to more stringent water restrictions, the total water consumption in the LGA decreased from 8,000ML in 2001 to around 6,290ML in 2002 (a 21.4% reduction) despite population growth which saw an increase in the number of properties to which water is supplied. However, despite a drop in total water consumption for the area between 2001 and 2002, water consumption has increased since 2002 as a direct result of population growth, and is now well above 2000-2001 levels (see Figure 5).

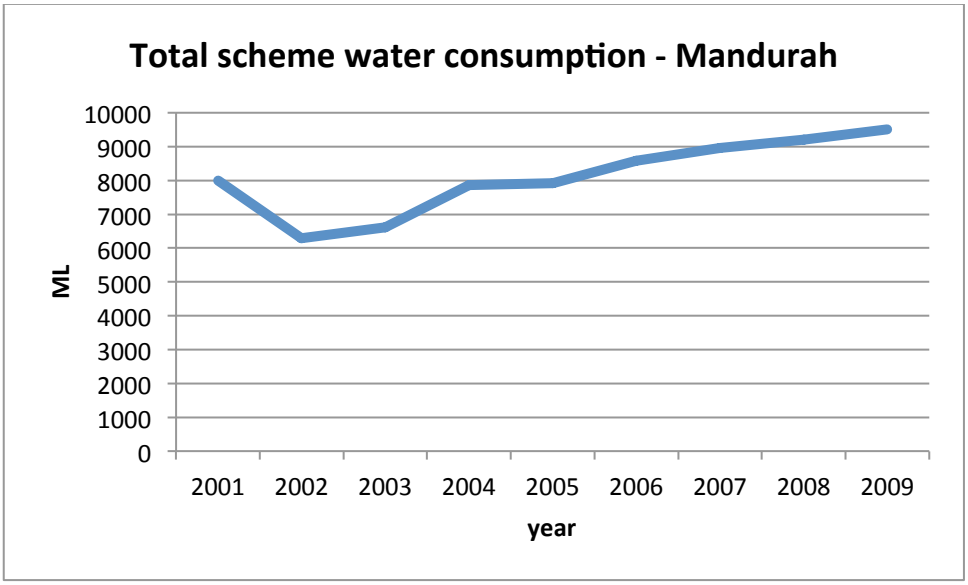

Figure 5: Natural capital – water (Source: City of Mandurah, 2012g)

Table 6: Natural capital – water (Source: Xamon, 2010; City of Mandurah, 2012g)

	Mandurah
Water consumption per household	270kL/person (2008-09) 27.4% decrease from 2000-01
Total scheme water consumption	9,510ML (2009) 51.2% increase from 2002

The greater Mandurah wastewater catchment currently comprises treatment plants at Gordon Rd, Halls Head, Caddadup and Pinjarra. It is reported that there will be a need for an increase in treatment and conveyancing capacity due to forecast population growth and also current maximum operating capacities nearing their threshold (WAPC, 2012).[13] The Water Corporation is currently reviewing wastewater planning for the greater Mandurah catchment.

Land

The Department of Planning undertakes the Developers' Intentions Survey on behalf of the Western Australian Planning Commission as part of the Urban Development Program (UDP). The UDP monitors urban land supply and demand and coordinates the actions required of state and local government agencies for the efficient planning and provision of physical and social infrastructure for new development. The results of the 2009 survey indicate that developers intend to continue to develop significantly with the Mandurah and Murray LGAs. Dwelling yield for the period from 2009-10 up to 2020 and beyond is set for 20,256 dwellings (Department of Planning, 2010). This is nearly the same number of dwellings as the whole of Mandurah, as of the 2011 Census.

There are over 5,000 hectares of land in Mandurah designated as parks, reserves, recreational facilities and other green spaces (City of Mandurah, 2011) (see Table 7 for a breakdown of different land types). However as a result of population growth the amount of open space per capita has declined from 802m^2 in 2006 to 676 m^2 in 2010.

Table 7: Natural capital – land (Source: City of Mandurah, 2011)

	Mandurah
Open space per capita (m^2)	676 m^2 person (2010) (15.7% decrease from 2005)
Extent of protected areas[14]	23.1%
Conservation area (City of Mandurah)	46.59 ha
Conservation area (other agencies)	3,956.58 ha
Foreshore area (developed)	78 ha
Foreshore area (natural state)	497.64 ha
Recreation (bushland)	447.93 ha
Recreation (used for recreation)	309.5 ha
Total areas of conservation, foreshore and recreation land	5,336.24 ha

Waste

The volume of kerbside refuse far exceeds the volume of material recycled. Kerbside collection of recyclables per capita in Mandurah increased for 2004/05, peaking in 2007/08 and has since declined, whereas kerbside collection of waste generated per capita has been on a slight decrease since 2006/07.

[13] Western Australian Planning Commission April (2012) Economic and Employment Lands Strategy: non-heavy industrial Perth metropolitan and Peel regions. Part 12 – Peel sub-region.

[14] Calculated by ISF - sum of hectares of conservation areas as a proportion of total land area in hectares

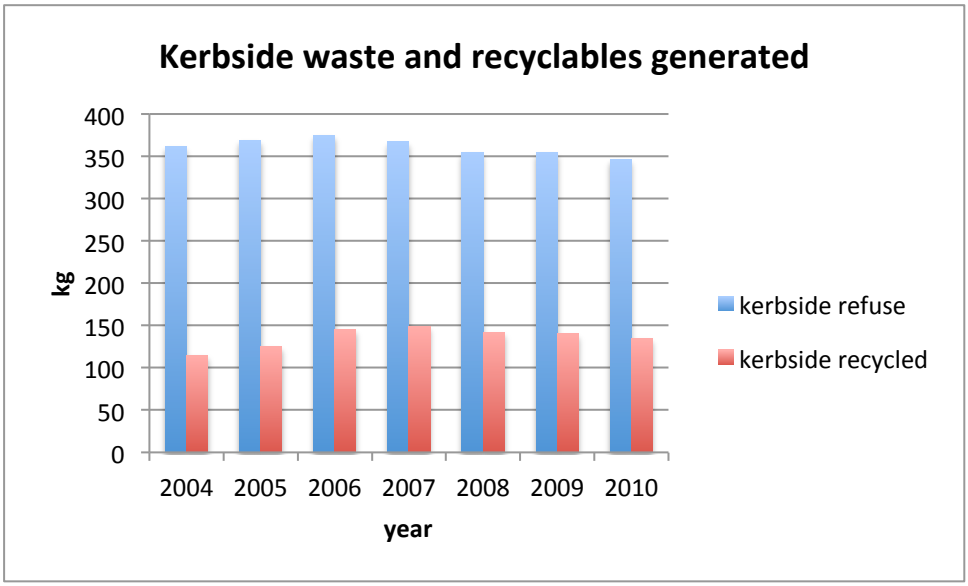

Figure 6: Natural capital – waste (Source: City of Mandurah, 2012g)

Social indicators

Skills and education

There are a number of ways to assess educational attainment of populations. Common measures are the proportion of the adult population that has a bachelor's degree or higher, and the proportion that has a certificate or diploma qualification. On one of these measures (bachelor's degree or higher) Mandurah has a significantly lower level of educational attainment than Greater Perth or WA, and on the other measure (certificate and diploma qualifications) the area has a higher level of educational attainment than Greater Perth or WA, suggesting that educational attainment in the area is skewed towards trade and vocational training rather than university qualifications. These results are shown in Figure 7 and Figure 8.

In the period from 2001 to 2006 the number of adults in Mandurah with university qualifications increased by 44.3%, however the *proportion* of adults with university qualifications increased by only 0.5 percentage points from 2.5% in 2001 to 3.0% in 2006.[15] This compares to a higher increase in the wider population, with university attainment increasing across Greater Perth by 1.0% from 6.4% in 2001 to 7.4% in 2006, and across WA from 5.8% in 2001 to 6.7% in 2006. These figures show that increases in university-level qualifications have been slower in Mandurah than in Perth or WA as a whole, and that the level of attainment in Mandurah is still less than half that of Perth or WA.

In contrast, the proportion of Mandurah residents with certificate or diploma qualifications increased more rapidly than in the wider population, from 15.2% of the adult population in 2002 to 16.3% in 2006. This is an increase of 1.06 percentage points in Mandurah in comparison to an increase of only 0.02 percentage points for Greater Perth. In Greater Perth 14.1% of adults have attained these qualifications and across WA as a whole 15.2% have done so. These figures show that while increases in the proportion of adults who have certificate or diploma qualifications have been faster in Mandurah than in Perth or WA as a whole, the level of attainment in Mandurah is only slightly higher than that of Perth or WA.

[15] 2011 census figures will show if this is a continuing trend.

It is apparent, when comparing percentages of Mandurah and WA residents who have tertiary qualifications, that the degree to which Mandurah lags behind in bachelor's degree or higher qualifications is greater than the degree to which it out-performs the rest of WA in certificate and diploma qualifications. There are a number of reasons why bachelor's degree qualifications have remained low while certificates and diplomas have increased relatively rapidly. These include low levels of high school educational attainment precluding graduates from certain courses, and distance of Mandurah from universities (especially prior to the train link to Perth). However, the establishment of the Peel Campus of Murdoch University will potentially decrease the differences in educational attainment. While the reasons for the increase in certificate and diploma qualifications are not clear from this analysis, they could be linked to the growth in hospitality, retail and mining-related employment in the region.

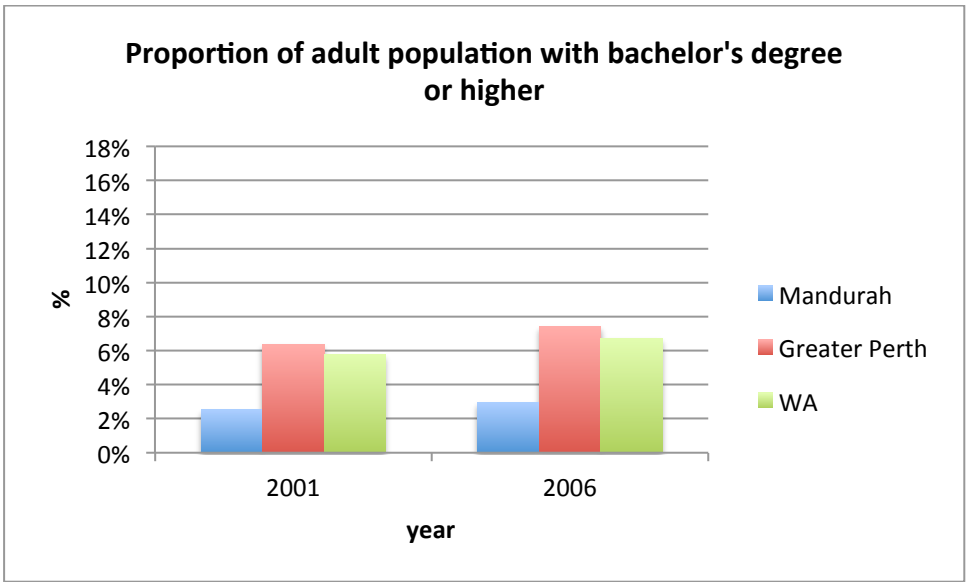

Figure 7: Comparison of adult population with bachelor's degree or higher qualifications (Source: ABS, 2012b)

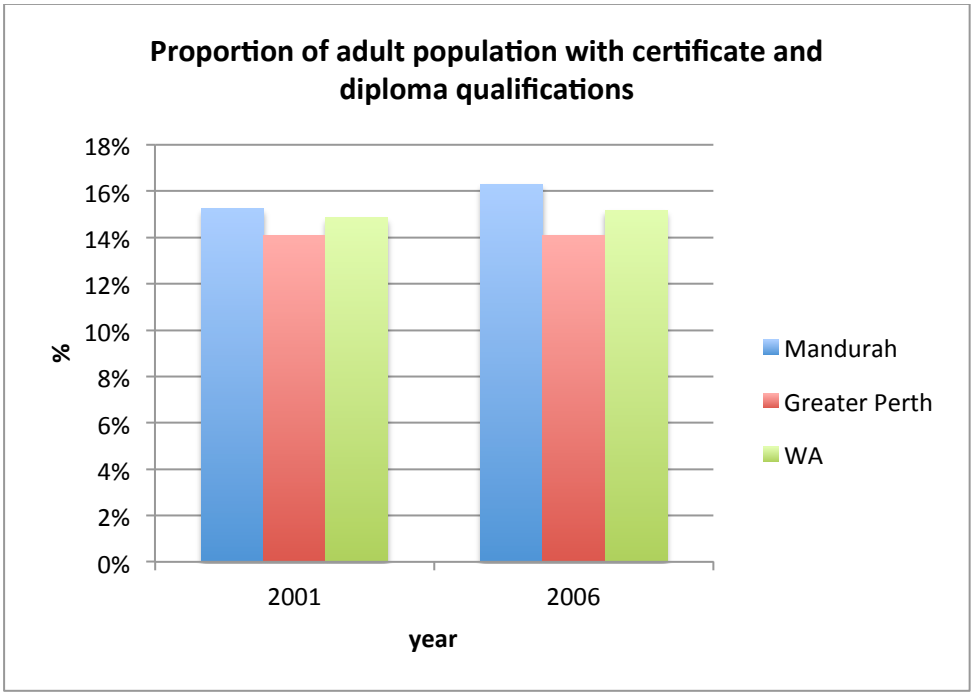

Figure 8: Comparison of adult population with certificate and diploma qualifications (Source: ABS, 2012b. Includes Certificate I-IV, Diploma and Advanced Diploma))

Health and socio-economic disadvantage

As research on the social determinants of health has shown, health outcomes are closely related to socio-economic status (World Health Organisation, 2012). Socio-Economic Indexes for Areas (SEIFA)[16] Index of Relative Socio-Economic Disadvantage (IRSD) scores suggest that Mandurah has areas of relative socio-economic disadvantage. They also show that there is some variability within the LGA, with a minimum census collection district (CD) score of 734 and a maximum of 1184.[17] Mandurah was ranked as the 69th-most disadvantaged LGA in WA in 2006.

