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From: Jodie Holbrook
Sent: Thursday, 29 September 2012
To:
Subject: WALGA submission: Parliamentary inquiry into FIFO/DIDO work practices

Good afternoon

Please accept this email and the attached Literature Review undertaken by the Western Australian Local Government Association as our submission to the Parliamentary inquiry into FIFO/DIDO work practices.

Western Australian Local Government Association

The Western Australian Local Government Association (WALGA or "The Association") is the united voice of Local Government in Western Australia. The Association is an independent, membership-based organisation representing and supporting the work and interests of all140 Local Governments in Western Australia.

The Association provides an essential voice for approximately 1,250 elected members and over 14,500 employees of the Local Governments in Western Australia and Christmas Island and Cocos (Keeling) Island Councils. The Association also provides professional advice and offers services that deliver financial benefits to Local Governments and the communities they serve.

The Role of Local Government

Local Governments play a key role in Australia's system of government and provide a range of services to their respective communities Today, Local Government is constituted and primarily regulated by the Local Government Act 1995 but there are many other legislative instruments which impact the way Local Governments operate in their diverse array of activities.

Local Governments are a key democratic institution in Western Australia's local communities and Councils have well-established relationships with the communities they serve and represent, local national and international businesses, organisations as well as other spheres of government.

Services provided by Local Governments in Western Australia include the traditional roads and waste collection but also now extend to recreation, medical services and other human services. In a State as socially, geographically and economically diverse as Western Australia, the scale and scope of Local Governments, the services they provide and their service delivery capacity are almost as diverse as Western Australia itself. The challenge for policy-makers is to develop and administer a system of Local Government which provides sufficient flexibility and capacity for all Local Governments to best serve their communities in governance, democratic representation, service delivery and the provision of infrastructure.

Local Government- the challenges

All Local Governments throughout Western Australia strive to provide the highest quality services within the constraints of Local Government revenue streams, Australia's vertical fiscal imbalance and ongoing cost-shifting from other spheres of Government, all of which are well documented by the 2003 Hawker Report.

Beyond systemic funding pressures faced by Local Governments, there are a number of challenges faced by rural and remote Local Governments:

- Difficulty securing key staff and accommodation;
- Increasing community expectations;
- Funding pressures;
- Local Government as the service provider of last resort

These are compounded in regional and remote areas with a Fly in fly out (FIFO) and Drive in Drive Out (DIDO) workforces.

As the service provider of last resort, the financial constraints of Local Governments in rural areas are significantly restricted when Councils fill the void left by other spheres of government to fund medical and other human services which are expected by the community.

There are also geographic factors which impact Local Governments' capacity to fund service delivery and infrastructure upgrades and maintenance. Western Australia, which accounts for approximately one third of the continent of Australia, is sparsely populated and highly urbanised. Approximately 75 percent of the State's 2.2 million people live in the Perth metropolitan region.

The geographic reality of a sparsely populated land mass increases the financial viability challenges that confront Western Australia's 109 country Local Governments. Coupled with geographic factors are the demographic challenges confronting country Local Governments within the context of Australia's ageing population. Many Local Governments in agricultural areas face a trend of population decline, leaving a shrinking rate base to fund renewal and maintenance of ageing infrastructure. Other Local Governments, in 'seachange'or resource-rich locations, face problems associated with rapid growth: Workforce changes with FIFO and DIDO practices, development of new facilities and infrastructure ahead of the community's capacity to pay.

WALGA Submission

The WALGA submission to the Parliamentary inquiry into FIFO/DIDO work is a copy of a literature review that WALGA undertook in 2010 on impacts of Fly in/fly out on Western Australian Communities. The WALGA review considered many of the issues raised in the Committees terms of reference notably:

1. Health effects of the rotating 24/7, 12 hour working roster is having on the working men and women;
2. Economic impacts on small businesses in regard to the FIFO DIDO;
3. Rate revenue lost to the mining communities due to the FIFO and DIDO workforce:
4. Social and cultural impacts working rosters have on communities (eg sporting clubs, community groups, family relations hospital, depression and other mental illness)
5. Costs on Local Government and other community based organizations due to a FIFO and DIDO workforce such as
    a. Additional road costs
    b. Impacts of increased traffic
    c. Impacts of local health and medical services
    d. Impact on Volunteer emergency services provision; and
    e. Impacts on local policing services.

The research identified that there is a clear lack of baseline data or evidence in many areas, particularly in reference to the impact on and role of Local Government.

To date, much of the research into FIFO has focussed on the impact on individual and families and did not into account any impact on the broader community. WALGA referred this body of research to the Australian Centre for Excellence in Local Government Excellence (ACELG) ACELG was established in 2009 to showcase innovation and best practices across Local Government and encourage the adoption of innovative practices and solutions. In WA ACLEG has partnered with Edith Cowan University, which has previously supported research students from the school of psychology to undertake research into the impact of FIFO on individuals. WALGA understands ACELG is looking at developing a research project on the impact of FIFO and the Local Government sector in 2012.

RECOMMENDATION

Much of the evidence and data that exists in Western Australia is anecdotal and limited to the Pilbara region of Western Australia.

There is a need to establish a stronger evidence base to encourage better outcomes and improve long term sustainable community planning.

WALGA hopes that the outcomes of the Inquiry will support the need for better research and development of strategies to support communities with FIFO /DIDO workforces.

This submission has not been endorsed by our WALGA State Council at this time. As such I request that the submission is considered interim and is not made public on the website until WALGA confirms that it has been endorsed.

I would be happy to provide more information if requested by the Committee and can be contact

Yours sincerely

Jodie Holbrook
WALGA Policy Manager Community

Research into the Impacts of Fly-in/Fly-out on Western Australian Communities

Literature Review

September 2010

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Planning & Community Development Policy Officer

Contents

1. Executive Summary

Fly-in/Fly-out (FIFO) has become a common practice in the Australian land-based mining industry since the 1980s. In general there are a number of economic benefits to using FIFO over the construction of new mining towns, including:

- Relative costs of FIFO operations in comparison with the establishment and continued operating costs of conventional towns;
- Continuing improvements in the cost, reliability and safety of transport;
- Conventional towns lack the economic diversity and alternative employment opportunities required by contemporary two income families.

While there may be economic benefits for the mining industry, FIFO might thus be seen as a benefit to larger or metropolitan centres as it adds further diversity to their economic bases. At the same time FIFO can be destructive to local communities where it results in infrastructure and service demands that the communities cannot meet, or erosive where a shift from —permanent to FIFO communities reduces the economic viability of local infrastructure and services. FIFO, where it occurs near established communities, may also threaten those towns by reducing the number of workers who, through their relocation, might otherwise have been potential direct contributors to the social and financial well-being of those centres.

In 2005 the Chamber of Minerals & Energy Western Australia (WA) reviewed the impact of mining settlements and FIFO on environmental sustainability. In terms of ecological footprint, a FIFO camp occupies a much smaller footprint than a residential town. The establishment of a town requires extensive land clearing for housing, roads and recreational facilities, including the provision of essential infrastructure on a much larger scale than that of a FIFO camp: power, water and wastewater treatment.

The move away from conventional mining towns lacking in health, education, social, recreation and retail services towards FIFO arrangements has seen an improvement in the quality of life for some mine workers. Mining employees working compressed and long rosters have limited leisure time during the work period, but can have limited leisure time during the work period, but have an uninterrupted block of leisure time during their leave period. The benefits of having blocks of leave include uninterrupted relaxation periods; being able to undertake and complete projects within a short time frame (e.g. home repairs); accessing community services during standard working hours; and more time to spend with children (e.g. volunteer at school during school hours, spend time together after school). In saying this, the latest statistics from WA indicate that 74 per cent of FIFO employees found it hard to participate in the community.

There are many anecdotal claims that FIFO has negative impacts on WA mining employees, leading to elevated risk of high stress levels, depression, binge drinking, and recreational drug-use. However, the most recent study into health impacts of FIFO revealed that FIFO and extended working hours did not lead to poor quality relationships, high stress levels or poor health, on average in the long-term; there were generally no

significant differences in these characteristics between FIFO and Daily Commute employees, or between the FIFO sample and the wider community.

In conclusion, while there is a significant amount of negative publicity given to FIFO in the WA media, a stronger evidence base is needed to confirm the veracity of these claims. Furthermore, the research indicates that many mining companies are working proactively to improve the working conditions and experience of their employees, and the benefits experienced by some individuals and families should not be overlooked.

2. Introduction

At June's State Council meeting, the following project scope was endorsed.

That WALGA:

1. **undertake a desktop study[1] on the impacts of 'fly-in/fly-out', 'drive-in/drive-out', working rosters and the effects they are having on the mining communities of Western Australia to determine:**
   a) **health effects that the rotating 24/7, 12-hour working roster is having on the working men and women;**
   b) **economic impacts on small businesses in regard to the 'fly-in/fly-out', 'drive-in/drive-out';**
   c) **rate revenue lost to the mining communities due to the 'fly-in/fly-out', 'drive-in/drive-out', work force;**
   d) **social and cultural impacts working rosters have on the communities (e.g. sporting clubs, community groups, family relationships, hospitals, depression/suicide and other mental illness);**
   e) **costs on local government and other community based agencies due to a 'Fly-in/Fly-out' and 'Drive-in/Drive-out' workforce, such as:**
      - **additional road costs to local roads;**
      - **impact of increased traffic – road safety;**
      - **impacts on local health and medical services;**
      - **impacts on local volunteer emergency services provision; and**
      - **impacts on local policing services.**
2. **engage with the various agencies / peak bodies that have already investigated 'fly-in/fly-out', 'drive-in/drive-out' matters to avoid duplication of effort; and**
3. **advise State Council on the outcome of the desktop study and the feasibility/costs of developing and undertaking further action.**

Moved Mayor Ron Yuryevich / Seconded Cr Henry Zelones **CARRIED**

[1] A literature review is an examination of the research that has been conducted in a particular field of study and can be defined as:

- The **selection of available documents** (both published and unpublished) on the topic, which contain information, ideas, data and evidence. [This selection is] written from a particular standpoint to fulfil certain aims or express certain views on the nature of the topic and how it is to be investigated, and
- The **effective evaluation** of these documents in relation to the research being proposed (p. 13) [C. Hart, *Doing a Literature Review: Releasing the Social Science Research Imagination*, London, Sage, 1998].