Table 8: Social and human capital – disadvantage (Source: ABS, 2008)

	Mandurah	Greater Perth	WA
SEIFA IRSD score	991	1029	1007
Minimum score of CDs	734	537	222
Maximum score of CDs	1184	1199	1199
Rank in WA	69 (of 142 LGAs)		
Rank in Australia	419 (of 667 LGAs		

While available data sources report health information at the whole-of-LGA level only, it is likely that the health status of the population in Mandurah also contains levels of variability similar to those evidenced by the SEIFA scores discussed above. At the LGA level, significant findings include the fact that Mandurah has a higher proportion of the population with a self-reported health status of fair or poor health (14.4% in comparison with 9.9% in WA). Mandurah also has a slightly higher proportion of the population who are daily smokers (16.2% in comparison with 15.3% of WA) as well as higher rates of psychological distress[18] (8.0% compared to 7.5% for WA), while the proportion of overweight or obese persons is more than 5% greater than the WA levels (see Figure 9). It is likely that aggregation to the LGA level is concealing higher concentrations of poor health status in specific areas of Mandurah.

Table 9: Social and human capital – health (Source: PHIDU, 2010)

	Mandurah 2007	Greater Perth 2007	Western Australia 2007
Proportion reporting fair to poor health	14.4%	9.3%	9.9%
Proportion of population that are daily smokers	16.2%	14.2%	15.3%
Proportion of population that are overweight or obese	40.5%	33.2%	34.8%
Proportion of population experiencing psychological distress	8.0%	7.4%	7.5%

[16] Socio-Economic Indexes for Areas (SEIFA) is a product developed especially for those interested in the assessment of the welfare of Australian communities. The ABS has developed four indexes to allow ranking of regions/areas, providing a method of determining the level of social and economic wellbeing in each region.

[17] Relatively advantaged areas (e.g. areas with many high income earners) have high index values.

[18] Percentages are of people experiencing high or very high levels of psychological distress as measured on the Kessler 10 scale.

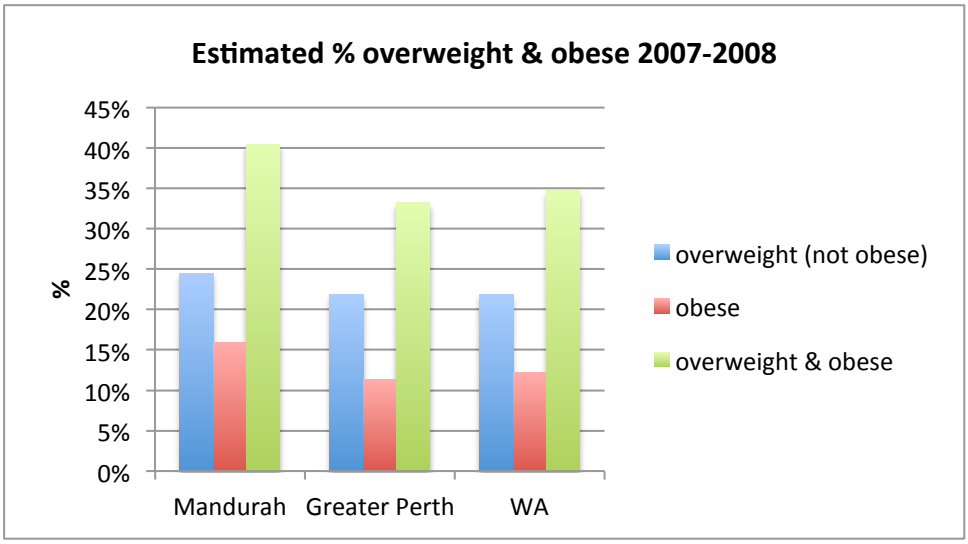

Figure 9: Comparison of estimated % overweight and obese (2007-08) (Source: PHIDU, 2010)

A regional health issue specific to Mandurah is the mosquito-borne diseases Ross River virus (RRV) and Barmah Forest virus (BFV). The Department of Health (WA) (2012) suggests that in southern WA the area of greatest risk for disease is the coastal plain between Mandurah and Busselton during spring and summer, and especially people living within 3-5 kilometres of saltmarshes, estuaries, tidal rivers and freshwater wetlands (WA Department of Health, 2012). Mandurah Council is involved in a Peel Mosquito Management Group – a regional and state partnership also supported by the University of Western Australia (City of Mandurah, 2012i). However time series data of infection rates in the region was not located in this review.

Employment and unemployment

According to the latest figures from the Small Area Labour Markets Survey, the unemployment rate in Mandurah in March 2012 was 6.4% with a participation rate of 64% for Lower Western WA (DEEWR, 2012b). As shown in the table below, unemployment in Mandurah is consistently higher than in Perth or WA as a whole.

Table 10: Social and human capital – employment (Source: NIEIR, 2012; DEEWR, 2012a & 2012b) (Note: * data is from the National Institute of Economic and Industry Research (NIEIR) State of the Regions report for WA Peel South West region, which comprises two WA planning regions on the coast south of Perth, incorporating the major centres of Mandurah, Manjimup and Bunbury; ** data is from DEEWR for Lower Western WA, which comprises the major centres of Mandurah, Margaret River and Albany).

	Mandurah	Greater Perth	Western Australia
Unemployment rate**	5.1% (August 2012)	3.5% (August 2012)	3.9% (August 2012)
Participation rate**	63.0% (August 2012)	69.3% (August 2012)	68.7% (August 2012)
	Peel South West	**Perth Central**	
Hours worked per week*	34.9 hours (2011) 1.7% change from 2007	25.5 hours (2011) 0.2% change from 2007	
Social security take-up*	10.7% (2011) 3.8% change from 2007	7.5% (2011) -0.4% change from 2007	

This is an improvement on unemployment levels experienced in Mandurah in the 1990s, when they were close to 20%. This rapid improvement is largely the result of the WA mining boom (Peel region is WA third largest mining region) and the related housing boom, and a 'sea-change' movement that has seen retired people move to Mandurah for the seaside lifestyle (City of Mandurah, 2012h). Both of these trends have increased employment in construction, mining, retail and service occupations in the area. At the 2006 ABS Census the construction industry employed 13.6% of the workforce (2001 - 10.2%), manufacturing 13.5% (2001 - 14.3%), retail 12.4% (2001 - 17.3%) and health care and social assistance 8.4% (2001 - 8.1%). Mining accounted for 5.2% of the workforce (2001 - 5.7%) and the rental, hiring and real estate services sector 2.4% (2001 - 7.5%) (ABS, 2002 & 2007).

This type of industry mix is vulnerable to a downturn in economic activity – and was listed as such in the University of Newcastle's Employment Vulnerability Index (Baum & Mitchell, 2009). Baum and Mitchell identified those areas vulnerable to job losses in an economic downturn, and developed an index to rank suburbs' levels of vulnerability. In Mandurah, 11 out 17 populated suburbs were listed in the highest vulnerability category (the 'red alert' category).

As shown in Table 11 there is little variability in the unemployment rate across the larger Mandurah/Murray region (see Figure 10 for a map of the region). Mandurah, where much of the population growth, medium density dwellings and new greenfield residential sites are located, has a slightly higher rate of unemployment than the less populous Murray area.

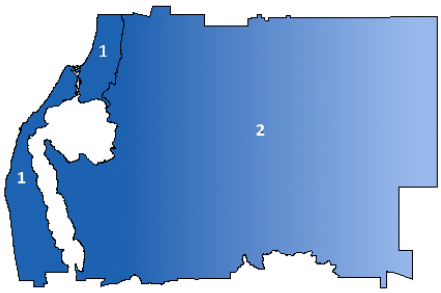

Figure 10: Map of Mandurah/Murray region
(Note: 1 - Mandurah; 2 - Murray)

Table 11: Social and human capital - employment (Source: DEEWR, 2012a)

	Unemployment rate March 2011	Unemployment rate March 2012
Mandurah	7.0%	6.4%
Murray	6.2%	6.0%

Security and crime

Long-term trend analysis tables published by the Office of Crime Prevention (2010) show annual crime rates per 1,000 persons since 2000-01 (until 2009/10) for Mandurah.[19] Regional and state crime rates are provided for comparison. This analysis reveals that Mandurah has recorded higher crime rates than the South West Statistical District (SD) over the last ten years for the selected offences (with the exception of illicit drug offences). The city's crime rates have been increasing over the period for offences against the person and, until 2007-08, also for property damage (Office of Crime Prevention, 2010). Residential burglary, non-residential burglary and other theft rates have been decreasing in line

[19] using Western Australia Police Monthly Recorded Crime and ABS Estimated Resident Population data

with state-wide trends. While illicit drug offence rates had been at South West SD and state levels at the beginning of the period, they have been consistently below those levels since 2003-04 (Office of Crime Prevention, 2010). See **Table 12** below for details.

Table 12: Social and human capital - security (Source: Office of Crime Prevention, 2010)

	Mandurah	South West	WA
Offence rate per 1000 persons	104.6 (2009-10)	91.3 (2009-10)	105.6 (2009-10)
Percentage change in offence rates	-12.5% from 2008-09	-11.0% from 2008-09	-15.1% from 2008-09

Despite these falls in crime rates, reporting of crime continues to highlight concerns for the Mandurah region, with headlines in local media such as '*Crime rates on the rise in Mandurah*' and reporting such as: '*[In] Mandurah suburbs, there were 105 more burglaries in 2010 than in 2009, while assaults increased by 126'* (Freemantle in my Community, 2011).

Economic indicators

Wealth and housing affordability

Standard of living is usually measured by disposable household income, adjusted for household size and controlling for housing costs. In the period between 2001 and 2007 household disposable income across Australia grew on average by 3.1% a year, accelerated to 6.5% per year during the global financial crisis (2008-2009) and in the years since has dropped back to 1.6% (NIEIR, 2012). In Mandurah disposable income grew by a total of 49% in the period from 2006 to 2011 or an average of 7.6% annually, which is greater than the national average (NIEIR, 2011).

The NIEIR (2011) report calculates household wealth as the value of dwellings owned by residents of an LGA plus holdings in financial assets less the stock of household liabilities. As the table below shows, household wealth has increased over the last decade, with most of this increase attributable to increased property values and possibly higher incomes associated with fly-in fly-out (FIFO) workers. Household debt service ratios and the ratio of debt to income have increased. The average house price in Mandurah in 2011 was $380,000, although there is variability between suburbs with averages of $730,000 in Barragup and $280,000 in Coodanup.

'Rental stress' and 'mortgage stress' are measures that identify those households in the bottom 40% of income distribution (with less than 80% of median income) that are spending more than 30% of income on mortgage or rent. Australians for Affordable Housing have said that 'Mandurah has the highest proportion of people in the rental market in housing stress' (42%) (Toohey *in* Schlesinger, 2011). Mandurah has also been referred to as a WA 'bankruptcy hotspot', with 'people on below average incomes struggling to meet their financial obligations'. According to figures from the Insolvency and Trustee Service Australia, the postcode covering Mandurah had the highest number of people in WA declared bankrupt with 98 unable to cover their debts and another 27 having to make a debt obligation repayment agreement in the 2010-11 financial year (Wright, 2012).

As shown in Figure 11 below, 9.10% of mortgaged owner-occupiers and 31.20% of private renters can be classified as being in mortgage or rental stress. These rates were above the Greater Perth and WA levels.

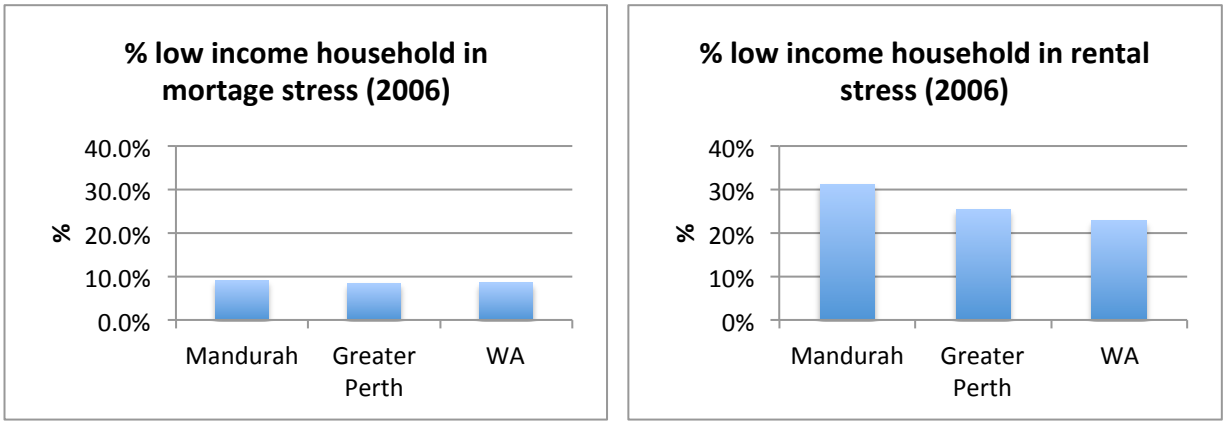

Figure 11: Comparison of % low income households in mortgage and rental stress (2006) Sourch: PHIDU 2010,

Table 13: Economic capital - wealth and housing affordability (Source: NIEIR, 2012) (Note: *represents growth in chain volume measures using ABS methodology)

	WA Peel South West Region 2001	WA Peel South West Region 2011
Wealth per household*	$296,000	$540,000
Household debt service ratio	13%	19%
Household debt to gross income ratio	1.05	1.49
Average dwelling price	$160,200	$355,900
Average dwelling price to household disposable income	2.0	3.2

Transport and infrastructure

The Department of Transport (formerly the Department of Planning and Infrastructure) developed a *Living Smart Households*[20] demonstration project for 15,000 households from the cities of Mandurah and Joondalup between April 2008 and May 2009. Surveys were undertaken in 2007 (before the railway from Perth to Mandurah was completed), 2008 (after completion of the railway), and 2010 (after the Living Smart program). Research results indicate that after the opening of the Mandurah rail service the number of trips by car dropped by 1.1%, with walking increasing by 8.4%, cycling by 4.9% and public transport use by 59.9%. Public transport usage increased a further 31.4% after the completion of the *Living Smart* program. However, while walking, cycling and public transport use increased, the major transport mode of choice for survey participants was still car travel (either as driver or passenger) (83%).

[20] The Living Smart Households programs was initiated to increase awareness of sustainability issues, whilst creating positive changes in the communities' environmental behaviour. One aspect of the project was research into travel methods, using a random sample of participants. See http://www.transport.wa.gov.au/activetransport/24651.asp for more information.

Table 14 Change in trips per person per year in Mandurah after railway and with Living Smart (Source: table adapted from WA Department of Transport, 2012: 9)

	2007 before rail	2008 after rail	Relative change before/after railway	2010 after LivingSmart		Relative change with rail / with rail and LivingSmart
Modes	**Trips/pn/pa**	**Trips/pn/pa**	**Change %**	**Trips/pn/pa**	**% of total**	**Change %**
Walk	76	82	8.4%	97	10%	18.3%
Cycle	23	24	4.9%	25	3%	4.2%
Motorcycle	6	8	34.0%	4	0.4%	-50.0%
Car driver	608	601	-1.1%	570	57%	-5.2%
Car passenger	261	245	-6.0%	251	25%	2.4%
All public transport	22	35	59.9%	46	3%	31.4%
Total	995	995		993		

Access to broadband Internet connection is a common measure of communications infrastructure. In Australia as a whole, the uptake of broadband services increased rapidly between the 2006 and 2011 census periods. In 2001, 36.0% of Mandurah residents had access to a broadband Internet connection; this had increased to 66.9% in 2011. This rate of uptake is below the pattern for Greater Perth (73.4% in 2011) and the whole of WA (71.4% in 2011) as shown in Figure 12.

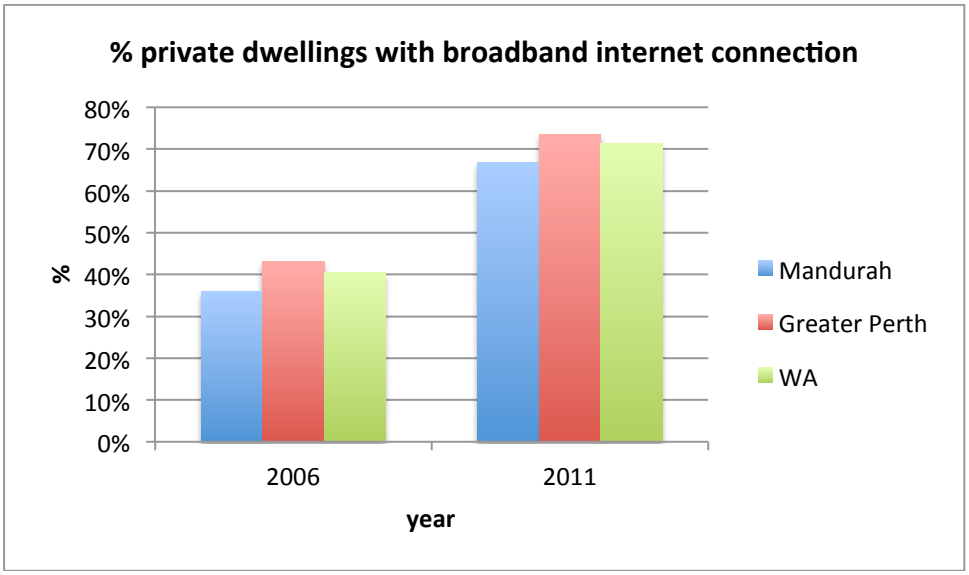

Figure 12: Comparison of broadband internet connection (2006 & 2011) (Source: ABS, 2007 & 2012a)

Productivity

According to the 2011 NIEIR report, the estimated residential gross regional product (GRP) of Mandurah was $2.537b in 2010/11, which was 2.6% p.a. growth from 2009 to 2011. The industry GRP for 2010/11 was $1.924b, with a per annum growth of 2.2%. According to the City of Mandurah (2012c), the Mandurah GRP is estimated at $2.811b, which represents 47.14% of Peel Region's GRP of $5.962b.

The industry with the largest output was rental, hiring and real estate services (approximately $911.611 million or 18.7% of the total ($4.887b) followed by construction trade (14.8%), and manufacturing (11.1%).

Mining and construction, manufacturing and retail are regionally important for income and/or employment in the Peel region. In 2009-10, mining was the leading contributor to the region's economy at 29.4% (35% in 2006-07), followed by construction at 16.6% (11% in 2006-07) and manufacturing at 9.9% (11.2% in 2006-07). The rental, hiring and real estate sector has fallen noticeably from a 12.7% GRP contribution in 2006-07 to 3.1% in 2009-10 (WA Department of Regional Development and Lands, cited in RDA Peel, 2010: 8). Recent events in the global and national resource and financial sectors, such as the Global Financial Crisis and increases in the Reserve Bank of Australia case rate must be considered when attempting to explain the decrease in the rental, hiring and real estate sector's influence in the regional economy.

GRP per capita in Mandurah in 2011 was $50,358 (for workers it was $189,199) (Remplan, 2012).[21] This compares to a gross domestic product (GDP) per capita for Australia of $40,234 (2011$) and $69,733 for the Peel Region (WA Department of Regional Development and Lands, cited in RDA Peel, 2010).

Business innovation

Local-level business innovation data is virtually non-existent, unless it is collected through small, locally based surveys. Patent counts per population are often used as proxies for innovation, but these can be unsuitable, as patents are only used in certain types of innovation (technology-based and radical innovative activity), meaning this measure excludes other more common forms of innovative activity such as service or organisational innovation.

The NIEIR *State of the Regions report 2011-12* does calculate patent applications per 100,000 population for the Mandurah. NIEIR calculates average of 8.13 patent applications per 100,000 population and an average of 4.09 patent applications for the years 1994-2009. This compares with the Australian average of 15.69 patent applications per 100,000 population for the same time frame.

[21] Using data incorporating Australia Bureau of Statistics' (ABS) June 2011 Gross State Product, 2007 / 2008 National Input Output Tables and 2006 Census Place of Work Employment Data

Stakeholders

Stakeholders were identified from a process of stakeholder mapping. Twenty-nine stakeholders were identified from this process. This list was refined and fourteen stakeholder organisations were invited to participate in an interview, resulting in 15 people being interviewed.[22]

Stakeholder interviews were conducted from 23 to 27 July 2012. The list of stakeholders interviewed is shown below.

Table 15: List of stakeholders

Interviewee	Position and Organisation	Role of organisation	Category
Lyndon Mutter	Senior Land Use Planner, Department of Environment and Conservation	State Government	Environmental
Brett Dunn	Senior natural Resource Officer, Urban Water Management Department of Water, Kwinana Peel Region	State Government	Environmental
Colleen Yates	A/ CEO, Peel Development Commission	Regional Planning Authority	Economic, Planning
Scott Haine	Department of Planning (Peel region)	State Government	Planning
Tony Free	Director, Sustainable Development, City of Mandurah	Council	Planning
Ben Dreckow	Principal Planner, Planning Services City of Mandurah	Council	Planning
John Gabrielson	City of Mandurah Manager of Natural and Built Environment	Council	Environment
Tim Hartland	Manager Community & Social Development, City of Mandurah	Council	Social
John Lambrecht	Executive Officer Regional Development Australia, WA	Local RDA	Economic
Kim Brooklyn	Operations Manager, Head Office, People Who Care	Local NGO	Social
Annabelle Calvert	Regional Manager South West, Mandurah Office, People Who Care,	Local NGO	Social
Shirley Joiner	Peel Preservation Group	Local NGO	Social
Jane O'Malley	Executive Officer Peel Harvey Catchment Council	Catchment management	Environmental
Colin Elton	Volunteer Friends of Peel River	Local NGO	Environmental
Chris Twomey	WACOSS	State-wide peak NGO	Social

[22] Note that in one organisation two people were interviewed together – a regional and local manager

Positive and negative views about population growth

A range of views about population growth, both positive and negative, emerged from the stakeholder interviews. When talking about population growth, some interviewees talked about the benefits for Mandurah. Others also took a statewide perspective and talked about why Mandurah was a strategic location for population growth compared to other areas of Western Australia. Some interviewees described benefits to Mandurah, saying '*growth is positive*'. Some pointed to the way that, by attracting more people to an area, '*population growth helps make the area economically sustainable, vibrant and socially alive*'. Others noted specific benefits, such as '*the positive impact of new NGOs moving into the centre, and bringing new ideas*'. Other benefits mentioned included vibrancy, increased diversity, and the potential for more services to be created (and supported) as population increases.

As noted above, in a statewide context, many saw Mandurah as a strategic place for population growth to be concentrated. A planner, for example, described the benefits of situating population in Mandurah as including:

- good connection to Perth (roads and rail)
- proximity to the coast and waterways which are positive amenity features
- a waterfront town centre
- capacity of a number of currently underdeveloped areas in the municipality (including the currently low density Mandurah city centre) to sustain higher population densities
- good recreation opportunities, such as popular boating and crabbing facilities.

However, when discussing the impact on Mandurah, most interviewees spoke more about the challenges associated with growth, rather than the benefits. Many saw population growth as posing significant challenges to maintaining environmental quality, and to ensuring sufficient and appropriate provision of social services. Yet somewhat paradoxically, at least with regard to the social issues, many proposed that further population growth was the means to solve these challenges:

> '*What needs to happen? Population needs to grow more – I know that might sound strange but we haven't yet reached a size where we can become a regional centre, a more sustainable regional centre.'*

Some appeared to oppose continuing population growth per se, with one for stakeholder describing continued population growth as '*the source of all our evils*' and suggesting '*we have to put up a "no vacancy" sign sooner or later'.* However, a more common view was that population growth was not necessarily negative but in this instance it had been poorly planned and managed:

> *'Mandurah is a clear example in my opinion of unsustainable development ... the focus from the state government has been just on placing people, and certainly not on the environmental and social impacts of that population growth.'*

Others echoed this, suggesting that the WA Planning Commission *'creates a lot of pressure to roll houses out on the ground'* and that this has led to poor outcomes because *'the way development has been rolled out so quickly is by filling in the wetlands, and building a lot of low density development that creates urban sprawl'.*

A planner described a number of specific social challenges and potential problems associated with further increasing the population of Mandurah, including vulnerability to climate change impacts; placing housing in proximity to waterways (meaning proximity to mosquito borne disease); few employment opportunities and few industrial areas that might generate employment; and bushfire risks associated with some of the rural residential blocks, on which there were tensions between maintaining residential amenity and managing fire risk.

Environmental Issues

In addition to the impacts identified by Elrick et al. (2008) and discussed earlier, stakeholders raised other environmental impacts of population growth, including:

- loss of fringing vegetation around Peel Harvey
- loss of species
- change from estuarine to oceanic system
- nutrients entering waterways and causing changes to ecosystems
- loss of natural areas
- limits to groundwater availability
- amenity issues around reduced open space.

Some of these are discussed in more detail below.

Cumulative effects of development resulting in biodiversity and habitat loss

Many interviewees highlighted the negative impacts of development on biodiversity and habitat. Some pointed to '*the loss of bushland and displacement of other species'* as a significant issue. Population growth was seen to be placing *'massive pressure'* on natural areas:

> *'These impacts are not a surprise to anyone, but the significant actions that are required just aren't being taken.'*

Stakeholders also said that vegetation has been significantly reduced since the 1990s but that vegetation mapping is out of date, so the exact extent of loss is unknown.

Council staff reflected on biodiversity impacts and the role of local government, suggesting that *'much of that is beyond council's capacity to protect because state legislation overrides what we may want to do at a council level*'. Interviewees noted that once land is zoned for urban development there is an expectation that development will take place, meaning that council has limited input into discussions about tree cover, habitat and so on. An example cited was a development proposal for which the land owners went through a process with DSEWPaC to determine the requirements under the EPBC Act.

A planner pointed to the Preston Beach settlement (a development of 400 lots) as an example of the tensions that arise between development and environmental protection:

> *'There's some investigation into extending that settlement into the north and south – but there are community concerns about the impacts that this might have on Lake Clifton. People want to live on the coast and developers are doing some initial investigations into how to develop the area, but at the same time there are concerns about the waterways.'*

One stakeholder noted that '*There is a tension between the growth which might be necessary and the need to protect or manage the environment'.* Another suggested that the approval system does not always ensure developers prioritise environmental protection, referring to the practice of developers providing offset habitat offsite as an example of how *'developers are buying their approvals'*. Other stakeholders also suggested that while *'there is a tendency to think that offsets and trade-offs are OK as*

a solution' they are not effective, because '*the reality is that we are still seeing a huge decline in species.'*

Council staff noted that most of the actions in the (soon to be released) Mandurah Council SoE report are about lobbying for change to statutory systems, particularly the state planning legislation in WA. As one stakeholder put it, many want to see the planning legislation changed *'so it more accurately represents a triple bottom line outcome'.* For example the provision for developers to provide 10% of land for public space has been the same since the 1960s. This was cited as one particular area where change would be beneficial for the Mandurah region. As more land is developed, the need for open space is being felt more acutely by stakeholders and there is interest in increasing the percentage that each individual development puts aside as open space. However any change would require '*high level lobbying'* by the council's mayor and CEO. Local environment groups suggested council has become more sensitive to the environmental impacts of development.