3. Literature Review

3.1 Introduction

Western Australia (WA) has a large mining industry which directly employs approximately 56,000 people.[2] There are currently more than 100 mine sites and refineries in operation, of which the majority are located in remote areas. There are difficulties in staffing remote mine sites using the local population, as three quarters of the WA population live in the Perth metropolitan region.[3]

The Mines Department of WA in its 1991 survey exploring the demography of the Long Distance Commuting (LDC) or Fly-In/Fly-Out (FIFO) employment phenomenon in WA concluded that FIFO had 'a minimal impact on the mining industry and was not expected to increase in a major way, in the foreseeable future'. The 1991 report was instigated in response to concerns expressed by Local Government on the negative impact of LDC and the perceived effect this might have on regional economies.[4]

Regional strategy documents and the media repeatedly emphasise the view that resource development companies[5] which operate in rural regions benefit from the resource in those regions but, by accessing their workforces and buying supplies and services from the larger centres, give little back to the regions.[6] In Australia, these 'fly-over'[7] effects are perceived to harm rural regions in a number of ways, including:

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[2] Australian Bureau of Statistics, *Labour Force, Australia, Detailed, Quarterly, Feb 2008, Western Australia*, 2008.

[3] Department of Industry & Resources, *Minerals and Petroleum*, Perth, Department of Industry & Resources, 2007 and Australian Bureau of Statistics, *Demography, Western Australia, 2004, Final*, 2006 quoted in S. Clifford, *The Effects of Fly-in/Fly-out Commute Arrangements and Extended Working Hours on the Stress, Lifestyle, Relationship and Health Characteristics of Western Australian Mining Employees and their Partners*, Perth, School of Anatomy and Human Biology, The University of Western Australia, Doctor of Philosophy, 2009, p. 1. By way of contrast, Local Government in WA employees approximately 13,000 employees.

[4] J. Watts, *Best of Both Worlds? Seeking a Sustainable Regional Employment Solution to Fly In - Fly Out Operations in the Pilbara*, Karratha, Pilbara Regional Council, 2004, p. 27.

[5] The relationship between mining companies and communities is explored in a series of Victorian case studies. See H. Cheney, R. Lovel & F. Solomon, *People, Power and Participation: A Study in Mining – Community Relationships*, <http://www.minerals.csiro.au/sd/CSIRO_Paper_MMSDfinal_11-2-02.pdf>, London, Mining, Minerals and Sustainable development Project, International Institute for Environment and Development, 2002 (Accessed 3 September 2010).

[6] The State Government Agreement, Royalties for Regions goes some way to addressing this issue, where the equivalent of 25 per cent of the of the State's mining and onshore petroleum royalties is returned to regional areas as an additional investment in projects, infrastructure and community services. See the Royalties for Regions website for further information: http://www.royaltiesforregions.wa.gov.au/

[7] K. Storey & M. Shrimpton, 'The Social and Economic Impacts of Long Distance Commuting on Employment in the Resource Sector', *Proceedings of the Annual Meeting of the Canadian Association of Geographers*, Hamilton, Ontario, Canada, McMaster University, 26–30 May 1987 quoted in K. Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', *Sustainability*, <http://www.mdpi.com/2071-1050/2/5/1161/pdf>, Vol. 2, 2010, (Accessed 16 June 2010), p. 1163.

- Failing to provide employment or training opportunities for people in the regions;[8]
- encouraging the removal of young people from communities in search of employment;[9]
- Inhibiting population growth, or leads to population decline, in rural communities as a result of lost training or employment opportunities;[10]
- Decreasing the share of benefits to local communities from resource developments;[11]
- Undermining government policy with respect to decentralisation and regional economic stability or growth;[12]
- Benefits of resource developments in remote areas accrue to larger, distant, metropolitan urban centres;[13]
- Smaller regional centres experiencing additional cost burdens resulting from the need to provide services for transient workers and operators, with little return on investment.[14]

Despite the disadvantages to rural regions, there are a number of factors which encourage mining companies to continue using FIFO operations including:

- Improved quality, and lower cost, of communications;
- Improvements in aircraft and aircraft safety, and relatively lower air travel costs;
- Lower turnover and absenteeism levels than in resource towns; and
- Preference for metropolitan living by many workers and their families.[15]

Further to the commercial advantages for mining companies in the use of FIFO operations, Storey has identified the key factors inhibiting the development of new mining communities in remote locations as:

- Cost of building and operating new resource towns;
- Absence of government financial support for new town development;
- Longer lead time for new town approvals and construction;
- Environmental implications of new town construction;
- Administrative implications of managing a company town in addition to a mine; and
- Increased costs associated with town closure, once resource is exhausted or no longer economically viable.[16]

[8] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1163.
[9] Ibid., p. 1163.
[10] Ibid., p. 1163.
[11] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1163. For a discussion of Australian mineral royalties, see L. Hogan & K. Donaldson, 'Mineral royalties: net economic benefits of mining in Australia', <http://www.abare.gov.au/publications_html/ac/ac_00/ac00_sept.pdf>, *Australian Commodities*, Vol. 7, No. 3, Sept 2000, pp. 519-531 (Accessed 30 June 2010).
[12] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1163.
[13] Ibid., p. 1163.
[14] K. Storey, 'Fly-in/fly-out and Fly-over: Mining and Regional Development in Western Australia', *Australian Geographer,* Vol. 32, 2001, p. 146.
[15] Ibid., p. 136.

As Sibbel notes, despite the number of years FIFO has been used as an employment practice in Australia, and the plethora of articles about the impacts of shiftwork and Long Distance Commuting internationally, only a small number of studies have been undertaken to understand its psychosocial impacts on communities and individuals.[17] In relation to the available studies on Western Australian FIFO practices, the literature focuses almost exclusively on the Pilbara region and there is limited evidence or specific research available relating to other regions.

As studies in Queensland have illustrated:

> *At a broad level, the impacts of the mining industry on the state's economy and social capital are clear and substantial. At the regional and local level though, the impacts are not so easily defined, particularly for a single mine. This is for two key reasons. Firstly, it is not transparent what the economic and social impacts of mining are on a particular region or local area compared to other industries and the provision of public services. Secondly, there is some diversity in the operations and supply of labour to mines, making it harder to identify the impacts of a particular operation on economic and social factors.*[18]

This literature review seeks to identify the main studies which have been undertaken into the economic, social, environmental and health impacts of FIFO on the workers, families and communities of Western Australia.

3.1.1 Defining 'Fly-In/Fly-Out'

The use of 'Fly-In/Fly-Out' as a descriptor for the work style to be explored in this desktop literature review is not wholly accurate and difficulty in selecting an appropriate term to describe the work style has been identified by a number of authors in the field.[19]

The practice has also been referred to as 'Long Distance Commuting' or 'commuter mining', however, for the purposes of this review, the common parlance 'Fly-In/Fly-Out' (FIFO) will refer to:

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[16] Ibid., p. 136.

[17] A. M. Sibbel, 'Editorial: Special Section on Fly-in/Fly-out', *The Australian Community Psychologist*, Vol. 21, No. 2, 2009, p. 5.

[18] J. Rolfe, S. Lockie & M. Franettovich, *Economic Impacts of Coal Mining on Small Country Towns – A Case Study of Nebo*, Paper presented at the 48th Annual Conference of the Australian Agricultural & Resources Economics Society, Melbourne, 2004.

[19] See Storey, 'Fly-in/fly-out and Fly-over', p. 147; M. Shrimpton & K. Storey, *The Effects of Offshore Employment in the Petroleum Industry: A Cross-National Perspective*, OCS Study MMS 2001-041, Herndon, Virginia, U.S. Department of the Interior, Minerals Management Service, Environmental Studies Program, 2001, p.1; R. Beach, D. Brereton & D. Cliff, *Workforce Turnover in FIFO Mining Operations in Australia: An Exploratory Study*, <http://www.csrm.uq.edu.au/index.html?page=5262#Community>, Brisbane, Centre for Social Responsibility in Mining and the University of Queensland Social Research Centre, 2003 (Accessed 24 June 2010), pp. v-vi.

Circumstances of work where the place of work is sufficiently isolated from the worker's place of residence to make a daily commute impractical.[20]

FIFO employment practices generally display the following characteristics:

- 'Involve work in relatively remote locations where food and lodging accommodation is provided for workers at the work site but not for their families';[21]
- A roster system where workers spend a fixed number of days at the work-site followed by a fixed number of rest days at home;
- Employees usually commute from a home base located in a large city, coastal community or large established town;[22]
- Typically, the employer organises and pays for transportation to and from the worksite and for worker accommodations and other services at, or near, the worksite;[23]
- Although flying is the most common form of transport, some employees drive-in and drive-out (DIDO) using either company-provided, or private road transport.[24]

3.1.2 Historical Context

Fly-In/Fly-Out (FIFO) has been used by the offshore oil industry since the 1940s in the Gulf of Mexico, and was first used in Australia in the 1960s to fly employees to and from offshore and onshore oil rigs and facilities.[25] It became a common employment practice in the Australian land-based mining industry since the 1980s.[26] In the last 20 years, the number of WA FIFO employees has increased 400 per cent during this time.[27] In WA alone,

[20] Watts, *Best of Both Worlds?*, p. 26.
[21] Storey, 'Fly-in/fly-out and Fly-over', p. 135.
[22] A. D. S. Gillies, H. W. Wu & S. J. Jones, 'The increasing acceptance of fly-in fly-out within the Australia Mining Industry', *Proceedings of the Australasian Institute of Mining & Metallurgy Annual Conference*, 1997, p. 2. See also A. D. S. Gillies, G. D. Just & H. W. Wu, 'The success of fly-in fly-out Australian mining operations', *Proceedings, Second Gold Forum on Technology and Practice*, Melbourne, The AusIMM, 1991, pp. 391-397.
[23] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1161.
[24] Sibbel, 'Editorial: Special Section on Fly-in/Fly-out', p. 5.
[25] L. Hogan & P. Berry, 'Mining and regional Australia: some implications of long distance commuting', <http://www.abare.gov.au/publications_html/ac/ac_00/ac00_dec.pdf>, *Australian Commodities*, Vol. 7, No. 4, Dec 2000, p. 648 (Accessed 30 June 2010); D. Houghton, 'Long distance commuting: A new approach to mining in Australia', *The Geographical Journal,* Vol. 159, 1993, p. 283; Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 10.
[26] K. Storey & M. Shrimpton, ' "Fly-in" mining: Pluses and minuses of long distance commuting', *The Mining Review,* Vol. 15, No. 6, 1991, pp. 27-35 quoted in Sibbel, 'Editorial: Special Section on Fly-in/Fly-out', p. 5.
[27] Hogan & Berry, 'Mining and regional Australia', pp. 648-659; Chamber of Minerals & Energy Western Australia, *People at Work 2005*, Perth, Chamber of Minerals & Energy Western Australia, 2005; Chamber of Minerals & Energy Western Australia, *Fly-in/Fly-out in the Western Australian Resources Sector*, Perth, Centre of Minerals & Energy Western Australia, 2008; and Department of Mines, *The Demography of Long Distance Commuting in the Western Australian Mining Industry*, Ontario, Centre for Resource Studies, Queens University, 1991 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 1..

approximately 20,000 of WA's mining employees are employed under FIFO arrangements.[28]

Prior to the introduction of FIFO in the 1980s, all permanent WA mining employees needed to live near a mine site.[29] Mineral development was traditionally accompanied by the growth of permanent settlement, and many of the state's interior communities have a mining heritage.[30]

As previously noted, the majority of mine sites are located in remote locations, necessitating the construction of new towns or development of existing towns for mine employees and their families. Twenty-five new mining towns were built in Australia between 1960 and 1975,[31] with numerous WA towns including Tom Price, Karratha, Newman and Paraburdoo, created or developed to accommodate the mine employees and their families.[32] The development and ongoing running costs associated with mining towns substantially inflated the cost of setting up and operating new mines.[33]

Figure 1: Development of the mining industry in Western Australia[34]

	Foundation to 1950s
PHASE 1	Numerous small mining towns were established – the lack of capability in transportations meant that the transit of mine workers, inputs and outputs could only occur in short hops and was a slow process. Towns were serviced by a narrow gauge railway system and very poor road network.
	1960s to mid 1980s
PHASE 2	The State's minerals boom was strongly reliant on residential workforces. Remote townships were developed by mining companies – in some cases, due to logistical factors and in others, as a response to government policy. Later on in this phase of development, there was a move towards 'normalisation' of company towns, where mining companies relinquished ownership of the towns and they became part of the normal Local Government structure.