Many pointed out the particular significance of local environmental assets, and the need to value these highly when weighing decisions about development. Of particular importance, and mentioned by many were the '*conservation category wetlands'* that '*are critical because they have been internationally recognised'*. As one put it, '*it's important that we consider these as not just constraints to development, but also as important habitat.'*

Site specific issues of vegetation loss, threatened species, and habitat

Council staff reported that council had historically worked with developers in a proactive way in an attempt to protect (or relocate) flora and fauna, even if there were no formal frameworks to use or no means of including these issues in the formal approval process, reporting that '*some of the bigger developers have been compliant with this but council hasn't had any statutory planning power to require it'.* This sort of partnership arrangement was built up in the period of rapid growth of the area, though as the council has become more cautious and the organisation of council has grown, one interviewee suggested that they have probably become more inclined to be more bureaucratic and rule-based in their approvals.

For larger pieces of land that are being developed, council seeks to relocate flora and fauna to Yalgorup National Park, with the assistance of a person licensed by DEC.[23] However council suggested that the outcomes of this are unclear *'they report on what they've moved and where to, but once they've been moved we don't know how they go'*. Council is currently involved in a project with Murdoch University to investigate this.

One interviewee suggested that as more land is developed, people are becoming increasingly aware of and concerned about the remnant vegetation that is being lost with development. In some cases land may have been zoned many years ago for urban development, but now that more vegetation clearing has taken place over the years the community is greatly concerned about the clearance of remaining areas, or even individual trees, especially Tuart[24] (*Eucalyptus gomphocephala*) and Redgums.

One community group interviewee suggested that even when plans are made to protect remnant patches of vegetation, mistakes can be made when it comes to implementing these on-site. The interviewee reported that during a recent development near the Mandurah train station a patch of trees was kept but the understory was cleared in the building process, despite a lengthy process of negotiating with council to have this vegetation protected for habitat. Instead animals (including snakes) apparently left the site and caused concerns for nearby residents.

[23] See for example recent bandicoot relocations from a Landcorp development near Mandurah train station (Landcorp, 2012).
[24] Native to SW Western Australia and distributed in a 400-kilometre strip it is estimated that around 65% of remaining Tuarts are on freehold land. See: http://www.dec.wa.gov.au/content/category/47/838/1627/

Threats to the estuary

As previously noted, the wetlands in Mandurah are internationally recognised, house one of the oldest communities of thrombolites in the world, and provide habitat for many threatened species. Given the significance of this estuarine environment, interviewees were concerned that the latest data (in Mandurah Council's SoE report) shows that none of the environmental indicators relating to the estuary have improved. Some have stayed the same, but many have declined, and many stakeholders saw this as a sign of poor environmental management: '*We knew the estuary system was deteriorating, but it's certainly accelerated over the last 10-15 years'.* This sense of urgency was echoed in many of the interviews:

> '*This is a Ramsar wetland and it's meant to be covered by four different international treaties. The auditor general did a report a year ago and it was scathing – but nothing has happened.'*

One interviewee pointed to excessive levels of phosphorous leaching into the estuary from agricultural areas, suggesting that *'Some of the farms in this area have so much phosphorous in their soil that even if they never fertilised again they have enough to last for the next 50 years.'* Another mentioned that monosifatic black ooze (MBO) is prevalent in the Peel Harvey and '*is now coming down the system*', and another pointed to areas of acid sulfate soil. Another pointed to the need to appreciate catchment-wide impacts, including the impacts of development: '*Water quality starts as a problem upstream but it's the receiving catchments that feel the impacts. So what they do further up in the catchment affects the water quality here*.' These issues were linked directly to population:

> *'With increased population there is an increased chance that the waterways could come under stress with additional nutrient loading – we don't want the water to go green.'*

Water quality, including nutrient run-off is a key contributor to poor estuary health, and a number of interviewees expressed concern about this issue. Interviewees noted the demand for population increase near areas of high amenity and the tensions that this brings, stressing '*we have to be very careful that we don't allow the waterway assets to be ruined by development'.* Some questioned the rate of infrastructure construction along the estuary and whether it was sustainable, giving the specific example of a Department of Transport's Boating Facilities study, which plans for boat ramps and jetties and is determined by population or lot numbers, not by the carrying capacity of the waterways, which as one stakeholder put it, '*means we just get more and more infrastructure*.'

Governance was raised as a key challenge for managing the estuary, particularly in light of the fact that the previous Peel Inlet Management Authority was disbanded in the early 2000s. Interviewees noted that there is currently no one department that actively or directly manages the waterway, with one suggesting that *'a central governance agency is needed if we're to have any hope of managing it*', and another agreeing the area was *'screaming out for a centralised statutory governance agency or system for Peel Harvey if we're to have any chance of protecting the fringe vegetation and estuary.'*

Climate change impacts

The potential for climate change, and particularly sea level rises to have serious impacts on the local area, was mentioned by a number of stakeholders as an issue that had implications for development strategies. For example one asked:

> *'Do we keep renourishing the beach or build defence mechanisms, or let it go as is? And how do you have those conversations with communities?'*

Stakeholders reported that Mandurah Council is involved in the Peron Naturaliste Partnership[25] which has nine local government members. The partnership has funding from the federal government to do hazard mapping of the coast for 100 years for three scenarios (low, medium and high sea level rise) plus a *'broad brush economic analysis'* and some case studies.[26] Council staff saw this partnership as a good example of council trying to build better relationships with other councils nearby.

Council stakeholders expressed a hope that the Local Planning Policy that council is currently developing (in response to the state government's review of the *State Coastal Planning Policy*) will demonstrate an effective and complementary approach to tackling climate change in coastal areas. Council also reported that it had recently suggested to the Productivity Commission that as well as periodic federal funding for projects, there may also be potential for 'developer contribution charges' to assist in funding climate change adaptation strategies (City of Mandurah, 2012h).

Groundwater and water availability

Water availability and groundwater in particular were environmental issues of concern raised by several interviewees. As one put it, *'we are just on the brink of running out of groundwater'.* Overuse of groundwater threatens the sustainability of existing bore uses as well as threatening to impact on the wetland ecosystems. In addition if such sites are on the coast, there is the risk of saline intrusion, which could permanently damage the aquifer.

One interviewee reported that groundwater allocations have traditionally been assigned with parcels of land, meaning that developers were able to plan for access to groundwater at little or no cost. However, with groundwater allocations fast approaching the available limits, it is likely that future urban developments will not have groundwater allocations associated with them. As a result of these groundwater constraints, developers will now need to invest more money to secure a source for irrigation.

Stakeholders noted that the limited groundwater supply impacts the management of open space – something which is becoming increasingly valued as the population increases. They pointed out that in the past, public open space was irrigated with groundwater. However, now that groundwater aquifers are becoming fully allocated:

> '*the public open space and school sites that are going to need to be created will all need a water source, but groundwater will not be available, they will need to find another non-potable source.'*

Managed Aquifer Recharge (MAR) is one system that it was suggested might be used to assist with groundwater provision.[27] The City of Salisbury was raised as a successful example, with one stakeholder reporting that *'they take stormwater and treated wastewater from development, push it down into a lower aquifer and then extract and distribute it to user groups'.* Hope was expressed that this technology might be applied in the Peel Region, although again, management of such systems remains a challenge, particularly when '*rural shires may not have staff or expertise to run them'.*

[25] The Peron Naturaliste Partnership (PNP) is a collaboration of nine local governments with the objective of providing a regional mechanism to facilitate effective and timely adaptation responses to climate change. The partnership was successful in gaining funding through the federal government's Coastal Decision Adaptation Pathways Program to *Develop Flexible Adaptation Pathways for the Peron Naturaliste Coastal Region of Western Australia.*

[26] This interviewee suggested the final report of this project is due to go to the federal government in September 2012.

[27] For example see http://www.csiro.au/en/Organisation-Structure/Flagships/Water-for-a-Healthy-Country-Flagship/Managed-Aquifer-Recharge.aspx

Waste water treatment for developments

Another issue raised in relation to water and development was water treatment. According to one interviewee development is occurring in some areas where there are currently no water treatment services, and some older developments are still on septic systems, which may be contributing to eutrophication of the estuary. While some developments may be required to install alternative water collection or treatment systems (such as stormwater recycling, and wastewater recycling systems) it was suggested that it may be challenging to find people who are able to manage the ongoing maintenance of these systems, if they are not owned and run by the Water Corporation.

It was suggested that recent changes to the role of the Department of Water may allow greater consideration of water issues in the planning and development approvals process because as an advising agency the department can now provide advice to all three levels of planning and rezoning rather than only becoming involved at the subdivision level. The Department now works directly with developers through the planning stages, requiring developers to comply with the 'Better water management policy' (WAPC, 2008). The intention is that this approach will deliver more effective outcomes because developers can talk to the department prior to drafting or submitting their documents into the planning process.

Building design

One interviewee suggested that low impact housing design had not really featured in Mandurah's rapid development, but rather that '*unfortunately WA has adopted the American style of development – slash and burn'*. It was suggested that low impact design could assist in reducing environmental impacts, especially where people are building on flood plains that require a large amount of fill:

> *'Nobody's looked at how the development should really be done in these environmentally constrained areas like the Peel – perhaps we should be going back to the old Queenslander style home.'*

Social Issues

Transport

Stakeholders suggested that transport needs in the area have changed rapidly in the past few decades as illustrated by the fact that '*Mandurah only got its first traffic lights in 1980'.* The key transport issues raised were the inadequacy of local public transport and the issues of access and connectivity this raises, as well as the impacts on local employment of the recently completed rail line to Perth, and the connectivity of the train station to the town.

A number of interviewees pointed to the 2007 completion of the Perth-Mandurah railway line (Mayes, 2012) as a major public transport improvement that provides Mandurah residents with a direct connection to Perth. However the location of the station was criticised by some, saying *'it's been designed to bring people to the transit rather than bringing the transit to people'.* One interviewee suggested that the train to Perth may also have had some negative impacts for the local area, asking *'has the new train service resulted in us losing great people up to Perth every day?'*

It was suggested that if Mandurah is going to grow and become a bigger city it will need a more integrated transport system which connects the different parts of the city. As one put it, *'our transport system needs to reach another level of maturity'.* Another also pointed to the need to address regional transport issues:

> *'We have no nationally significant transport links or facilities in the region, and no intra-regional links. We are only just now getting a bus service from Mandurah to Pinjarra. There is a state transport plan but not one for this region, and those services and infrastructure are really crucial for the industrial development for the region.'*

A lack of buses and bus shelters was raised as another key transport issue for the area. Interviewees suggested that inadequate bus services meant that older people *'can't go up the road and get their script filled'* and younger people *'can't get to the cinema with friends'*. Further it was suggested that where bus services do exist, the lack of sheltered stops makes people vulnerable to weather and the journey less comfortable, and may mean they are less likely to use the service, potentially making them more socially isolated. Some interviewees involved in social service provision noted that while there are large 'beautification' projects happening in the city centre, more basic infrastructure is still missing. One example given was the recent installation of park benches and vegetation at large intersections *'which no one wants to sit at'* compared with the lack of sheltered bus stops. This interviewee emphasised the need for sheltered bus stops, particularly for the young and elderly who may not have access to a car or may not be able to drive, and for whom public transport is critical to provide them with a connection to services and the capacity to be independent.

One interviewee noted that *'the train to Perth runs every 10 minutes but the only bus between Mandurah and Pinjarra only runs once a week'*[28]*.* This was given as an example of the way that Mandurah is now better connected to Perth but still not well connected within the region. It was suggested that this reflected the focus of planning agencies that *'are aiming to make Mandurah part of the city, without recognising that in fact it is rural or regional and so it has the limited services of a regional area'.* Others suggested these transport gaps made it difficult for people elsewhere in the region to access Mandurah for services:

> *'The government services are all in Mandurah and not in Pinjarra. How do people in Pinjarra get to Centrelink, or pay their bills, or go to the library? It's only in the last few years that Pinjarra has got a Woollies and Coles and a chemist.'*

One felt that city bus routes were all circuitous and very slow as they *'stop at every street.'*[29] Finally, the need for private vehicle ownership as a consequence of poor public transport was raised by several stakeholders who noted that for many residents *'you have to have a car to get to work'.*

Recreation, open space and amenity

A challenge raised by stakeholders was the need to meet the open space and recreation needs of a growing population. One stakeholder reflected that compared to the rapid pace of residential development, '*there's definitely been a lag in building new leisure and swimming facilities'* while another suggested that some of the newer developments do have open space and trees but that *'generally the attitude is build bold and build fast',* meaning that the focus is on delivering housing rather than the range of services and facilities that should be provided at the same time. Another pointed to the specific lack of recreation facilities for young people, suggesting that in areas of new development '*skate parks, youth centres, those things just don't exist'.*

One interviewee pointed out that developers are required to provide 10% of each development as open space but that because this can be for a range of potential uses, including water sensitive urban design,

[28] Our research appears to verify this. See: http://www.murray.wa.gov.au/Downloads/Residents/Resident%20Services/Young%20People/Waroona%20Pinjarra%20Mandurah%20Express%20Bus%20Timetable.pdf and: http://www.transperth.wa.gov.au/ServiceUpdates/ServiceChanges/tabid/132/newsid568/2625/Default.aspx

[29] For information about public transport services around the City see http://www.visitmandurah.com/images/TransportAccessGuideMap.jpg

translating this into significant open space that people can use for recreation can be challenging. Another described the challenge of delivering enough open space for recreation as *'playing a bit of catch up'* and reported that because open space is assigned on a development-by-development basis, it tends to be small fragmented areas. There was also a perception from community groups interviewed that the provision of open space needs to be addressed in a more strategic and integrated way in order to better meet community needs, for example:

> '*We need lineal parks in suburban areas that lead to a destination, and that also act as a biodiversity corridor, with paths that are wide enough to support pedestrians, cycling and small birds.'*

A specific constraint identified was the perceived reluctance by the Education Department to make school playing fields available for community use outside school hours.[30]

Some interviewees linked the issue of open space to that of population density. Concerns were expressed that increasing inner and near city development which involves infilling previously open blocks is resulting in the loss of green spaces. One NGO interviewed said their group's thinking on medium density has changed in recent times. They now consider two or three storey developments to be reasonable in areas such as the city precinct which has now been reclassified for higher density development. However they emphasised that if higher density development is to become more common, then there is a need to provide extra blocks of open space for residents. It was also suggested that the basic requirements for open space set by the state government do not adequately take into account increasing residential density. Mandurah City Council has a significant tree register, but one environmental group interviewed suggested that this has not been effective in preventing the loss of trees and open spaces.