[28] Australian Bureau of Statistics, *Labour Force, Australia, Detailed Quarterly, Feb 2008, Western Australia*, 2008; Chamber of Minerals & Energy Western Australia, *People at Work 2005*, Perth, Chamber of Minerals & Energy Western Australia, 2005 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 3.
[29] M. C. Graham, *The changing face of fly-in/fly-out mining operations in Australia,* Sydney, School of Mining Engineering, University of New South Wales, Bachelor of Engineering (Honours), 2000, p.1.
[30] Storey, 'Fly-in/fly-out and Fly-over', p. 133.
[31] Gillies, Just & Wu, 'The success of fly-in fly-out Australian mining operations', p. 391; Houghton, 'Long distance commuting', p. 283.
[32] Hogan & Berry, 'Mining and regional Australia', p. 648.
[33] Houghton, 'Long distance commuting', p. 282; Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 10.
[34] Chamber of Minerals & Energy of Western Australia, *Fly in/Fly out: A Sustainability Perspective*, Perth, Chamber of Minerals & Energy of Western Australia, 2005, p. 5.

	Mid 1980s to present
PHASE 3	Economic reform exposed Australian exporters to global competitive pressures. This led to the adoption and increasing use of FIFO practices to: • increase competiveness by reducing costs – the development of entire towns was no longer economically viable; • address skills shortages by providing FIFO as an attractive employment option; and • meet the lifestyle expectations of workers and families.

Over the past 25 years, what Storey terms the 'no town' model has replaced that of the 'new town'. According to Storey, this was 'encouraged by the expansion of mining activity into increasingly remote areas at a time when corporate interests were focusing on 'lean' and 'flexible' modes of production and when governments were unwilling to support the development of new single-industry communities in remote areas.'[35]

In some recent developments, the introduction of a 'temporary community' model is now being used in, or adjacent to, established communities to accommodate project labour, which Storey suggests means that it is not 'remoteness' that is necessarily the principal driver in decisions regarding the use of this approach.[36] Even some previous mining towns such as Telfer, have been converted from residential towns to FIFO camps, with retention of the enhanced facilities.[37]

3.1.3 Mining Communities in Western Australia

Veiga et al. define a sustainable mining community as 'one that realises a net benefit from a mining operation from the start of mining, through life of mine and beyond mine closure.'[38] In practical terms, the prerequisites for a sustainable community are:

- Ecological sustainability;
- Economic vitality; and
- Social Equity.

[35] K. Storey, 'Commute Work, Regional Development and Settlement Strategies', *Proceedings of the Conference on the Role of the State in Population Movements*: *The Circumpolar North and Other Periphery Regions*, Rovaniemi, Finland, 26–28 October 2009 quoted in Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1162.

[36] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', pp. 1161-1162.

[37] Watts, *Best of Both Worlds?*, p. 45.

[38] M. M. Veiga, M. Scoble & M. L. McAllister, 'Mining with Communities', *Natural Resources Forum*, Vol. 25, No. 3, 2001, pp. 191-202 quoted in J. Tuck, J. Lowe & P. McRae-Williams, *Managing Community Relationships, Reputation and Sustaining Competitive Advantage: The Case of Mining Towns*, <http://www.cecc.com.au/clients/sob/research/docs/jtuck/tuck_lowe_mccrae_Country_towns.pdf>, Paper presented to the 2nd Future of Australia's Country Towns Conference, Bendigo, 11-13 July 2005, Melbourne, Centre for Sustainable Regional Communities, La Trobe University, 2005 (Accessed 3 September 2010), p. 5.

In examining the criteria for the establishment of a new town, Pilbara Iron has outlined a number of factors in the Pilbara region that work against the financial viability of independent 'normal' towns, including:

- *The lack of robust population growth. The likely outcome for the region is stable or declining resident population;*
- *Aged infrastructure. In many areas, town infrastructure is close to 40 years old and major upgrades are needed;*
- *Infrastructure and assets are spread over large geographic areas and there is limited ability to achieves economies through sharing resources;*
- *Pilbara residents and the major employers have high expectations of quality and delivery of services; and*
- *Pilbara shires have limited revenue opportunities and are reliant on the grants process.*[39]

Research by Curtin University has identified the characteristics of an 'ideal' town in contrast with that of the stereotypical company-dominated town. An 'ideal' town has:

- *A resilient economy*
- *High levels of social and economic capital*
- *A balance of public and private investment*
- *A sense of community and belonging*
- *Robust and inclusive social and local networks*
- *Local formal and informal leadership and decision-making*
- *Adequate goods and services*
- *A young population with high average education levels*
- *Tolerance of diversity*
- *A high proportion of owner-occupied accommodation*
- *Upward population growth*

By contrast, a company-dominated town tends to have:

- *A polarised 'mono-economy'*
- *A tendency to exclude entrepreneurialism and outsiders*
- *A high service and amenity demand*
- *The company determining property rights*
- *Paternalistic practices*
- *Little or no social capital*
- *A tendency to exclude new ideas and cultures*
- *The company heavily influencing local governance*
- *Reduced local capacity for decision-making*[40]

[39] Pilbara Iron, *Understanding the Pilbara Region and Its Economy: A Baseline Socio-Economic Assessment*, <http://www.riotintoironore.com/documents/pilbara_researchdocument.pdf>, Perth, Pilbara Iron, 2005 (Accessed 3 September 2010).
[40] Ibid.

As the Pilbara Iron report suggests, while there may be major impediments for some towns to achieve 'ideal' town status, 'aspirational planning by government and industry can help to ensure that many of the ideal attributes are met'.

Despite the variation between mining communities, community 'wellbeing' is 'inextricably linked with the associated mining company operations within that community, irrespective of the type of mining community'.[41] The following provide examples of some mining community models currently being practiced in WA:[42]

Purpose-built Town to Normalisation – Tom Price, Shire of Ashburton

Tom Price was purpose-built by Hamersley Iron in 1965 after rich deposits of iron-ore were discovered in the nearby Hamersley Ranges. It was officially named Tom Price Townsite in 1967, but was not a gazetted townsite until 1985.[43]

When Hamersley Iron initially built the town the company had 'full control and responsibility over all aspects of town management, maintenance and development' and was classified as a 'closed town'.[44]

During the 1980s, a process of normalisation occurred, with State and Local Government starting to assume responsibility for standard functions of the community. The majority of State and Federal Government functions were also transferred to the relevant government entity during the 1980s, as well as the transfer of accountability for assets and services to Local Government.

Pilbara Iron currently retains responsibility for township utilities and provides in-kind maintenance and management services.[45]

The town today has a wide range of facilities including a major supermarket, bank, doctor, hospital, fuel outlets, library, primary schools, a secondary school, TAFE, and several motels and restaurants. There are also three large ovals, a lawn bowls green, indoor cricket centre, eighteen-hole golf course, an Olympic-size swimming pool, and tennis, netball, basketball and squash courts. [46]

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[41] Tuck, Lowe & McRae-Williams, *Managing Community Relationships,* p. 5.

[42] Initial classification of the host communities at the point of entry of a new mining operation may include: New single company mining towns; New central (multi-company) mining towns; Existing town with a diverse economic base; Existing town in transition from mining dependence to broader economic base; Existing town currently mining dependent; FIFO site and associated community; or FIFO base, distant city or town from mining operation [Tuck, Lowe & McRae-Williams, *Managing Community Relationships,* p. 5].

[43] Landgate, 'Tom Price', *History of Country Town Names*, <http://www.landgate.wa.gov.au/corporate.nsf/web/History+of+Country+Town+Names>, (Accessed 2 September 2010).

[44] Pilbara Iron, *Understanding the Pilbara Region and Its Economy*.

[45] Ibid.

[46] Shire of Ashburton, 'Tom Price', <http://www.ashburton.wa.gov.au/community/townsites/tom_price.html>, (Accessed 2 September 2010).

A Baseline Community Assessment of Tom Price, conducted by Rio Tinto Iron Ore in 2007 found that:

> *there appears to be a collective uncertainty over the identity of the town. This issue centres on whether Tom Price is a 'mining town', or a 'town with a mine'. In many respects, interviewees felt that the answer determined the level of investment within the town, and hence the community spirit, cohesiveness and ultimately the outlook for the future.*[47]

The current Tom Price Town Centre Revitalisation Project will undoubtedly contribute to the continued development of Tom Price.[48]

Purpose-built Town to FIFO Camp – Telfer, Shire of East Pilbara

The town of Telfer was built in 1976 by Newmont Mining to accommodate workers at the Telfer gold mine. By the early 1990s, the population had grown to almost 1,000 and community services included a supermarket, police station, bank, community hall, library and sporting facilities. According to Storey, 'at this time the community had all of the characteristics of a remote mining town with a male/female ratio of 2.4/1, 50 per cent of the population under the age of 35 and an annual turnover in population of 20 per cent'.[49]

In 1990, a merger between Newmont Australia Ltd and BHP Gold Ltd resulted in the creation of Newcrest Mining, with ownership of the Telfer mine now lying with Newcrest.[50]

In 1996 Newcrest Mining made the decision to switch to FIFO operations. The rationale was 'to give the mine access to a larger supply of skilled workers and to those who would otherwise have been unwilling to relocate to Telfer'.[51] This change resulted in all commercial services being withdrawn, and only recreational facilities were retained. Existing housing was used to accommodate the FIFO workers.

Operations at Telfer mine were suspended in 2000 because of escalating operating costs but in 2002 Newcrest announced a redevelopment plan and the mine was officially reopened in 2005 as a FIFO operation, with approximately 1000 personnel onsite.[52]

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[47] Rio Tinto Iron Ore, *A Baseline Community Assessment: Tom Price*, 2008.

[48] Shire of Ashburton, 'Tom Price Town Centre Revitalisation Project', <http://www.ashburton.wa.gov.au/TPTCR1>, (Accessed 2 September 2010). The need for revitalisation of Tom Price was also identified by Rio Tinto Iron Ore, *A Baseline Community Assessment: Tom Price*, 2008.

[49] G. G. Moore, *Mining Towns in Western Australia*, Chamber of Minerals & Energy of Western Australia, Perth, 1997 quoted in Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1172.

[50] Newcrest Mining Ltd, 'History of NCM', <http://www.newcrest.com.au//history.asp>, 2006, (Accessed 3 September 2010).

[51] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1172.

[52] Newcrest Mining Ltd, 'Operations – Telfer', <http://www.newcrest.com.au/operations.asp?category=6>, 2006, (Accessed 3 September 2010).

The underground mine at Telfer has a forecasted life of a further 7 years (to 2017) and the open pit for 13 years (to 2023).

Purpose-built Town to Mixed Residential/FIFO – Leinster, Shire of Leonora

The town of Leinster was established as a 'closed' or company town in 1976 by the Agnew Gold Mining Company to provide accommodation facilities for workers at the nearby Agnew nickel mine.[53] The town was originally planned as a 210-residential unit community.

The mine struggled for financial viability in the early 1980s and was eventually closed: both the mine and town were place under 'care and maintenance'.

In 1989 WMC Resources (now part of BHP Billiton) purchased the operation and recommenced mining. The town was repopulated, providing accommodation for workers from its Leinster Nickel and Agnew Gold operations.[54]

According to Storey, 'the town's status as a closed, company town added to its attractiveness as a residential option',[55] and 'that the metaphor of 'an oasis in the desert' was a recurring theme in residents' description of the town'.[56]

The situation changed when WMC Resources offered workers the opportunity to be residents of the town, or work FIFO rosters. By 2000, the population was approximately 1,400, of whom 587 were residents (including workers, children and non-working spouses) and the remaining two-thirds FIFO workers.[57]

A 2005 study found that the shift from residential workforce to predominantly FIFO operation had caused a shift in the town. According to Pattenden:

> *material infrastructure in the residential part of the town was less utilised and deteriorated. Town shops lost a large part of their client base and service to residents declined. There was a significant reduction in the number of people who had any involvement in the organisation of and participation in community activities such as sport and social functions. The number of school children declined bringing into question the viability of schooling in the community and further reduced the opportunities for interaction activity and stimulation that parents regarded as necessary for healthy child development. Furthermore, the decline in the number of social contacts added to the 'burn-out' factor associated with the*

[53] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1172.
[54] Shire of Leonora, 'Leinster Township', <http://www.leonora.wa.gov.au/about_us/leinster_township.html>, 2007 (Accessed 2 September 2010).
[55] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1172.
[56] C. Pattenden, *Shifting Sands: Transience, Mobility and the Politics of Community in a Remote Mining Town*, Unpublished PhD Thesis, Perth, University of Western Australia, 2005 quoted in Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1172.
[57] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1172.

> *intensity of living, working and socialising in close proximity with the same group of people and turnover in the residential workforce increased.*[58]

In 2000-01, WMC Resources conducted a review of the town's future. According to Storey, many of the town's residents believed that 'the outcome of the review would be the dismantling of the town's residential infrastructure and a conversion to FIFO only'.[59]

Today the town consists of 283 houses, a caravan park, some 800 single persons' quarters and motel services supporting a population of 700 residents and 700 FIFO personnel. The town has facilities including a major supermarket, beautician, post office, service station, newsagency, coffee shop, hairdressing salon, nursery, primary school, pre-primary centre, day-care centre, playgroup, doctor, Silver Chain Nursing Post and St John's Ambulance sub-centre.

Leinster has an Olympic-size swimming pool, health and fitness centre, two air-conditioned squash courts, basketball, netball and tennis courts, a grassed oval and an air-conditioned indoor sporting stadium. There is also an 18-hole golf course and race course.[60]

3.1.4 Demographic Data

Gender and Age Profiles

Only 21 per cent of employees in the WA mining industry are women. Most (approximately 79 per cent) of the male WA mining employees are aged between 25 and 54, while female WA mining employees tend to be older than women working in other WA industries.[61] Around 45 to 50 per cent of Australian FIFO employees are married, and an additional 20 to 25 per cent are in a de facto relationship, which reflects the marital status profile of the broader community.[62]

Place of Residence

Maxwell's analysis of ABS data demonstrates the importance of commuting workforces in a number of mineral-orientated Local Government areas [Figure 2].

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[58] C. Pattenden, *Shifting Sands: Transience, Mobility and the Politics of Community in a Remote Mining Town*, Unpublished PhD Thesis, Perth, University of Western Australia, 2005 quoted in Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', pp. 1172-3.

[59] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1173.

[60] Shire of Leonora, 'Leinster Township'.

[61] Australian Bureau of Statistics, *Social Marital Status by Age and Sex – Western Australia, 2006*, 2008, quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 18.

[62] Australian Mines and Metals Association, *Long Distance Commuting: A Road Well Travelled*, Melbourne, Australian Mines and Metals Association, 1998 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 20.

Figure 2: Visitors as a Percentage of Total Employment: Selected Regions and Shires of Western Australia – 1991 and 1996 Censuses[63]

	1991	1996
Statistical Division		
Perth	0.060	0.066
South West (Bunbury)	0.084	0.094
Lower Great Southern (Albany)	0.101	0.108
Pilbara (Port Hedland/Karratha)	0.260	0.336
Central (Geraldton)	0.382	0.417
Local Government Areas		
Ashburton (includes Newman)	0.320	0.426
Coolgardie (includes Kambalda)	0.110	0.166
Cue	0.545	0.693
East Pilbara	0.216	0.373
Kalgoorlie-Boulder	0.113	0.142
Laverton	0.283	0.607
Leonora (includes Leinster)	0.318	0.491
Mount Magnet	0.334	0.288
Port Hedland	0.214	0.281
Roebourne (includes Karratha)	0.288	0.302

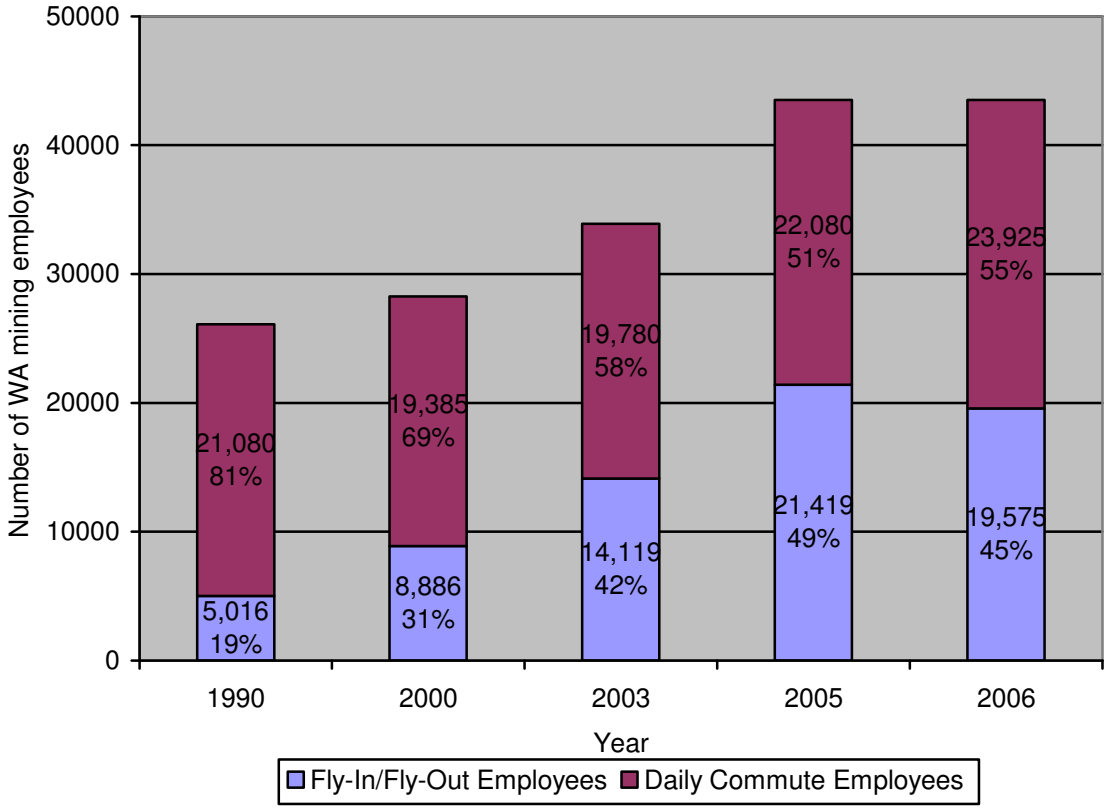
Source: Australian Bureau of Statistics

The increases were particularly notable in the Pilbara shires and in the northern goldfields shires of Laverton and Leonora. Differences in proportions are particularly evident when comparing the largely resident populations of the City of Kalgoorlie-Boulder and the Shire of Coolgardie, and the largely FIFO populations of Leonora and Laverton.[64]

The proportion of WA mining employees using FIFO increased from 19 per cent in 1990 to 31 per cent in 2000 [Figure 3]. The proportion of WA mining employees using FIFO peaked at 49 per cent in 2005, while the most recent data suggests around 45 per cent of the WA mining industry employees are FIFO.

[63] P. Maxwell, *The Rise of Fly-in, Fly-out: A Mineral Industry Perspective on Work Place, Residence and Regional Development in Western Australia*, Perth, Minex: Mining and Exploration International Conference and Expo, 2001, p. 17.
[64] Ibid., p. 17.