Health

Some interviewees felt that the character of the region had changed dramatically due to the rapid growth of population, resulting in a less 'connected' community with impacts on wellbeing:

> '*It used to be a welcoming place – people had social connection, now there's not the social connection there used to be. The disconnect creates mental health problems.'*

While it was noted that '*Mandurah does now have better facilities overall as a result of population growth in this area'*, and that these include a large healthcare centre, specific gaps in the provision of health and medical facilities were identified, including the absence of local cancer treatment facilities (which are in Perth) and mental health facilities (which are in Rockingham). These perceptions about ongoing health service gaps appear to be supported by statistics about health professionals in the area. The number of General Practitioners (GPs) in Mandurah per 100,000 people is just 96.7 compared to the WA average of 157.2 and the Australian average of 178.6 (Mayes, 2012: 17). Provision is as low as 26.5 in Waroona, with Waroona and Boddington having only one GP each. The number of child and community health nurses is also low in the region. For example there is only one full-time equivalent community health nurse in Serpentine-Jarrahdale for a population of over 17,000 (Mayes, 2012: 17).

Some interviewees raised the issue of mosquito borne disease as another health concern in the area. In Western Australia, the mosquito-borne diseases of most public health concern are Ross River virus (RRV) disease and Barmah Forest virus (BFV) disease. One environment group interviewed expressed these concerns:

[30] The issue of shared use of school facilities is being explored in other jurisdictions as a policy issue for local government (Suter & Halsey, 2011).

> *'You get increased population come into the area, well it's all wetland here, so mosquitoes are a natural part of that system. From a health perspective we probably want to stop putting people in those mosquito areas. But then the planning minister keeps putting more people there.'*

Service provision and access

Many interviewees suggested that important social services and community infrastructure had not kept up with the rapid pace of development in the Mandurah area. Particular social issues raised by interviewees included access to services such as public transport, family, youth and children's services, including childcare, family or financial counseling, and emergency accommodation. One interviewee suggested that various social challenges were now emerging as a consequence of *'hyper growth'*, or the rapid growth of residential development, without a parallel growth in social services and infrastructure, suggesting *'you build hyper fast, and then you watch the social issues grow'*. Others observed:

> *'There has been a period of rapid growth and all those things which come with a big city have not really caught up.'*

> *'From a social perspective it's been the dog chasing the tail – the infrastructure, the social services have all been continuing to catch up.'*

Generally stakeholders felt that there were also more young families moving into the area, or as one put it *'we are seeing more young people in our mortgage belt'.* In this context, people raised concerns about the limited services available to support parents, suggesting that *'there is a day-care waiting list because demand is now so high'* and that *'people have to wait three to four years for childcare in this area, this is a real issue for working mums who want to return to work.'* Interviewees also suggested that the high demand in Mandurah for family and relationship support services was exacerbated by issues associated with the increasing number of 'fly-in fly-out' (or FIFO) families.[31] One pointed to the social and relationship pressures of FIFO arrangements including, for example, *'when a parent comes home and pulls the kids out of school to go on holiday'*, and the difficulties for the remaining parent who may struggle to alternate between periods when their partner is home and periods when they are effectively a sole parent.

Stakeholders also reflected that the average age of those currently in the workforce now is relatively high, meaning that in 10 years' time many of them will be retired, noting *'we really have to plan for that'*. Many spoke of the implications of the ageing population as one of the 'big issues that we need to plan for', but some worried that '*being a fast growth council area we don't have the resources to keep up'.*

Some interviewees pointed to issues associated with services and support for migrants and culturally and linguistically diverse (CALD) groups. The arrival of immigrants and people from CALD backgrounds in the area has highlighted the limited access to migrant support services, the inadequate recognition of migrant skills and education, the constraints on service provision by community groups due to low staffing and funding levels and visa restrictions that made it difficult for migrants to enrol for study at the location of their choice.

Community safety

Interviewees suggested that the area had *'historically been very safe'* and while it still had low rates of crime, for some people, perceptions of safety had decreased in recent years. It was suggested that

[31] Fly-in fly-out (sometimes abbreviated to FIFO) refers to people employed on contracts, usually in remote areas. Rather than relocating to the area, these workers are regularly flown in to their place of employment for several days or weeks, then flown home for a period of leave.

because the region is a high growth area a lot of residents hadn't grown up in the area, and as a result many don't know their neighbours and feel isolated. Isolation was raised as a key issue for older residents living alone, especially those who moved to the area in later life: *'We have a low crime rate but the older population feels really unsafe'.* Some interviewees mentioned an *'unstable youth culture'* which gets reported on in local media, and others mentioned some murders a few years ago which were uncharacteristic for the region and had also contributed to some residents feeling of unsafe.

Education

While it is not clear whether or how this phenomenon is related to population growth, some interviewees pointed to perceptions of a growing divide in the education system in the local area:

> *'The latest census tells us we have the highest percentage of children going to private schools and lowest going to public schools in the state. This is resulting in a two-speed education system. State schools are left with more of the problematic kids, the kids who don't want to be there.'*
>
> *'Some of our schools were recently rated as poorly as remote schools from the Kimberley, and we also have low levels of education among our kids.'*

However, other interviewees pointed to a recent improvement in education services, including the extension to Year 12 of two high schools that previously only provided education up to Year 10, and a 'wraparound' (childcare) service introduced in a 'poor performing' school.

Housing affordability and availability

Interviewees raised significant concerns about housing availability and affordability. New housing developments have tended to deliver more expensive housing, rather than the kind of affordable housing that the area was known for in the past. Interviewees suggested that the decline in cheaper housing options for lower income families in Mandurah has caused many of these households to relocate to more affordable areas in Pinjarra. Staff from Mandurah City Council also acknowledged the importance of this issue, and reported that council is working on delivering an affordable housing strategy by the end of 2012.

The need for public housing in Mandurah was raised, with waiting lists for public housing in the area described as very long. Some pointed to the phenomenon of families using caravan parks in Mandurah as long-term accommodation because of the shortage of affordable housing. Homelessness was also identified as a major problem with limited services in the immediate area. Lack of affordable short-term or emergency accommodation – often required in the event of family breakdown, was also mentioned. Finding private rental accommodation was also described as very difficult, with one interviewee suggesting *'there are no cheap units'* in the area. Others pointed to problems, including *'marriages going under'* and family breakdown, as a result of the high mortgages, high levels of mortgage stress and a '*high mortgagee repossession rate'* experienced by households in the area.

Interviewees also suggested that, while on the one hand there was an ongoing need for affordable housing in the area, on the other, the global financial crisis (GFC) meant that some of the newer 'high-end' developments had failed to sell. An apartment block in the city centre where *'half the properties are sitting empty'* was cited as an example. Council also reported that another impact of the GFC and associated vacancy rates was the reduced valuations of vacant properties in a recent Valuer General's land valuation, which resulted in a reduction of $2 million in the rate base for council.

Many interviewees related these various housing problems to the phenomenon of population growth, which was largely associated with expensive new housing. Some pointed to the stark contrast between housing types – the large, expensive, luxury housing being built along the waterways, and the lower quality housing on the other side of the main road, with one using the phrase *'a tale of two cities'*. These comments reflect the identification by council of social division as a *'central and critical issue'* for Mandurah (City of Mandurah, 2010).

Governance structures and planning

Local and state government challenges and relationships

Council staff noted that it was challenging for council to respond, not only to the size of population growth, but to changes in the speed of development:

> *'We have laid off planning staff – the planners are working on strategic rather than development approvals, because planning and building now are so quiet. But community and social development is just so busy – the development has flat lined somewhat, but now everyone's moved in so there's a need for community development work.'*

Staff also reported challenges in responding to the increased demands from a growing population for both community services and community development programs, when council's resources were so limited. Coordination of this response with neighbouring councils – some of which showed little interest and some of which had few qualified staff in these areas, was also reported to be difficult. Staff reported that the Department of Local Government is considering administrative boundary options and amalgamations, and some interviewees suggested that an amalgamation between Mandurah and the Shire of Murray was under consideration.

Council staff also suggested that the state government had been slow to act on the full range of issues associated with population growth and rapid development. For example, in relation to the need to protect biodiversity, one interviewee from council commented:

> *'often we are relying on the federal government to step in and make a decision when we might want the state government to step in*.'

Council staff suggested that while council *'always tries to do fauna relocation for large size pieces of land that are being developed'* there were '*no obligations on the landowner to do this'* and that it had '*taken a long time to get the state government to support this and to apply this as a condition at state level.'* Council staff also reported that council is hoping to discuss a range of potential planning requirement changes with the state government, in order to improve environmental outcomes. These included measures in relation to retaining core bushland corridors, water sensitive urban design (WSUD), and increasing the 10% open space provision for developers. One interviewee described consideration of such issues as part of '*moving away from the focus on just placing people'.*

Inconsistencies with administrative boundaries and characterizing the region

Many interviewees raised the question of the classification of Mandurah, with many asking *'is it city, suburb or rural?'* or *'are we a region, are we a district or are we an outlying suburb of Perth?'* Another noted that *'increasingly the metro area sees Mandurah as urban and part of Perth but we're a region'.* A number pointed to a lack of a clear vision for the area, suggesting that *'some of big questions about growth are not really resolved – do we support development to the east? Are we aiming to develop into a bigger city or trying to stay as is?'* These questions were explicitly linked to issues of funding, with many questioning the different ways various agencies classify the area, suggesting that classifications are inconsistent and in some cases result in lower levels of funding and services.

Interviewees highlighted the differing administrative boundaries that different state government organisations apply to the region. For example it was reported that Mandurah is considered part of the *Swan Bio Plan* by the Department of Environment and Conservation (DEC), but is part of the south metro district according to the Department of Education. As one interviewee put it, '*Government is just like that – every agency has different boundaries'.*

One interviewee suggested that Mandurah is often classed by state government as a metropolitan area for planning and service provision purposes, but that in fact it has distinctive regional characteristics, not least of which is the lack of social services and connective infrastructure. For example, Mandurah is considered to be a metropolitan suburb by the health service, and so does not receive funding to deliver rural services, even though in the eyes of many *'it's obviously rural*'.

It was suggested that the classification of Mandurah as metropolitan in many cases results in less funding, or less support in providing essential services. As one put it, *'If we were recognised as a region then we would get regional funding'.* Another pointed out that *'the metro improvement tax doesn't come down this far',* while another suggested that regional funding streams were also not providing sufficient funding to Mandurah:

> *'What we receive from 'royalties for regions' as a region is a drop in the ocean compared to what they get up north – I think this is symptom of us not being seen as a region.'*

For some this was seen as *'a political classification – it's cheaper if it's not designated as rural'.* Similarly, another pointed to the recent relocation of police and child protection staff away from Mandurah, suggesting that if Mandurah was considered a regional centre it would have services such as these maintained within town rather than moved elsewhere in the region. Another noted that *'the importance of being classified a region is high for local government – because it gives us the "royalties for regions" funding stream'.* A number of interviewees thought that clarification of the state government's vision for the area and access to an appropriate and more reliable and predictable source of funding was important if Mandurah was to be able to *'properly develop as a regional centre'.*

Housing stock and density

In the interviews many stakeholders discussed the issue of residential density, suggesting there were a range of strongly-held views on this issue: '*There was some resistance from local residents about the Mandurah Quay development – they prefer quieter low rise type development to high density.'* One interviewee spoke of a time when community members, including environment groups, had opposed higher density dwellings in the city centre, but suggested there was now a growing realisation that two and three story buildings in particular could be a useful addition to the city. The need to build greater density in the city centre of Mandurah especially near the train line and other public transport, was identified by more than one planner. However, it was suggested that there may not be high levels of community support for this kind of development:

> *'The city has proposed precinct plans for higher density near the train station and in the town, also near education facilities. But we don't really know how the market will react to some of these higher density opportunities that are coming along.'*

One stakeholder suggested that most houses in the area are being built as three- or four-bedroom homes, based on the broadly held view that *'that's what people want'*, and that these types of dwellings would have the greatest resale value. However, this interviewee noted that in fact in Mandurah, according to 2006 ABS Census data, there is a high proportion of households that comprise couples without dependants or lone-person households. The majority (62.5%) of Mandurah households are one- or two-person households, and this household type is in the majority in every suburb of Mandurah,

except Lakelands. This suggests there is a greater need for smaller dwellings, including one- or two-bedroom apartments.

Locating future development

A number of interviewees pointed out that Mandurah LGA is long and narrow and follows the coast, and that much of it is already urbanised, leaving relatively small pockets of land available for possible development. As a result of the existing constraints on Mandurah, a regional perspective in planning was identified as critically important. Interviewees reflected that many of Mandurah's population issues will need to be resolved *'beyond the boundaries of Mandurah'* – through the creation of housing areas for a larger workforce, and new industrial or rural agricultural activities to stimulate economic development and employment.