Figure 3: Approximate number of WA mining employees using FIFO and Daily Commute (DC) arrangements between 1991 and 2006[65]



In a 2005, the Chamber of Minerals & Energy WA's survey of over 100 mining operations and over 18,000 mining industry personnel showed:

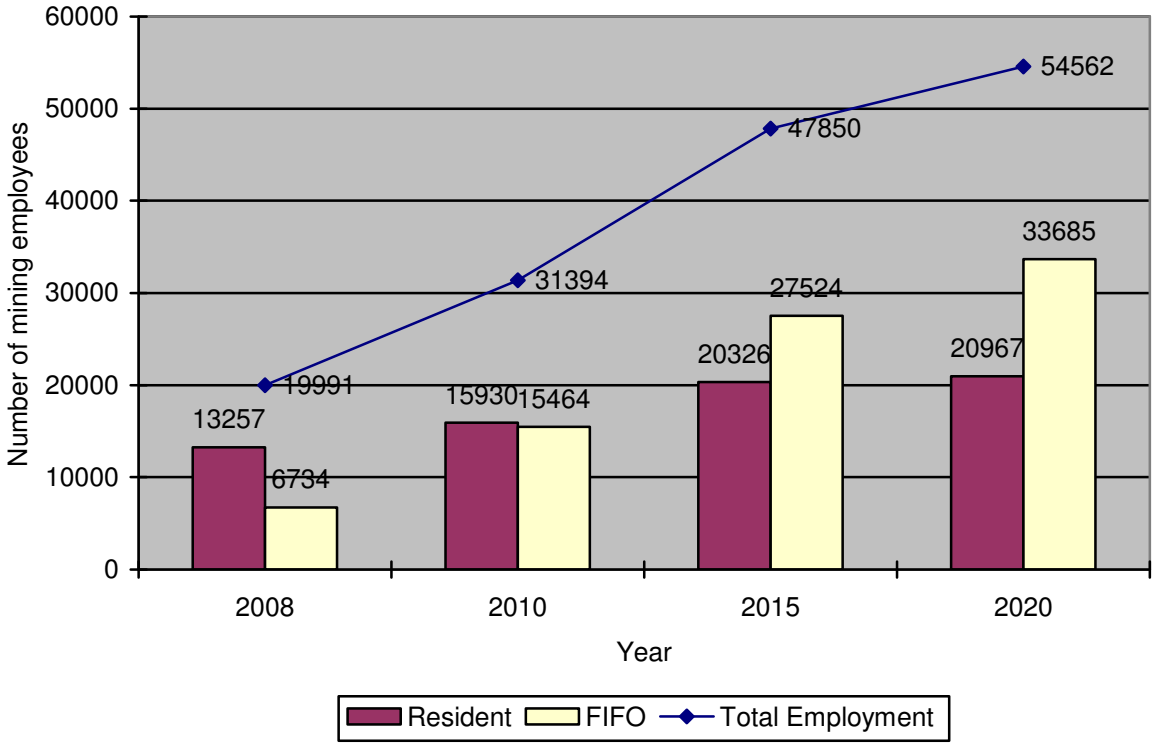
- 76.5% of all personnel were employed directly by mining companies;
- 23.5% of all personnel were employed by contractors;
- 53% of all mining employees are employed on a residential basis;
- 47% of all mining employees are employed on a FIFO basis, including 4.7% utilising Drive-In/Drive-Out arrangements;
- 62.5% of directly employed personnel are residential and 37.5% are FIFO; and
- 22.3% of contractor personnel are residential and 77.7% are FIFO.[66]

The following projections from the Chamber of Minerals and Energy WA indicate how the use of FIFO is anticipated to increase in the Pilbara region over the next 10 years [Figure 4].

[65] Maxwell, *The Rise of Fly-in, Fly-out*, p. 15; Chamber of Minerals & Energy Western Australia, *Fly-in/Fly-out in the Western Australian Resources Sector*, Perth, Chamber of Minerals & Energy Western Australia, 2008 and Australian Bureau of Statistics, *Labour Force, Australia, Detailed, Quarterly, Feb 2008, Western Australia*, 2008 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 18.

[66] CME WA, *Fly in/Fly out: A Sustainability Perspective*, p. 9.

Figure 4: Pilbara: Resource Related Employment 2008-2020[67]



As the Heuris Report points out, estimated resident population numbers do not provide a complete picture of the likely number of people working in the Pilbara who draw to some degree on local services of key population centres:

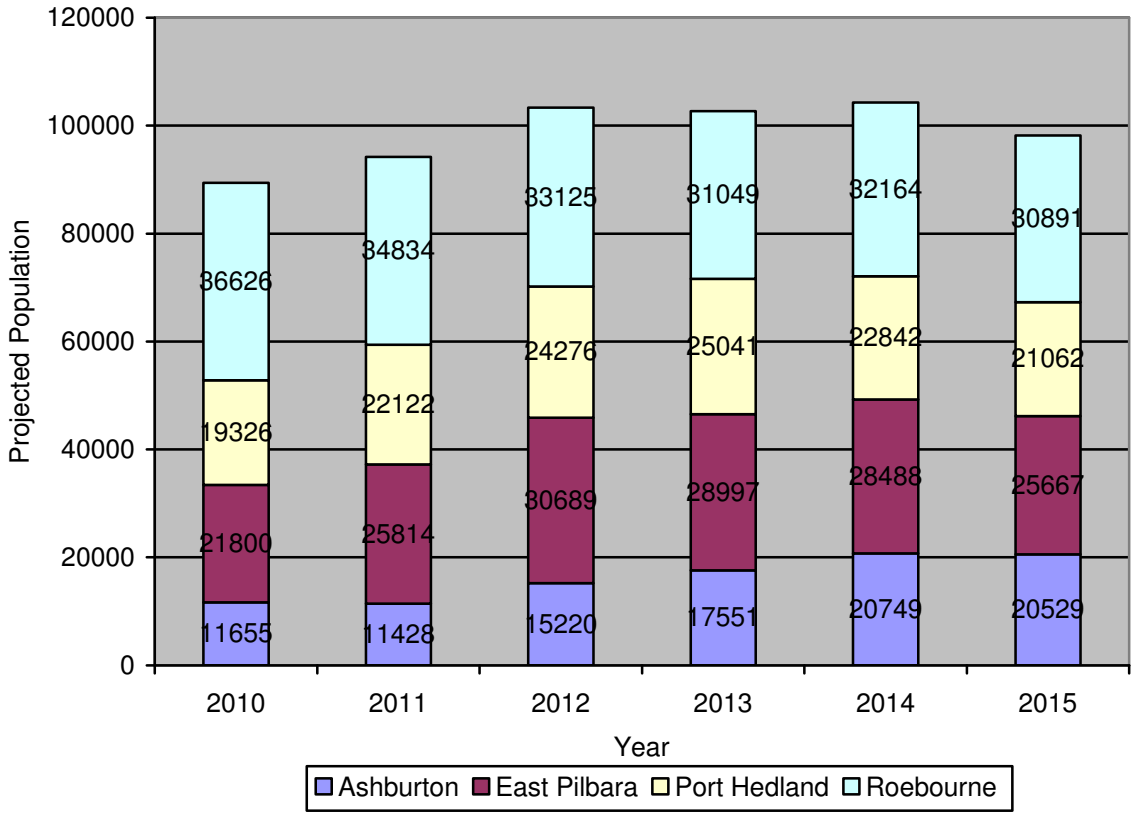
> *These service demands are primarily a function of the peoples' geographical locations (described by the ABS as a 'service population'), rather than workforce status. Hence some FIFO and construction workers may draw on township/shire services because they are located in or sufficiently close to population centres to access a range of services.*[68]

The following graph shows the combined population projections for the Pilbara Local Governments of Ashburton, East Pilbara, Port Hedland and Roebourne [Figure 5].

[67] Company Employment Data & Publicly Available Investment Plans; Heuris Projections from Chamber of Minerals & Energy Western Australia, May 2010. See M. Waller, *Planning for resources growth in the Pilbara: revised employment & population projections to 2020*, <http://www.cmewa.com/UserDir/CMEPublications/100517-MPR-Pilbara%20demographic%20projections-April2010-v1152.pdf>, Report prepared for Pilbara Industry's Community Council by Heuris Partners Ltd, 2010 (Accessed 2 September 2010).

[68] Waller, *Planning for resources growth in the Pilbara*, pp. 3-4.

Figure 5: Combined projections for the Pilbara region of the projected estimated resident population, FIFO and construction employment by Local Government (April 2010)[69]



The projections indicate that FIFO and construction workers can inflate estimated resident populations by 20 to 40 per cent at peak activity periods, implying much greater pressures on critical service provision in the Pilbara than the estimated resident population numbers alone would indicate.[70]

3.1.5 Rosters

While the majority of Australian employees in industries other than mining work a 'standard' roster of approximately 40 hours over a five consecutive eight-hour shifts followed by two days of leave, the majority of rosters in the WA mining industry use compressed rosters.

Compressed rosters utilise extended shifts and multiple consecutive shifts to compress total work hours in as few days as possible, resulting in a relatively intense work period followed by a long block of leave.[71]

[69] Ibid., p. 4.
[70] Ibid., p. 4
[71] Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 13.

The Minister for Labour and Industry, John Kobelke, commissioned a review of extended working hours, which was published in 2004. As a result, in 2006 the WA Government published a *Code of Practice for Maximum Working Hours* which recommends employees work no more than 728 hours per three months before implementing additional fatigue management strategies (e.g. scheduling less hazardous tasks during nights shifts, not permitting employees to work overtime).[72]

Clifford's research was able to identify work and personal characteristics that predict which FIFO employees and partners are particularly dissatisfied with their roster and FIFO, and include those with:

- Long and compressed rosters;
- Poor relationship quality;
- High stress levels; and
- Low levels of support.[73]

3.1.6 Living in the Regions

Australian art critic Robert Hughes is attributed with describing Australians as —a people obsessed with the outback but with little desire to live there, a view corroborated by the distribution of the population in that country.[74]

Since the late 1960s, the Perth metropolitan area has continued to increase, and despite growth in regional centres such as Bunbury, Geraldton, Kalgoorlie and Albany, no town besides Mandurah outside the Perth metropolitan area has accounted for more than two per cent of the state's population during this time.[75]

The 1999 Department of Commerce & Trade report *Living in the Regions: The Views of Western Australians*, found that the majority of Perth people showed relatively little understanding of the economic opportunities available in regional Western Australia.[76] Furthermore, there was limited awareness of specific regions, particularly those in the north, with a significant number of respondents unable to name any towns in some

[72] Commission for Occupational Safety & Health, *Code of Practice: Working Hours*, Perth, Western Australian Department of Consumer and Employment Protection, 2006 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 13.
[73] Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 222.
[74] H. Priestley, 'Fall of the Mining Town. Eastern Goldfields in Focus 2000', *Australia's Mining Monthly*, March 2000, pp. 38–41 quoted in K. Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', pp. 1176-1177.
[75] Maxwell, *The Rise of Fly-in, Fly-out*, p. 13.
[76] Patterson Market Research in conjunction with Focused Management & Hames Shirley, *Living in the Regions, The Views of Western Australians: The State Report*, <http://rdl.wa.gov.au/Content/Publications/StatInfo/LivingInRegions.aspx>, Perth, Department of Commerce and Trade, 1999 (Accessed 30 July 2010).

regions. The report found that 'questions about perceived quality of life and essential services also drew a significant 'don't know' response.

There is significant qualitative evidence surrounding the reasons why the attraction and retention of employees across a number of sectors has been difficult in some regional areas, and align with some of the more commonly cited reasons why mining employees and their families chose not to live near a mine site (if a residential option is available). A study of the Pilbara region indicated that these include:

- Inadequate financial incentives to truly cover the costs incurred living in the Pilbara;
- Loss of culture/entertainment/sporting variety;
- Distance from family/friends and these social support structures (this includes the cost of having relatives visit and stay in the area affordably);
- Access to medical facilities and emergency services;
- Costs and lack of child care services;
- Lack of specialty services in towns, including services for children with special needs;
- Local Pilbara conditions including issues such as poor literacy and academic levels (based on Department of Education data),[77] violence and crime;
- Failure to penetrate established social circles in the town;
- Poor career prospects for spouse, partner or children;
- Limited options with regard to schooling for children;
- Lack of public transport; and
- No sense of hometown belonging.[78]

For industries outside of the resources sector, comparability with resource company wages can be a powerful incentive to draw people out of the service industries into the mining and resource sector, resulting in difficulties in staff retention.[79]

Watts, in her exploration of the impacts of FIFO on the Pilbara, extrapolated that the Pilbara was not well-recognised as a region, a view supported by the opinions of the business community 'and thus some publicity and promotion is warranted'. Watts recommends that:

> *in order to attract stable permanent residential workforce populations to the Pilbara, as well as capitalise on the potential tourist economy, future regional*

[77] For further information about schooling in rural and remote areas, see P. A. M. White-Davison, *Rural Views: Schooling in Rural/Remote Communities*, <http://www4.gu.edu.au:8080/adt-root/public/adt-QGU20030303.140524/>, Brisbane, Griffith University, 1999 (Accessed 2 August 2010).

[78] D. Gallegos, *Fly-in Fly-out Employment: Managing the Parenting Transitions*, <http://www.ngala.com.au/files/files/75_Fly_In_Fly_Out_Report.pdf>, Perth, Centre for Social and Community Research, Murdoch University, 2006 (Accessed 15 June 2010), pp. 17-18; Watts, *Best of Both Worlds?*, p. 89. For a more detailed discussion see Watts, *Best of Both Worlds?*, pp. 90-100.

[79] Pilbara Iron, *Understanding the Pilbara Region and Its Economy*.

> *Strategic Plans must include recommendations to plan for, promote and publicise the Pilbara.*[80]

Some work is being done in this area with the release of the Western Australian Planning Commission's *Pilbara Framework – Regional Profile*. The profile provides a spatial planning profile for the Pilbara region and the background and rationale for the Pilbara Framework, which will set out the spatial strategic direction of the region.[81]

As Storey comments, 'Perth and its hinterland will grow as long as the perceived benefits of climate, living costs, services, employment and other opportunities continue to draw people there, rather than to other parts of the state.'[82]

3.2 Economic Impacts

In 2005, it was estimated that $12.6 billion per year of mining operations in Western Australia (WA) were reliant on Fly-In/Fly-Out (FIFO), which represented 47 per cent of the $27 billion earned from mineral and petroleum operations.[83]

The growth of the WA gold mining sector has seen increasing numbers of operations with a relatively short life. Previously uneconomic deposits have become viable in light of increasing mineral prices and increasing productivity through technological advances in working practices. This combines to provide greater economic incentives for the use of FIFO.[84]

In general there are a number of economic benefits to using FIFO over the construction of new mining towns, including:

- relative costs of FIFO operations in comparison with the establishment and continued operating costs of conventional towns;
- continuing improvements in the cost, reliability and safety of transport;
- conventional towns lack the economic diversity and alternative employment opportunities required by contemporary two income families.[85]

However, some studies have indicated that the economic benefits of FIFO can dissipate with long-term operations.[86] Additionally, while there may be economic benefits for the mining industry, Storey suggests:

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[80] Watts, *Best of Both Worlds?*, p. 88.

[81] Western Australian Planning Commission, *Regional Profile: Pilbara Framework*, <http://www.planning.wa.gov.au/Plans+and+policies/Publications/1975.aspx> Perth, Western Australian Planning Commission, 2009.

[82] K. Storey, 'Fly-in/fly-out and fly-over', p. 141.

[83] CME WA, *Fly in/Fly out: A Sustainability Perspective*, p. 6.

[84] Ibid., p. 7

[85] Ibid., p. 12.

> *Fly-in/fly-out might thus be seen as a benefit to larger or metropolitan centres as it adds further diversity to their economic bases.*[87] *At the same time fly-in/fly-out can be destructive to local communities where it results in infrastructure and service demands that the communities cannot meet, or erosive where a shift from permanent to fly-in/fly-out communities reduces the economic viability of local infrastructure and services.*[88] *Fly-in/fly-out, where it occurs near established communities, may also threaten those towns by reducing the number of workers who, through their relocation, might otherwise have been potential direct contributors to the social and financial well-being of those centres.*[89]

The economic impacts of a mining project on a local or regional area can be summarised as follows:

- *The extent to which project operators purchase inputs from the local or regional economy. The more that a project operator sources from the local or regional economy, the more money that is directly injected into the economy; and*
- *The extent to which money spent in a local or regional economy is retained within that economy. If there is not much opportunity for people receiving income to spend it on goods and services in their local or regional area, then not as much money will be kept in the local or regional area. Larger and more diverse regional economies tend to be better at keeping expenditure in their economy and not 'losing' it to other regions.*[90]

3.2.1 Accommodation

A major economic benefit of FIFO is 'that employers can provide relatively cheap accommodation for employees near a remote mine site, compared to Direct Commute (DC) arrangements (in locations without existing infrastructure).[91] Further exacerbating the problem for communities is the cost of housing in areas dominated by the mining industry.[92]

To illustrate this, the Department of Local Government and Regional Development's *Regional Price Index 2007* found Pilbara prices were approximately +20 per cent higher than Perth. To put this in context, given a marginal tax rate of 38c in the dollar, a well-paid

[86] Houghton, 'Long distance commuting', p. 285; Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 12.
[87] See also Hogan & Berry, 'Mining and regional Australia', p. 657.
[88] See also Maxwell, *The Rise of Fly-in, Fly-out*, p. 8.
[89] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1177.
[90] Rolfe, Lockie & Franettovich, *Economic Impacts of Coal Mining on Small Country Towns*.
[91] CME WA, *Fly in/Fly out: A Sustainability Perspective*, p. 12 & Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 11.
[92] See M. Scheltens & Y. Morris, *Homelessness in High Income Mining Towns and the Opportunity for Big Business to Play a Part*, <http://rimmrights.org/Documents/Australia-homelessness%20and%20mining.pdf>, Paper presented to the 4th National Homelessness Conference, 1-3- March 2006, Sydney, 2006 (Accessed on 3 September 2010).

employee spending $100,000 per annum to live in Perth would need to earn an additional $35,000 per annum to offset the additional living costs associated with living in the Pilbara.

The higher commodity prices in the Pilbara region were mainly due to cost of housing and recreation and education.[93] In 2007, the cost of housing was highest in the Kimberley and the Pilbara, at +27 per cent and +49 per cent respectively, the cost of housing in Perth.[94]

Housing in the Goldfields-Esperance in 2007 was slightly more expensive than housing in Perth, and this was attributed to an increase in economic activity, more specifically, the Esperance Port and the Ravensthorpe mining developments.[95]

Relatively cheap FIFO accommodation have also substantially reduced set-up costs for new mines, whereby previously unprofitable ore bodies are now able to become viable mine operations.[96]

Cost analyses of two mining operations in Western Australia (WA) have shown considerable economic savings. In one case, using a FIFO option over DC arrangements was found to be 23 per cent cheaper ($23 million) over a five-year period, even after taking into account the employees' frequent flights.[97] WA's first onshore FIFO operation, Argyle Diamonds mine, reportedly saved $50-70 million by constructing FIFO accommodation instead of a DC mining town.[98]

3.2.2 Maintenance of Local Roads

No specific research appears to have been undertaken into the impacts of a FIFO and 'Drive-in/Drive-out' (DIDO) workforce on additional costs for Local Government associated with the maintenance of local roads.

Typically the mining industry employer organises and pays for transportation to and from the worksite and for worker accommodations and other services at, or near, the

[93] Department of Local Government and Regional Development, *Regional Prices Index 2007*, Perth, Department of Local Government and Regional Development, 2007, p. 2.
[94] Ibid., p. 3.
[95] Ibid., p. 3.
[96] Department of Mines, *The Demography of Long Distance Commuting in the Western Australian Mining Industry*, Ontario, Centre for Resource Studies, Queens University, 1991 and Chamber of Minerals & Energy Western Australia, *Fly-in/Fly-out in the Western Australian Resources Sector*, Perth, Chamber of Minerals & Energy Western Australia, 2008 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 12.
[97] Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, pp. 11-12.
[98] Houghton, 'Long distance commuting', pp. 283-284; Storey, 'Fly-in/fly-out and Fly-over', p. 136; Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 12. See also Graham, *The changing face of fly-in/fly-out mining operations in Australia*.

worksite.[99] Specific evidence would need to be gathered in relation to the extent to which mine workers travel on local roads to and from a site.

No studies appear to have been undertaken which indicate the extent to which mines and mining companies use local roads that are maintained by Local Governments for the transportation of mineral products, however, further investigation may need to be undertaken if this is perceived to be a broader issue for the Local Government sector.

3.2.3 'Mono-Economy' Towns

The literature of the WA mining industry has identified 'mono-economies', particularly in the Pilbara region.[100] The Pilbara region is on the Australia's most productive regions, however, the economy is almost exclusively driven by the mining (iron ore, oil and gas) industries accounting for approximately 90% of Gross Regional Product (GRP) of the Pilbara.[101] Pilbara Iron's 2005 baseline socio-economic assessment of the Pilbara region also found a decreasing number of small and medium-sized enterprises (SMEs) in the region with 2000 SMEs in 2000-1 and 1100 in 2005. This was in contrast to an increased number of small businesses through WA during the same period.[102]

In 2004-05, the value of mining in the Pilbara was $16.5 billion, nearly 60% of the value of minerals and energy production of WA for that year. By comparison, the next largest industry in the Pilbara region, retail, was valued at $325.7 million. In 2007, approximately 24% of the Pilbara's workforce was employed in the mining industry. The Pilbara's population will continue to fluctuate according to the level of mining and energy investment in the region, with population 'impacted by productivity gains as well as FIFO practices, and the narrow economic base of the region.' [103]

In the case of Tom Price and Paraburdoo, studies and economic modelling by Rio Tinto have demonstrated that the cessation of mining operation in these towns would have a dramatic impact on the population, with a large number of people expected to leave to seek employment elsewhere. Furthermore, 'the economic flow-on effects to private and government businesses in the towns would be significant'.[104]

Rio Tinto has suggested that the growing importance of tourism and the role of the Local Government sector in Tom Price indicate that the town will continue to exist, 'albeit at a