Interviewees also commented that because future development will be '*in areas that are not so easy to develop',* it may well be more costly. Land to the east of Mandurah, which might be available for future development, is characterised by poor soils in which nutrients are not easily retained, and high water table areas, where nutrients are transported into the estuary, making it highly eutrophied.[32] It was suggested that while the high nutrient level had resulted from previous agricultural use, '*urban residential development has the potential to create further negative impacts on the catchment and water quality'*, meaning that great care would need to be taken in undertaking any development in this area. One interviewee suggested that some development is proposed for areas over cave systems (castes) and that this may necessitate special design strategies to manage surface water flows. Flooding was also cited as a serious issue in some areas, with one stakeholder suggesting *'the flood risk of some of the areas that are being proposed by the planning commission are ridiculous'.* Another interviewee suggested that while development used to be '*fill and drain*', increasingly developers are having to bring in more fill to raise the site above groundwater level as well as install drainage for stormwater drains, and employ more intensive water sensitive urban design (WSUD) features to ensure nutrient leaching levels are kept at or below pre-urban levels. There is an area to the north-east of Mandurah where there are plans for an industrial zone, but this would necessitate removal of trees and other vegetation cover, with associated environmental impacts.

Stakeholders also reported that some agencies are increasingly taking a more cautious approach to approving development, with a view to reducing future environmental impacts:

> *'Council has recognised that land use planning is one of our biggest issues. There's very little point in investing money in revegetation and water quality projects as a way to fix it up behind. We have to get in early to work on land use planning in the first place.'*
>
> *'The Department of Water is recognising the pressures of massive population growth and is preparing management plans, they are saying "if you want to put people here we need to understand the hydrology much better", and that provides us with guidance on which areas might be more or less suitable for housing.'*

One interviewee noted that the Sandy Swan coastal plain has soils that are under water in the winter and dry in the summer and provide a wetland support system, meaning '*it's really not the best area for a lot of urban expansion'*. Rather than development, a number of stakeholders identified agriculture as the most appropriate focus for this area, however one suggested that the council (the Shire of Murray) may prefer the land to become housing to generate rates.

[32] See footnote 9 for definition of eutrophication

The more cautious approach that many stakeholders would like to see taken to the siting of future development was summed up by the interviewee who said *'if we are going to have population growth then let's put people in places where it is environmentally appropriate'.*

Economic issues

Industry and commercial development

A number of interviewees suggested that while booms in mining and construction industries had been important drivers of recent population growth, there was a need to look beyond these industries to ensure that the local economy and the employment opportunities it offers are sustainable in the longer term. As one put it, *'our mining sector is not a growth sector anymore – the jobs will be there for 40 years but there are no new jobs'.* Similarly another said *'construction has dropped off, mining is stable but low, but there's no new employment to accompany the growth in population'.* Another pointed to signs of a possible downturn in the local economy, noting that *'there are a lot of businesses closed, even on the foreshore, even the old businesses, they've just closed, and nothing new is being built. The feedback from business people is that it's really hard to make a living in Mandurah'.* Stakeholders also suggested there was a need for a greater '*diversity of employment*' in the area.

Some stakeholders did point to examples of large projects that are planned or under consideration and that would encourage economic growth and provide employment, such as the Peel Wastewater reuse project, the development of a new equestrian centre and the relocation of the Murdoch veterinary school in the Serpentine Jarrahdale Shire. Further, a stakeholder described the Regional Development Commission (RDC) as having a three-part plan for supporting local industry, encompassing industrial land, agriculture and tourism.

Interviewees also suggested commercial development needed to be better managed. Some pointed to a reasonable district-sized shopping centre on Pinjarra Road which is approximately 20,000 square metres with a Kmart, Big W and a number of specialty shops, and which provides local employment as well as goods and services. However they suggested that the development of this shopping centre *'drew some vibrancy out of the* [Mandurah] *CBD'* and now the city is '*trying to draw people and businesses back into the CBD*', which some interviewees thought would be a challenge judging by the high vacancy rate in some recently built CBD apartments.

Cost of living and affordability

Some interviewees suggested that because population growth had been (at least partly) driven by the mining boom it had resulted in rising house prices in the area, as well as a range of other price rises, the combination of which had made the area less affordable for people on lower incomes. They reflected that '*Mandurah has a spread of people with lots of money and people with not much – there's a definite undercurrent of people really struggling'.*

One suggested that prices of goods in Mandurah, particularly food, are high because they now have *'the urban price tag on everything, plus some, because of transport costs'.* These comments suggest that rising house prices and costs of living associated with recent population growth in Mandurah may be pushing people on lower incomes to relocate to more affordable areas.

Work and employment

The need to generate new employment opportunities was mentioned by many as critical. Unlike in previous decades where new arrivals comprised large numbers of retirees, the area is now home to many working age people who need employment, preferably locally based. As one put it:

> '*Population growth needs to be accompanied by employment growth – it's one thing to keep approving suburban subdivisions here, but we also need more jobs for the people who are going to live there.'*

People described limited employment opportunities and a low diversity of types of work. There is a perception that the area relies too heavily on a few sectors and a small number of large employers, which makes it vulnerable to job losses if any of those employers experience a downturn. This seems to have been illustrated in recent times where *'the wind down in construction has caused difficulties because so many people worked in that sector'.* Another noted that in addition to the slowdown in construction, '*tourism has been lagging and retail has flagged due to GFC'.*

However interviewees noted something of a 'catch-22' problem because, while the area had grown enough to need new employment opportunities, attracting significant new industry to the area is problematic because the city is *'not big enough'.* Others pointed to a tension between the growth which might be necessary to create new employment opportunities, and the need to protect the environment.

Interviewees pointed out that the area does have some large events which provide some opportunities for employment and economic growth, such as world cup water skiing, ironman competitions and the Channel Seven Mandurah Crab Fest which is Mandurah's 'premier annual event' and was enjoyed by more than 120,000 locals and visitors in 2012. Other ideas suggested as means of increasing work options in the area included locating government agencies or head offices in Mandurah, and focusing on nature-based tourism. Another opportunity identified was the development of agriculture-related water management initiatives, including the planned wastewater pipeline, and agri-tourism, which had the potential to attract *'students from overseas who will pay to spend time on a farm'.*

Tourism and nature based tourism - opportunities and challenges

Tourism is a major industry for Mandurah, and for many interviewees represented a potential source of greater local employment. However many noted that tourism is currently *'very patchy and seasonal'* and that the area was missing various tourism facilities. For many, there was a need to better manage and plan for the growth of the industry. Several suggestions and challenges were raised. Environment groups suggested that they would like to encourage *'responsible environmental tourism'* that *'makes use of our natural assets without eating away at that natural capital',* but that there were significant challenges in ensuring that such ventures were managed well. The Peel Development Commission is planning to work with DEC and Indigenous land managers to develop commercial ecotourism ventures within Yalgurup National Park, a project that aims to generate income while also conserving the environmental integrity of these areas. One interviewee saw potential in encouraging backpacker or budget tourism, but noted that the community has tended to respond negatively to such proposals, and that many caravan sites are *'being lost to development because they are on prime land'.* Another suggested that the emphasis on placing private development along the estuary has meant lost opportunities for low impact commercial activity, such as small cafes and restaurants, that might have made the area more attractive to tourists:

> *'We are privatising the best assets for the few that can afford them instead of turning them into an income source and letting everyone enjoy them.'*

Others mentioned the need to address the more subtle aspects of tourism service provision, including customer service training and developing for local staff. The general inference of these comments was that more attention needs to be paid to strategic planning for tourism in the area.

Challenges and issues of population growth in Mandurah

The indicator framework and the analysis of stakeholder interviews, planning documents and other studies have shown multiple dimensions to the experiences of population growth in Mandurah. In the analysis of these different aspects there are some areas of agreement and other areas of divergence.

The indicator framework analysis shows that population growth is having environmental, social and economic impacts on the local area. Both the environmental indicators and the stakeholder interviews highlight the declining quality of the natural environment in Mandurah. Land clearing for development, modification of foreshore and ongoing issues with nutrients entering the estuary are three key issues faced in the region. Nutrient run-off from agriculture (and now urban development), habitat fragmentation as rural land is cleared and built on, physical changes to shorelines as infrastructure is built, and now uncertainty in the face of climate change, see many of the regions assets under threat.

The indicator framework demonstrated that there is growing per capita resource efficiency (water and waste) but that continued population growth means that the *total* growth in levels of water use and waste generation has continued. Time series data for energy consumption was unavailable. While the indicators used for this project in relation to water focus on potable water consumption by households, in this particular case study the research identified locally relevant issues related to wastewater treatment capacity and also groundwater supply. The declining amount of native vegetation and the increasing rate of urban infill development were also represented in the stakeholder interviews as a force which is resulting in a decreasing availability of habitat for threatened species, and reduced access to open space.

The social indicators show that Mandurah has a great deal of diversity in its socio-economic structure, something that was illustrated clearly in the stakeholder interviews. Mandurah has a complex economic geography and has areas with high rates of disadvantage, unemployment, health and social issues next to areas with high property values and incomes. Despite a strong economy, the Peel Region has a long history of higher-than-state-average unemployment (Peel Development Commission, 2012) and Mandurah continues to have higher levels of unemployment than Perth. Lack of industrial diversity and a narrow range of skilled occupations in the local workforce remain an issue.

The issue of health was brought up by several interviewees in the context of population growth, with issues raised including community development and social cohesion, mental health and wellbeing, health services and the health risks associated with locating residential development in close proximity to areas of high mosquito numbers.

Stakeholders in Mandurah were very aware of recent population growth and the resulting changes to the character of the local area. As one put it:

> '*Mandurah used to be a retirement village for farmers – Now it has high end and middle income and not an awful lot for everyone else.'*

Another described the area as having '*gone from a sleepy hollow to a mini-Perth without any of the benefits of being rural*.' Interviewees also noted the changing demographics that are a result of population growth. There is also an increase in cultural and linguistic diversity:

> '*The latest census tells us that we are finally getting a migrant base with more people from a migrant background*[33]*, prior to that we had a very Anglo Saxon community.'*

Five issues or challenges that emerged strongly in this case study from the stakeholder interviews and the analysis of documents were:

- lack of coordinated governance of the catchment and estuary, resulting in ongoing deterioration of the wetland system
- lack of local employment and variety of local employment
- lack of integration to planning and service delivery between levels and departments of government, including neighbouring local governments
- lack of affordable housing
- constrained health and social services for some social issues.

Governance was raised as a key challenge for managing the estuary, particularly in light of the fact that the previous Peel Inlet Management Authority was disbanded in the early 2000s. As previously mentioned, interviewees noted that there is currently no one government department that actively or directly manages the waterway. Interviewees suggested that the funding of and establishment of a Peel–Harvey Catchment governance model and an integrated plan for the integrated catchment management of the Peel–Harvey Estuary system is needed.

Semi-skilled and unskilled professions dominate the occupational profile of Mandurah. Industries such as manufacturing and retail are vulnerable to national and international economic conditions (such as a high Australian dollar and low consumer sentiment), which, when combined with the lower skill levels of occupations, means lower employment security. Research carried out for the National Sea-Change Taskforce (2012) found that population growth and development activity in coastal areas is not translating into the long-term economic development usually associated with population growth. This is because coastal development is usually associated with decline in traditional resourced-based industries such as agriculture, fisheries and forestry and their replacement with retail and service industries that do not provide the same variety of occupations. Lack of available land then limits further industrial development.

The issue of integration for service delivery relates in part to how Mandurah is seen by various governments. For planners and service providers we spoke with, there remains an important question about the identity of Mandurah in relation to metropolitan Perth – is it a satellite city, a region or a suburb? The recent completion of a fast train link to Perth[34] makes it more connected and makes it appear more like an outer suburb of Perth, but for other purposes it is variously considered a region or a regional city. Many stakeholders suggested that it should be considered a regional centre and needs to be treated as such when it comes to funding for services, and also when it comes to the location of service hubs and government agency 'shopfronts' within or close to Mandurah.

Affordable housing has arisen as a key issue as property prices rise and household debt levels also rise. While average incomes have risen, the patchy nature of wealth across the region sees many people in rental and mortgage stress. Social issues and limits to services were raised as key issues that affect the attractiveness of the area for new residents and the wellbeing for existing residents, and may compound issues of employment and productivity.

[33] ABS data suggests that in the 2006 census, 21.% of Mandurah residents were born overseas, 70.4 Australian born and 8.3% not stated (OMI, 2011)

[34] Transperth's Mandurah Line

Information gaps and opportunities

The region is relatively well characterised in terms of social and environmental challenges – notably by the two *Peel Away the Mask* reports commissioned by the Peel Community Development Group which most recently used interviews, workshops and public survey primary research to explore social issues (Mayes, 2012) and the *Catchment Condition and Priorities Report* (Peel-Harvey Catchment Council, 2011), which describes in detail the existing environmental data about water, ecosystems and flora and fauna along the estuary. In addition the 2012 City of Mandurah State of the Environment Report is soon to be released and contains locally relevant data.

Feedback from interviewees about data and indicators

Many of those interviewed expressed interest in indicators, with one suggesting that '*to have co-indicators across state and commonwealth would be great.'* Another noted that indicators were *'currently a very topical'* issue for the region, with the WA Land Information System office investigating the possibility of land mapping connected to indicators and apparently considering using the Peel as a pilot project for that purpose. Stakeholders also noted that indicators will be important for measuring the impact of investment in regions.

Specific comments on environmental indicators included:

- In relation to the biodiversity measures, one concern raised was that '*we usually only talk about vulnerable and threatened species, but even if they are abundant they still deserve to be treated humanely*'.
- One interviewee noted that the working DSEWPaC framework seems to be lacking measures related to coastal damage and inundation and loss. The interviewee argued that these should be included in order to '*place a cost on the natural areas lost*'. It was suggested that coastal area loss was also an important measure of the impacts of climate change. It was proposed that this loss needs to be surveyed regularly, including not only loss of beach, plus the incremental loss of natural vegetation and also the 'dollar value' impact on the properties nearby.[35]
- There was a suggestion that climate change and atmosphere be broken into two separate categories because the impacts of climate change are so diverse. It was suggested that there could be many indicators for climate change that could also relate to social and economic indicators.
- The City of Mandurah has stated publicly the need for more fine-grained modelling data for coastal risk: *'The City has undertaken a coastal zone risk assessment as ... which provided an indication of areas and levels of risk, but it was recognised that more detailed locally relevant modelling and data was required. The City suggests that downscaled climate projections and hazard mapping should be a higher priority'* (City of Mandurah, 2012h).
- One interviewee suggested that the state government is looking at mapping all vegetation as a way of assessing suitability for development and that there are discussions about vegetation mapping of the whole South West. They suggested that knowledge about coverage of native vegetation is now quite patchy and that the calculation of coverage is out of date. Water monitoring is undertaken locally by local environment groups – for example the Peel Preservation Group and Friends of River Peel.
- One group monitors the Serpentine River every month – and sends details to the state EPA, however it is not clear to them whether this information is used by the state government.