[99] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1161.
[100] Rio Tinto Iron Ore, *The Economic Impact of Mining in Tom Price and Paraburdoo*, <http://www.riotintoironore.com/documents/economic_impact_of_mining_on_towns_brochure_June_07.pdf>, 2007. See also J. Rolfe, B. Miles, S. Lockie & G. Ivanova, 'Lessons form the Social and Economic Impacts of the Mining Boom in the Bowen Basin 2004-2006', *Australasian Journal of Regional Studies*, Vol. 13, No. 2, 2007, pp. 134-153.
[101] Pilbara Iron, *Understanding the Pilbara Region and Its Economy*.
[102] Ibid.
[103] Rio Tinto Iron Ore, *The Economic Impact of Mining in Tom Price and Paraburdoo*.
[104] Ibid.

diminished capacity, after the end of nearby mining'. In the case of Paraburdoo, Rio Tinto suggests that in the absence of mining production, 'it is difficult to identify today those activities that could support the economy of the town into the future, after mining has ceased'.[105] Research into people's sense of community in mining towns has found similar results where 'change was relevant in all communities and often centred on the fear of economic decline in rural areas leading to competition for resources and industries'.[106]

As the Rio Tinto report concludes:

> *the* [Baseline Community] *studies have not sought nor offered solutions for the challenges that will exist in the towns as resident workforces are withdrawn. However, they have highlighted an urgent need for different sectors to work together to stimulate debate and determine strategies for the future of the inland Pilbara*.[107]

3.2.4 Rates Revenue

No specific research into the loss of Local Government rates revenue as a result of a FIFO and DIDO workforce was able to be sourced as part of this literature review.[108]

The Chamber of Minerals & Energy WA noted:

> *Many criticisms of FIFO appear to be based on grievances related more to the revenue base of local governments rather than the nature of the working arrangements themselves. Without dismissing these concerns, it does not seem sensible to impose restrictions on mining operations which would affect the viability of certain mines and quite possible result in the reduction of economic opportunities for regional communities*.[109]

The question is a complex one, and it could be argued, very difficult to obtain a definitive answer. In calculating the loss of Local Government rates revenue, considerations would need to be made regarding:

- Would the current FIFO workforce and/or their families choose to live in the nearest community to the mine, if FIFO was not made available as an employment practice?
- Would there be an increase in costs associated with the maintenance of local roads, if the focus were to shift from FIFO, to a Direct Commute approach?

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[105] Ibid.

[106] H. Cheney, R. Lovel & F. Solomon, *"I'm Not Anti-Mining But…"*, <http://www.minerals.csiro.au/sd/CSIRO_Paper_MCA2001.pdf>, Paper presented to the Mineral Council of Australia Environment Workshop, Adelaide, 2001 (Accessed 3 September 2010).

[107] Rio Tinto Iron Ore, *The Economic Impact of Mining in Tom Price and Paraburdoo*.

[108] The issue has received attention in the media. See --, 'Mining giants should pay rates: MP', *North West Telegraph*, 30 June 2010.

[109] CME WA, *Fly in/Fly out: A Sustainability Perspective*, p. 12

- Any extra revenue raised from rates due to an increase in population would presumably be consumed by the increased costs of providing services to a larger resident population.

There has been some suggestion that FIFO has a negative impact on the grants funding which Local Governments may receive.[110] Federal Finance Assistance Grants (FAGs) are calculated on the resident population of a Local Government area, with a small allowance for service population.

Regional studies conducted in the Central Pilbara found that the increasing per person cost of supporting existing townships and ancillary support services for iron ore companies and government was caused by a declining regional population.[111] Priestley's study in the Eastern Goldfields found that the population decline of several small towns was at least partly as a result of the increased use of Long Distance Commuting in both established mines and new mining developments.[112]

If the current model for the allocation of FAGs, and calculation of population figures to include the FIFO workforce, is to be reviewed, then a significant evidence base must be established. These statistics would need to establish the level of use and demand by the FIFO workforce for Local Government-provided facilities or services.

3.2.5 Small Business

Research conducted by Watts in the Pilbara indicated that small businesses and the local business community perceive the FIFO workforce as a threat to their survival, growth and diversity.[113] Many of the small local businesses indicated that they believed a cap should be placed by the State Government on the number of FIFO workers.

Pilbara Iron's 2005 economic modelling showed that despite substantial wealth being generated in the region, most of the payments to suppliers for goods and services were made outside of the Pilbara region. A postcode search of supplier invoices estimated that 61 per cent of Pilbara Iron's purchases of goods and services were made within WA, however, just nine per cent were made within the Pilbara region. Furthermore, of the nine per cent of purchases within the Pilbara region, the value added by local industries was

[110] B. McHugh, 'Fly-in-Fly-out in the Noughties', <http://www.abc.net.au/rural/content/2009/s2764167.htm>, *ABC Rural*, 7 December 2009 (Accessed 15 June 2010).

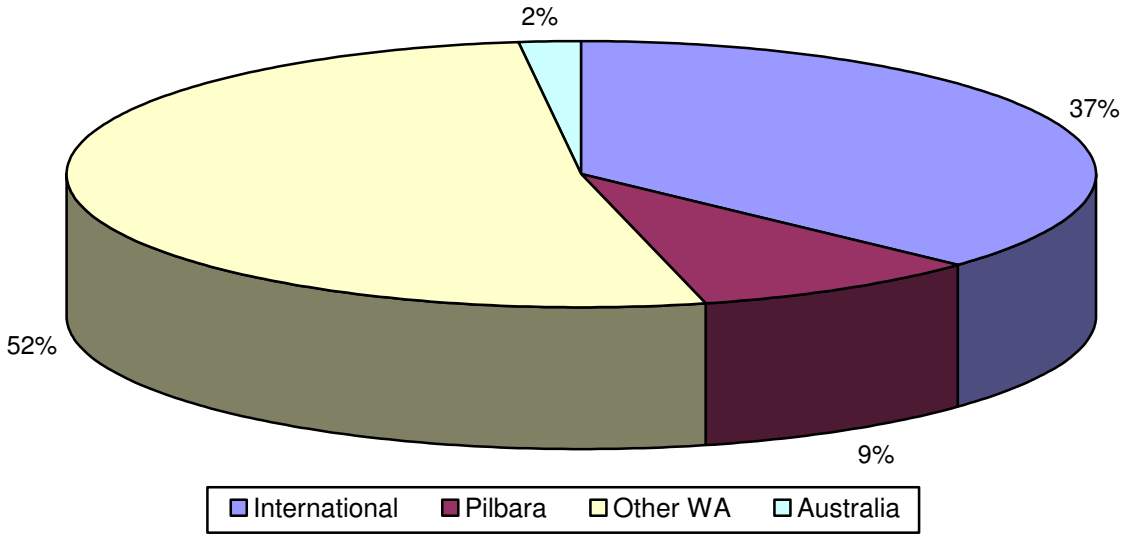
[111] L. Hogan & A. Byrne, *Regional Minerals Program: An Assessment of Infrastructure and Government Services in Regional Australia*, Canberra, ABARE Research Report 2000.5, 2000; Dames & Moore, *Central Pilbara Infrastructure Planning Study under the Commonwealth Regional Minerals Program*, Final report prepared for the Department of Resources Development and the Commonwealth Regional Minerals Program, Perth, 1999, quoted in Hogan & Berry, 'Mining and regional Australia', p. 657.

[112] H. Priestly, 'Fall of the Mining Town', *Eastern Goldfields in Focus 2000, Australia's Mining Monthly*, Perth, Aspermont, pp. 38-41, quoted in Hogan & Berry, 'Mining and regional Australia', p. 657.

[113] Watts, *Best of Both Worlds?*, p. 101.

estimated to be around six per cent of total spend, as not all of the local Pilbara purchases represented goods that were manufactured in the Pilbara region. Pilbara Iron believed that an underdeveloped services sector compounded the issue.[114]

Figure 6: Pilbara Iron spend on goods and services 2005[115]



While the State Government might prefer that mining companies base their FIFO workforces in the regions, it is probably unrealistic to expect that they will implement policies which would require companies to do so. Policy instruments could be used to encourage mining companies to try to ensure that greater levels of economic benefits from their projects accrue to the regions.[116] Storey suggests that 'fly-over' effects:

> *can be mitigated by the inclusion of adjacency principles in impact agreement signed between the resource developer and local groups or governments in which hiring and purchasing preferences are given to local workers and businesses, providing that they meet certain capability and cost requirements. Such agreements are standard practice in Canada, but appear somewhat less well developed in Australia.*[117]

3.3 Environmental Impacts

In 2005 the Chamber of Minerals & Energy Western Australia reviewed the impact of mining settlements and Fly-In/Fly-Out (FIFO) on environmental sustainability. In terms of ecological footprint, a FIFO camp occupies a much smaller footprint than a residential town. The establishment of a town requires extensive land clearing for housing, roads and

[114] Pilbara Iron, *Understanding the Pilbara Region and Its Economy*.
[115] Ibid.
[116] Storey, 'Fly-in/fly-out and Fly-over', p. 142.
[117] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1164.

recreational facilities, including the provision of essential infrastructure on a much larger scale than that of a FIFO camp: power, water and wastewater treatment.[118]

Additionally, at the end of a mine's operating life, mining companies are obligated to rehabilitate not just the mine site, but the area utilised by the FIFO camp. Despite the claims of the Chamber of Minerals and Energy that rehabilitation of the area would not be required where a residential town has been created, notable exceptions exist.[119]

Shay Gap was a short-lived iron-ore mining town in the Pilbara region of WA, 188 km east of Port Hedland. It was a company town developed by Goldsworthy Mining Ltd in the 1960s and was formally gazetted as a town in 1972.[120] At its peak, the town had a population of over 850 people. In 1994 the town was closed by the company and most of the buildings and structures either demolished or relocated elsewhere.

3.4 Social Impacts

The impact of Fly-in/Fly-out (FIFO) employment has been the subject of much public debate.[121] The move away from conventional mining towns lacking in health, education, social, recreation and retail services towards FIFO arrangements has seen an improvement in the quality of life for some mine workers.[122]

Anecdotal claims frequently appear in the media, and much of the research which has been conducted has focussed on interviews with individuals or more recently, families. There is a dearth of quantitative research of sufficient sample size to ascertain broader impacts on the community, although many of the recent papers have acknowledged that further work must be done to examine the impacts of FIFO on the communities of Western Australia (WA).

It is not only FIFO work practices which are seen to have an impact on communities. Research from Queensland indicates that high turnover in the mining industry can have an undesirable effect on the communities associated with the mine, as when employees resign; both they and their families will leave the community. As Beach, Brereton & Cliff point out:

> *Where populations are unstable, it is much more difficult to build and maintain a sense of community and to sustain activities such as clubs and associations, which contribute positively to the social life of the community*.[123]

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[118] CME WA, *Fly in/Fly out: A Sustainability Perspective*, p. 11.
[119] Ibid., p. 11.
[120] Landgate, 'Shay Gap', *History of Country Town Names*, <http://www.landgate.wa.gov.au/corporate.nsf/web/History+of+Country+Town+Names>, (Accessed 2 September 2010).
[121] Sibbel, 'Editorial: Special Section on Fly-in/Fly-out', p. 6.
[122] CME WA, *Fly in/Fly out: A Sustainability Perspective*, p. 15.
[123] Beach, Brereton & Cliff, *Workforce Turnover in FIFO Mining Operations*, p. 4.