[35] Mandurah Council has a coastal adaptation and mitigation plan on the Internet with maps of the coastline.

In terms of data sources, Mandurah Council is currently completing an updated state of the environment report. This is the second SoE report, following the first one in the late 1990s. While the second report was accepted in April 2012, it is not yet publicly available. Council staff report that gaps are obvious in their SoE report, where they were not able to access data and that this had especially been an issue with getting access to university research. Council also encountered some challenges in accessing data from state government agencies. Some interviewees thought data was available but not being shared readily:

> '*Peel Harvey is one of the most studied water systems in the country – the information is there but the question is whether people are prepared to release it.'*

Specific comments on social Indicators:

- One NGO reported that they are thinking of using the World Health Organisation (WHO) instrument within their organisation and are interested in wellbeing measures which include psychological stress. Several interviewees expressed their interest in having a wellbeing measure because: *'a people-orientated measure rather than an institutional-oriented measure will give colour to the data – it gives the human story not just the number crunching story.'*
- Dealing with ageing was identified as a priority for the indicator list, because as one interviewee put it: '*the ageing issue is a tsunami coming to Australia'.* Early childhood development was also raised as a key area for indicators. Mandurah Council has recently identified this issue as important and will soon release a new strategy focusing on the 0-12 age group.
- In relation to security, perceptions about the occurrence of crime was identified as an important indicator. Council staff mentioned that council is considering using response time to call outs to police as an indicator of safety.
- In relation to cultural diversity one interviewee noted that language proficiency may not indicate whether there is cultural harmony. For example, people who are second generation immigrants and speak English may still experience cultural conflict in the community.
- It was suggested that sport and recreation might be a useful part of the social considerations, for example availability of key facilities was a key issue.

Table 16: Natural capital - data availability, gaps and alternative measures

Natural Capital				
Theme	**Indicator**	**Measure**	**Data availability at case study level**	**Alternative case study level measure (if applicable)**
Climate and atmosphere	1. Air quality	Number of days in year that key pollutants exceed national air quality standards	Not available	No alternative measure available
	2. GHG emissions	Net greenhouse gas emissions	Not available	Tonnes CO_2 saved from entering the atmosphere since 1999
		Greenhouse gas emissions per capita	Available	Tonnes CO_2-e per person per year
	3. Energy usage	Residential and non-residential electricity use	Not available	No alternative measure available
Ecosystems and biodiversity	4. Terrestrial ecosystems	Extent of native vegetation	Not available	No alternative measure available
		Extent and distribution of protected areas	Available	n/a
	5. Vulnerable and endangered species	Number of endangered species, populations and communities listed under the *EPBC Act*	Not available	Number of threatened / rare / priority-listed species / communities
	6. Reestablishment of local vegetation communities	Number of hectares under restoration by council and volunteers	Not available	No alternative measure available
Water	7. Water consumption and availability	Water consumption (per capita)	Available	Total scheme water consumption
		Water availability to meet demand	Not available	No alternative measure available
Land	8. Ground cover	Ground cover	Not available	No alternative measure available
Waste	9. Waste disposed to landfill	Waste disposed to landfill	Not available	Kerbside collection of waste generated per capita
	10. Recycling rates	Proportion of waste generated being recycled	Not available	Kerbside collection of recyclables per capita

Table 17: Social and human capital - data availability, gaps and alternative measures

Social and Human Capital				
Theme	**Indicator**	**Measure**	**Data availability at case study level**	**Alternative case study level measure (if applicable)**
Skills and education	11. Educational attainment and qualifications	Highest level of educational attainment	Available	n/a
	12. Education services	Ratio of childcare places to children aged 0-5 years resident in the LGA	Not available	No alternative measure available
		Ratio of primary school places to primary school aged children resident in the LGA	Not available	No alternative measure available
Health	13. Self-reported health status	% reporting fair to poor health	Available	n/a
	14. Life expectancy	Life expectancy	Not available	No alternative measure available
	15. Persons who smoke daily	% of adults who are daily smokers	Available	n/a
	16. Obese persons	% of adults overweight or obese	Available	n/a
	17. Mental health	Proportions of adults experiencing psychological distress	Available	n/a
	18. Access to open space	Open space per capita	Available	n/a
Institutions and governance	19. Fair and functioning institutions and governance	Levels of trust in key institutions	Not available	No alternative measure available
	20. Community engagement	Proportion of people who volunteer	Available	n/a
Employment	21. Underemployment	Underemployment rate	Not available	Hours worked per week
	22. Unemployment	Unemployment rate	Available	n/a
	23. Local employment	% people working and living in the same LGA	Not available	Participation rate
Security	24. Security	Feelings of safety	Not available	No alternative measure available
		Incidence of personal and household crime	Not available	Offence rate per 1000 persons

Table 18: Economic capital - data availability, gaps and alternative measures

Economic Capital				
Theme	**Indicator**	**Measure**	**Data availability at case study level**	**Alternative case study level measure (if applicable)**
Wealth	25. Household net wealth	Household net worth	Not available	Wealth per household
Housing	26. Housing supply gap	Net dwelling gap	Not available	Average dwelling price
	27. Housing affordability	Low income households in rental stress	Available	n/a
		Low income households in mortgage stress	Available	n/a
Transport and infrastructure	28. Mode of transport to work	Car as driver	Available	Car as driver, relative change before/after rail
		Car as passenger	Available	Car as passenger, relative change before/after rail
		Public transport	Available	Public transport, relative change before/after rail
		Walking	Available	Walking, relative change before/after rail
		Other	Available	Cycle and motorcycle, relative change before/after rail
	29. Transport infrastructure	Kilometres of dedicated cycling paths	Not available	No alternative measure available
	30. Access to broadband Internet	% households with broadband connection	Available	n/a
Income	31. Income disparity	Disparity in disposable household weekly income	Not available	Household debt service ratio; Household debt to gross income ratio
Productivity and innovation	32. Multifactor productivity	Multifactor productivity	Not available	Gross regional product
	33. Innovation	Business with innovative activity	Not available	Patent counts per population
Socio-economic status	34. Relative socio-economic disadvantage	ABS Index of Relative Socioeconomic Disadvantage (IRSD) score	Available	n/a

Table 19: Contextual indicators - data availability, gaps and alternative measures

Contextual Indicators				
Theme	**Indicator**	**Measure**	**Data availability at case study level**	**Alternative case study level measure (if applicable)**
Population	35. Population size	Number of persons	Available	n/a
	36. Rate of growth	Annual rate of population growth	Available	n/a
	37. Population density	Number of persons per square kilometre	Available	n/a
	38. Gender and age profile	Gender and age profile	Available	n/a
Land use	39. Land use change	Rates of greenfield development	Not available	No alternative measure available
Cultural diversity	40. Proficiency in spoken English	% do not speak English well or not at all	Available	n/a
	41. Indigenous population	% Indigenous	Available	n/a
	42. Country of birth	Country of birth	Available	n/a
Regional migration	43. Net overseas migration	Net overseas migration	Not available	No alternative measure available
	44. Overseas born	% born overseas	Available	n/a
	45. Domestic or internal migration	Net number of regional internal migrants	Available	n/a

Summary – Theme and indicator data for Mandurah

Table 20: Natural capital - data figures

Natural Capital						
Theme	**Indicator**	**Measure**	**Data**	**Frequency**	**Spatial resolution**	**Data source**
Climate and atmosphere	1. Air quality	Number of days in year that key pollutants exceed national air quality standards	n/a	n/a	n/a	n/a
	2. GHG emissions	Tonnes CO_2-e per person per year	Mandurah 16.5 Western Australia 18	One off	LGA	SoE
		Tonnes CO_2 saved from entering the atmosphere since 1999	estimated >128,000	One off	LGA	Local Council
	3. Energy usage	Residential and non-residential electricity use	Not available	n/a	n/a	n/a
Ecosystems and biodiversity	4. Terrestrial ecosystems	Extent of native vegetation	Not available	n/a	n/a	n/a
		Extent and distribution of protected areas	Over 5,000 hectares	One off	LGA	Local Council
	5. Vulnerable and endangered species	Number of threatened / rare / priority-listed species / communities	Number of threatened animals 11; threatened ecological communities 1; rare plants 2; priority-listed plants 12; priority-listed animals 5; priority-listed ecological communities 1	One off	LGA	SoE
	6. Reestablishment of local of vegetation	Number of hectares under restoration by council and volunteers	Not available	n/a	n/a	n/a

Water	7. Water consumption	Water consumption (per capita)	372kL (2000-01), 270kL (2005-06), Decrease*	Annual	LGA	SoE
		Total scheme water consumption	9,510ML (2009) 51.2% increase from 2002	Annual	LGA	SoE
Land	8. Ground cover	Ground cover	Not available	n/a	n/a	n/a
Waste	9. Waste disposed to landfill	Kerbside collection of waste generated per capita	Actual figures not available, only graph (see Figure 6)	Annual (2004-2010)	LGA	SoE
	10. Recycling rates	Kerbside collection of recyclables per capita	Actual figures not available, only graph (see Figure 6)	Annual (2004-2010)	LGA	SoE

Table 21: Social and human capital - data figures

Social and Human Capital						
Theme	**Indicator**	**Measure**	**Data**	**Frequency**	**Spatial resolution**	**Data source**
Educational attainment	11. Educational attainment	% adults with tertiary qualifications	2.5% (2001), 3.0% (2006), Increase*	5 years (Census)	LGA	ABS
		% adults with certificate/ adv diploma	15.2% (2001), 16.3% (2006), Increase*	5 years (Census)	LGA	ABS
	12. Education services	Ratio of childcare places to population of children aged 0-5 years resident in the LGA	Not available	n/a	n/a	n/a
		Ratio of primary school places to population of primary aged children resident in the LGA	Not available	n/a	n/a	n/a
Health	13. Self-reported health status	% reporting fair to poor health	14.4% (2007), WA 9.9% (2007)	2004 & 2007	LGA	PHIDU, compiled from ABS & NHS
	14. Life	Life expectancy	Not available	n/a	n/a	n/a
	15. Persons who smoke daily	% of adults who are daily smokers	16.2% (2007), WA 15.3% (2007)	2004 & 2007	LGA	PHIDU, compiled from ABS & NHS
	16. Obese persons	% of adults who are overweight or obese	40.5% (2007), WA 34.8% (2007)	2004 & 2007	LGA	PHIDU, compiled from ABS & NHS
	17. Mental health	% of adults rated as psychologically distressed	8.0% (2007), WA 7.5% (2007)	2004 & 2007	LGA	PHIDU, compiled from ABS & NHS
	18. Access to open space	Open space per capita	$676m^2$ person (2010) 15.7% decrease from 2005	Annual	LGA	Local Council

Institutions and Governance engagement	19. Fair and functioning institutions and	Levels of trust in key institutions	Not available	n/a	n/a	n/a
	20. Community engagement	% of volunteering	15.2% (2006), 15.3% (2011), Increase*	5 years (Census)	LGA	ABS
Employment	21. Underemployment rate	Hours worked per week	34.9 hours (2011), 1.7% increase from 2007	Annual	NIEIR region	SoR
	22. Unemployment rate	Unemployment rate	Lower Western WA 5.1% (August 2012), WA 3.9% (August 2012)	Monthly	DEEWR labour force region	DEEWR, Labour Force Region
	23. Local employment	Participation rate	Lower Western WA 63.0% (August 2012), WA 68.7% (August 2012)	Monthly	DEEWR labour force region	DEEWR, Labour Force Region
Security	24. Security	Offence rate per 1000 persons	Mandurah, 104.6 (2009-10), -12.5% change from 2008-09 South West, 91.3 (2009-10), -12.5% change from 2008-09 WA, 105.6 (2009-10), -12.5% change from 2008-09	Annual	LGA	Office of Crime Prevention

Table 22: Human capital - data figures

Economic Capital						
Theme	**Indicator**	**Measure**	**Data**	**Frequency**	**Spatial resolution**	**Data source**
Wealth	25. Household net wealth	Wealth per household	$296,000 (2001), $540,000 (2012), Increase*	Annual	NIEIR region	SoR
Housing	26. Housing supply gap	Average dwelling price	$160,200 (2001), $344,900 (2012), Increase*	Annual	NIEIR region	SoR
	27. Housing affordability	Households in rental stress	31.2% (2006); WA 22.8% (2006)	5 years (Census)	LGA	PHIDU
		Households in mortgage stress	9.1% (2006), WA 8.5% (2006)	5 years (Census)	LGA	PHIDU
Transport and infrastructure	28. Mode of transport to work	Car as driver, relative change before/after rail	-1.1% (2007-2008)	3 individual years	LGA	WA Dept. of Transport
		Car as passenger, relative change before/after rail	-6.0% (2007-2008)	3 individual years	LGA	WA Dept. of Transport
		Public transport, relative change before/after rail	59.9% (2007-2008)	3 individual years	LGA	WA Dept. of Transport
		Walking, relative change before/after rail	8.4% (2007-2008)	3 individual years	LGA	WA Dept. of Transport
		Cycle, relative change before/after rail	4.9% (2007-2008)	3 individual years	LGA	WA Dept. of Transport
		Motorcycle, relative change before/after rail	34.0% (2007-2008)	3 individual years	LGA	WA Dept. of Transport
	29. Transport infrastructure	Kilometres of dedicated cycling paths	Not available	n/a	n/a	n/a
	30. Access to broadband	% households with broadband connection	36% (2001), 67% (2006), Increase*	5 years (Census)	LGA	ABS
Income	31. Income disparity	Household debt service ratio	13% (2001), 19% (2011), Increase*	Annual	NIEIR region	SoR

		Average dwelling price to household disposable income	2.0 (2001), 3.2 (2011), Increase*	Annual	NIEIR region	SoR
Productivity and innovation	32. Multifactor productivity	GRP per capita	Mandurah $50,358 (2011), Peel Region $69,733 (2011), Australia $40,234 (2011)	Annual	LGA	Local Council
	33. Innovation	Patent counts per population	8.13 per 100,000 (1994-2011), national average 21.01	Annual	NIEIR region	SoR
Socio-economic status	34. Relative socio-economic	ABS IRSD score	Mandurah 991, Greater Perth 1029, WA 1007	5 years (Census)	LGA	ABS

Table 23: Contextual indicators - data figures

Contextual Indicators						
Theme	**Indicator**	**Measure**	**Data**	**Frequency**	**Spatial resolution**	**Data source**
Population	35. Population size	Number of persons	48.877 (2001), 73,605 (2011), Increase*	Annual	LGA	ABS
	36. Rate of growth	Annual rate of population growth	Average 4.2% per annum 2001-2011	Annual	LGA	ABS
	37. Population density	Number of persons per square kilometre	280.58 (2001), 422.53 (2011), Increase*	Annual	LGA	ABS
	38. Gender and age profile	Gender and age profile	See Figure 3	5 years (Census)	LGA	ABS
Land use	39. Land use change	% infill development	Not available	n/a	n/a	n/a
		% greenfield development	Not available	n/a	n/a	n/a
Cultural diversity	40. Proficiency in spoken English	% do not speak English well or not at all	0.2% (2001), 0.5% (2011), Increase*	5 years (Census)	LGA	ABS
	41. Indigenous population	% Indigenous	1.7% (2001), 1.9% (2011), Increase*	5 years (Census)	LGA	ABS
	42. Country of birth	Country of birth	See Table 24	5 years (Census)	LGA	ABS
Regional migration	43. Net overseas migration	Net overseas migration	Not available	n/a	n/a	n/a

	44. Overseas born	% born overseas	19.4% (2001), 25.4% (2011), Increase*	5 years (Census)	LGA	ABS
	45. Domestic or internal migration	Net number of regional internal migrants	Data inconclusive[36]	Annual (2006-2010)	SLA	ABS

[36] ABS (cat. no. 3412.0) Migration, Australia, 2010-11 experimental regional internal migration estimates. Data for Mandurah inconclusive.

References

ABS 2002, 2001 'Census of Population and Housing'.

ABS 2007, 2006 'Census of Population and Housing'.

ABS 2008, 'Census of Population and Housing: Socio-Economic Indexes of Areas (SEIFA), Australia (cat. no. 2033.0.55.001).

ABS 2012a, 2011 Census of Population and Housing.'

ABS 2012b, 'Time Series Profile', Australia (cat. no. 2003.0).

Baum, S and W. Mitchell 2009, 'Red Alert Suburbs: An employment vulnerability index for Australia's major urban regions', Centre of Full Employment and Equity: Newcastle.

CALM nd., 'Thrombolites of Lake Clifton – Threatened Ecological Communities of Western Australia – Information post', www.dec.wa.gov.au/, accessed 8 September 2012.

City of Mandurah 2009a, 'Keep home fires burning brightly to reduce smoke', media release 16 June 2009.

City of Mandurah 2009b,'Our Strategic Plan 2009-2012'.

City of Mandurah 2009c, 'Submission to the Inquiry into the impact of the global financial crisis on regional Australia', WA Parliament.

City of Mandurah 2010, 'Health and Wellbeing Plan 2010-2012'.

City of Mandurah 2011, 'Annual Report 2010-11'.

City of Mandurah 2012a, 'City's Profile', http://www.mandurah.wa.gov.au/profile.htm, accessed 17 September 2012.

City of Mandurah 2012b, 'Economic Development', http://www.mandurah.wa.gov.au/EconomicDevelopment.htm accessed 20th July 2012.

City of Mandurah 2012c, 'Gross Regional Product', http://www.economicprofile.com.au/mandurah/economy/gross-regional-product, accessed 8 September 2012.

City of Mandurah 2012e, 'Planning Services', http://www.mandurah.wa.gov.au/planning.htm, accessed 17 September 2012.

City of Mandurah 2012f, 'Reducing Your Emissions', http://www.mandurah.wa.gov.au/8985.htm, accessed 17 September 2012.

City of Mandurah 2012g, 'State of the Environment Report: Mandurah 2011'.

City of Mandurah 2012h, 'Submission to the Productivity Commission – Barriers to Effective Climate Change Adaptation.'

City of Mandurah 2012i, 'What is Being Done', http://www.mandurah.wa.gov.au/mosquitoes-what.htm, accessed 21 September 2012.

CZM Pty Ltd 2009, 'Coastal Zone Climate Change Risk Assessment and Adaptation Plan – Summary Document', report prepared for the City of Mandurah.

Department of Conservation and Land Management (DCLM) 2004, 'Thrombolite (Stromatolite-like Microbialite) Community of a Coastal Brackish Lake (Lake Clifton) – Interim Recovery Plan 2004-2009'.

Department of Education, Employment and Workplace Relations (DEEWR) 2012a, 'Labour Force Region', http://www.deewr.gov.au/lmip/default.aspx?LMIP/LFR, accessed 17 September 2012.

Department of Education, Employment and Workplace Relations (DEEWR) 2012b, 'Small Area Labour Market', http://www.deewr.gov.au/lmip/default.aspx?LMIP/SALM, accessed 17 September 2012.

Department of Environment and Conservation (DEC) 2006, 'Draft – A 100-year Biodiversity Conservation Strategy for Western Australia: Blueprint to the Bicentenary in 2029', Government of Western Australia, Perth.

Department of Environment and Conservation (DEC) 2012, 'Western Australia Air Monitoring Report'.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2009, 'Biodiversity hotspots', http://www.environment.gov.au/biodiversity/hotspots/index.html, accessed 8 September 2012.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012, EPBC 'Area Protected Matters Report LGA Mandurah', WA, report created 28/09/12.

Elrick, C., Travers, A., Bond T. and Kay, R. 2008, 'Coastal Zone Climate Change Risk Assessment and Adaptation Action Plan: Issues Paper, report prepared for the City of Mandurah', Coastal Zone Management Pty Ltd, Perth.

Everall Consulting Biologists 2002, 'Economic Development and Recreation Management Plan for the Peel Waterways, report prepared for the Water and Rivers Commission'.

Freemantle in my Community 2011, 'Crime rates on the rise in Mandurah', 23/02/2011 http://fremantle.inmycommunity.com.au/news-and-views/local-news/Crime-rates-on-the-rise-in-Mandurah/7584202/, accessed 25 September 2012.

Hale, J. and Butcher, R. 2007, 'Ecological Character Description of the Peel-Yalgorup Ramsar Site, report to the Department of Environment and Conservation and the Peel-Harvey Catchment Council', Perth, Western Australia.

Landcorp 2012, 'Flora and Fauna Fact Sheet – Mandurah Junction'.

Mandurah Coastal Times, 2012. 'Black cockies extinct in 50 years' Rachel Fenner, 8/02/2012, http://mandurah.inmycommunity.com.au/news-and-views/local-news/Black-cockies-extinct-in-50-years/7613326/.

Mayes, R. 2012, 'Peel Away the Mask II', The John Curtin Institute of Public Policy, Curtin University, for the Peel Community Development Group, February 2012.

National Economics (NIEIR) 2012, 'State of the Regions Report', NIEIR: Canberra.

National Sea Change Taskforce 2012,' Draft Policy Framework'.

Office of Crime Prevention 2010, 'Community Safety and Crime Prevention Profiles City of Mandurah', 2009–10', http://www.crimeprevention.wa.gov.au/uploads/file/Crime%20Profiles%202009-10/Mandurah%202009-10.pdf, accessed 25th September 2012.

Office of Multicultural Interests Department of Local Government (OMI) 2011, 'The people of Western Australia – Statistics from the 2006 Census: Mandurah', http://www.omi.wa.gov.au/omi_diversity_statistics.cfm#Sect3, accessed 8 September 2012

Peel-Harvey Catchment Council 2011, 'Catchment condition and priorities, Peel-Harvey Catchment 2011, a report by Ironbark Environmental to the Peel-Harvey Catchment Council and Regional Development Australia (Peel), Mandurah, Western Australia'.

Peel Development Commission 2012, 'Peel Profile, March 2012'.

Public Health Information Development Unit (PHIDU) 2010, 'A Social Health Atlas of Australia, 2009'.

Regional Development Australia Peel (RDA Peel) 2010, 'The Peel Regional Plan 2011-2016'.

Regional Development Australia Peel (RDA Peel) 2011, 'Peel 2032 – A strategic plan for the Peel Region to overcome its challenges and achieve economic, social and environmental sustainability by 2032'.

Schlesinger, L. 2011, 'Mandurah residents among those with most housing stress in Perth', Property Observer, Tuesday, 13 December 2011, http://www.propertyobserver.com.au/residential/mandurah-residents-among-those-with-most-housing-stress-in-perth/2011121252812, accessed 8 September 2012

State of Western Australia 2009, 'State Planning Policy 3.6 – Development Contribution for Infrastructure, Planning and Development Act 2005'.

Suter, S. and Halsey, N. 2011, 'Shared Use of School Facilities 'Policy Considerations', http://www.lga.sa.gov.au/webdata/resources/files/2010_15_-_Sustainable_Sport___Recreation_Facilities_-_Shared_Use_of_Schools_Report_-_June_2011.pdf, accessed 21 September 2012.

Valle-Levinson, A. 2010, 'Definition and classification of estuaries', Contemporary Issues in Estuarine Physics, Cambridge University Press.

WA Department of Health 2012, 'Mosquito-borne diseases', http://www.public.health.wa.gov.au/3/1187/2/mosquitoborne_diseases.pm, accessed 22 September 2012.

WA Department of Transport 2012, 'Living Smart Households (Sustainability program) – Monitoring and Evaluation'.

WA Planning Commission (WAPC) 2005, 'Forecast Resident Population for the Peel region'.

WA Planning Commission (WAPC) 2008, 'Better urban water management', http://www.water.wa.gov.au/PublicationStore/first/82305.pdf, accessed 17 September 2012.

WA Planning Commission (WAPC) 2009, 'Southern Metropolitan and Peel Sub-Regional Structure Plan for public comment (June 2009)', cited in RDA Peel 2010, The Peel Regional Plan 2011-2016.

WA Planning Commission (WAPC) 2010, 'Outer Metropolitan Perth and Peel Sub-regional Strategy'.

WA Planning Commission (WAPC) 2012a, 'Economic and Employment Lands Strategy: non-heavy industrial Perth metropolitan and Peel regions, Part 12 – Peel sub-region'.

WA Planning Commission (WAPC) 2012b, 'Western Australia Tomorrow Population Report No. 7, 2006 to 2026: Mandurah LGA'.

World Health Organisation 2012, 'Social determinants of health', http://www.who.int/social_determinants/en, accessed 7 September 2012.

Wright, S. 2012 'Mandurah tops list for bankrupts' The West Australian online, March 28, 2012, 4:00 am, http://au.news.yahoo.com/thewest/regional/rockingham/a/-/news/13284559/mandurah-tops-list-for-bankrupts/, accessed 8 September 2012

Xamon, A. 2010, 'Household water consumption – Mandurah', media release Tuesday, June 15, 2010, http://www.alisonxamon.org.au/household-water-consumption-mandurah, accessed 17 September 2012.

Appendix A

Table 24: Contextual indicators - country of birth (Source: ABS, 2012b)

Country of birth	2001	2011	Percentage point change 2001-2010
Australia	74.9%	68.6%	-6.3%
Bosnia and Herzegovina	0.0%	0.0%	0.0%
Cambodia	0.0%	0.0%	0.0%
Canada	0.1%	0.2%	0.0%
China (excl. SARs and Taiwan)	0.0%	0.2%	0.1%
Croatia	0.0%	0.1%	0.0%
Egypt	0.0%	0.0%	0.0%
Fiji	0.0%	0.0%	0.0%
Former Yugoslav Republic of Macedonia	0.0%	0.0%	0.0%
Germany	0.5%	0.4%	0.0%
Greece	0.0%	0.0%	0.0%
Hong Kong (SAR of China)	0.0%	0.1%	0.0%
India	0.3%	0.5%	0.2%
Indonesia	0.1%	0.1%	0.1%
Iraq	0.0%	0.0%	0.0%
Ireland	0.3%	0.4%	0.1%
Italy	0.3%	0.3%	0.0%
Japan	0.0%	0.1%	0.0%
Korea, Republic of (South)	0.0%	0.1%	0.0%
Lebanon	0.0%	0.0%	0.0%
Malaysia	0.1%	0.2%	0.1%
Malta	0.0%	0.0%	0.0%
Netherlands	0.7%	0.6%	-0.1%
New Zealand	1.9%	3.5%	1.6%
Philippines	0.2%	0.6%	0.4%
Poland	0.1%	0.1%	0.0%
Singapore	0.1%	0.2%	0.0%
South Africa	0.4%	1.4%	1.0%
South Eastern Europe	0.1%	0.0%	0.0%
Sri Lanka	0.0%	0.1%	0.0%
Thailand	0.1%	0.2%	0.2%
Turkey	0.0%	0.0%	0.0%
United Kingdom, Channel Islands and Isle of Man	12.4%	13.5%	1.1%
United States of America	0.2%	0.3%	0.1%
Vietnam	0.0%	0.0%	0.0%
Born elsewhere	1.2%	2.0%	0.8%
Country of birth not stated	5.7%	6.0%	0.3%