3.4.1 Participation in Community & Leisure Activities

Mining employees working compressed and long rosters have limited leisure time during the work period, but can have limited leisure time during the work period, but have an uninterrupted block of leisure time during their leave period.[124]

The benefits of having blocks of leave include:

- having sufficient time to completely recover from work-related fatigue
- uninterrupted relaxation periods
- being able to undertake and complete projects within a short time frame (e.g. home repairs)
- taking short holidays
- accessing community services during standard working hours
- more time to spend with children (e.g. volunteer at school during school hours, spend time together after school)

Preliminary Australian research has found FIFO may have negative impacts on employees' lifestyle with at least two thirds of Australian FIFO employees reporting their work prevented social and community interaction and participation in sporting events and clubs.[125] Keown reports that over 60 per cent of WA mining employees are dissatisfied with the impact of their work scheduling on their social and domestic lives.[126] The latest statistics from WA indicate that 74 per cent of FIFO employees found it hard to participate in the community.[127]

Extended working hours, particularly night work, can:

- reduce the amount of leisure time employees have to relax, socialise with others, and participate in the community
- change the timing of employees' leisure time so that it is not aligned with other people's leisure time or when community services are available
- prevent employees from participating in events that require regular attendance (e.g. sports teams, common interest groups)
- inhibit the ability to keep up-to-date with new developments and changes in plans[128]

[124] Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 32.
[125] Beach, Brereton & Cliff, *Workforce Turnover in FIFO Mining Operations*, p. 4; Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 1. See also V. M. Gent, *The impacts of fly-in/fly-out work on well-being and work-life satisfaction*, Perth, School of Psychology, Murdoch University, Bachelor of Arts (Honours), 2004.
[126] N. Keown, *Digging Deep for Better Health: A Study of the Health Status of Men in the Goldfields Mining Industry of Western Australia: Overview Report*, Kalgoorlie, Goldfields Men's Health Inc., 2005, p. 4.
[127] Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 109.
[128] K. Heiler, *The Struggle for Time: A Review of Extended Shifts in the Tasmanian Mining Industry*, <http://www.justice.tas.gov.au/__data/assets/pdf_file/0008/76418/sft_overview.pdf>, Sydney, Australian Centre for Industrial Relations Research & Training, University of Sydney, 2002 (Accessed 8 July 2010), p. 14; Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 2.

The employee's roster cycle can also impact on their partner's community interactions, hobbies and social activities. Partners taking on an increased domestic and childcare workload during the employee's work period have less free time available for leisure and social activities.[129] A survey of WA mining partners reported moderate negative impacts of mining working arrangements on their social and domestic activities.[130]

A survey of the recreational facilities of Australian FIFO accommodation camps found that the most commonly available facilities were pool tables, swimming pools, tennis courts and gymnasiums.[131] The presence of such equipment suggests FIFO employees undertake some physical activity for recreation between shifts, however, information about number of participants or duration of activity is unavailable.

Participants interviewed by Watts over the course of the Pilbara study believed that cultural, sporting variety and entertainment choices had been compromised by the gradually declining population. A great deal of caution should be exercised in making these casual linkages, and as Watts notes 'the implementation of FIFO work styles in many areas of the Pilbara was associated by many participants… with the population decline, and thus, by the simple linking of cause and effect, the practice of FIFO, the catchall scapegoat, was blamed'.[132]

3.4.2 Policing

No specific research appears to have been undertaken into the impacts of a FIFO and DIDO workforce on additional costs associated with policing in communities impacted by FIFO rosters.

If further research is to be undertaken in this area, close collaboration must be made with the WA Police, particularly in obtaining local crime and incident statistics for communities with FIFO workforces.

3.4.3 Relationships

Romantic Relationships[133]

One of the main anecdotal criticisms levelled at FIFO and extended working hours is that it places pressure on romantic relationships leading to relatively poor quality relationships and an increased incidence of break-ups and divorce compared to the wider

[129] Gallegos, *Fly-in Fly-out employment: Managing the Parenting Transitions*, p. 96.
[130] Keown, *Digging Deep for Better Health*, p. 4.
[131] Australian Mines and Metals Association, *Long Distance Commuting: A Road Well Travelled*, Melbourne, Australian Mines and Metals Association, 1998.
[132] Watts, *Best of Both Worlds?*, p. 97.
[133] For an early article into the motivation for a 'commuter marriage', see E. A. Anderson, 'Decision-Making Style: Impact on Satisfaction of the Commuter Couples' Lifestyle', *Journal of Family and Economic Issues*, Vol. 13, No. 1, 1992, pp. 5-21.

community.[134] A media report from 2003 claimed 70 to 80 per cent of WA FIFO employees had relationship problems, compared to 50 per cent of the general community.[135] Yet another attributed an increase in the WA community divorce rate to an increase in the number of WA FIFO employees, though the author fails to identify the research which shows a link between the two.[136]

By definition, FIFO employees frequently alternate between living at home and at the FIFO accommodation, and as such, FIFO employees and partners need to frequently adjust to living together and living apart and this can be a source of disruption and stress.[137] The range of moods and emotions experienced by FIFO employees and their partners, which fluctuate across the mining roster as they cycle through phases of separation and reunion, has been well documented.[138]

Research has indicated that partners of FIFO mining employees can be hesitant to socialise during the leave period without the employee, as socialising with other couples can encourage feelings of loneliness or jealousy.[139] In contrast to this, Watts found that being separated from a partner gave both parties space to develop personal interests and time for their own pursuits, which may not have existed before.[140]

Qualitative research has revealed spouses of FIFO employees left at home may feel a sense of empowerment. Women in particular reported that they developed skills and

[134] K. Hampson, 'Fly-in, fly-out couples employing 'sex spies', *The West Australian*, Perth, 7 June 2008; D. Gibson, 'Help urged for families of fly-in workers', *The West Australian*, Perth, 5 May 2006; G. Parker, 'Fly-in, fly-out a 'bush cancer', *The West Australian*, Perth, 25 August 2005 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 28; L. Tucak, 'Fly In/Fly Out takes its toll on mine workers', *Stateline Western Australia*, < http://www.abc.net.au/stateline/wa/content/2003/s991767.htm>, 14 November 2003, (Accessed 14 June 2010); M. O'Donnell, 'Industry supports fly in, fly out operations', <http://www.abc.net.au/7.30/content/2005/s1484332.htm>, *The 7.30 Report*, 17 October 2005 (Accessed 28 June 2010); B. Quartermaine, 'Divorce surge 'linked to mining'', *The Sunday Times*, <http://www.perthnow.com.au/news/western-australia/divorce-surge-linked-to-mining/story-e6frg13u-1111112546959>, Perth, 19 November 2006 (Accessed 5 August 2010).

[135] Tucak, 'Fly In/Fly Out takes its toll on mine workers'.

[136] Quartermaine, 'Divorce surge 'linked to mining''.

[137] Houghton, 'Long distance commuting', p. 287; K. R. Parkes & M. J. Clark, *Psychosocial Aspects of Work and Health in the North Sea Oil and Gas Industry Part V Offshore Work/Leave Schedules: Data Analyses and Review*, <http://www.hse.gov.uk/research/otopdf/1997/oto97012.pdf>, London, Health and Safety Executive, 1997 (Accessed 12 August 2010).

[138] See Gallegos, *Fly-in Fly-out employment: Managing the Parenting Transitions*, Ch. 4; K. R. Parkes, S. C. Carnell & E. L. Farmer, 'Living Two Lives: Perceptions, attitudes and experiences of spouses of UK offshore workers', *Community, Work and Family,* Vol. 8, No. 4, 2005, p. 419; A. M. Sibbel, *The psychosocial well-being of children from Fly-in/Fly-out mining families*, Perth, Psychology Department. Edith Cowan University, Bachelor of Arts (Psychology) Honours, 2001.

[139] K. R. Parkes, S. C. Carnell, S.C. & E. L. Farmer, 'Living Two Lives: Perceptions, attitudes and experiences of spouses of UK offshore workers', *Community, Work and Family,* Vol. 8, No. 4, 2005, p. 422.

[140] Watts, *Best of Both Worlds?*, p. 63.

capabilities that they previously believed were not within their ability or scope, leading to increased confidence and a sense of satisfaction and achievement.[141]

Family Relationships & Parenting

While anecdotal evidence has asserted that FIFO may impose a higher than normal level of stress on families, research examining the psychological stresses upon the families of FIFO workers has found that children from FIFO families did not experience significantly higher levels of depression, anxiety or family dysfunction than non-FIFO children.[142]

Much of the research noted that occasions such as birthdays, Easter and Christmas and school events, and family events where the absence of a parent may be most keenly felt. However, the participants in Gallegos' study did not appear to find the absence of a FIFO worker as being particularly problematic.[143]

The importance of support networks was continually noted, and included:

- Families of the partner at home and the worker;
- Friends;
- Mother's groups or playgroups;
- Childcare or babysitters;
- Neighbours;
- Organisations including Healthdirect, Ngala, parenting helplines, child health nurses;
- Doctors; and
- The employer.[144]

While Heiler's study did not specifically focus on the impacts of FIFO rosters on the community, she believed 'there is a strong interrelationship between the impact of the roster on families, the isolations and weakening of the community, and the additional pressure this in turn places on families'.[145] The latest research indicates that communities are playing an 'increasingly important and effective role is assisting families and mindful of the significance of FIFO families, of significance is the provision of parenting education and support services, child care, and relationship counselling'.[146] Considering the extensive nature of research into the impacts of FIFO and shiftwork on individuals and families, it is suggested that future research should focus on the broader role of, and impacts on, communities.

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[141] Watts, *Best of Both Worlds?*, pp. 62-3. See also Sibbel, *The psychosocial well-being of children from Fly-in/Fly-out mining families* .

[142] CME WA, *Fly in/Fly out: A Sustainability Perspective*, p. 16; Sibbel, *The psychosocial well-being of children from Fly-in/Fly-out mining families*, quoted in J. C. Taylor & J. Graetz Simmonds, 'Family Stress and Coping in the Fly-in Fly-out Workforce', *The Australian Community Psychologist*, Vol. 21, No. 2, 2009, p. 34.

[143] Gallegos, *Fly-in Fly-out employment: Managing the Parenting Transitions*, p. 54.

[144] Ibid., pp. 57-58.

[145] Heiler, *The Struggle for Time*, p. 3.

[146] Taylor & Graetz Simmonds, 'Family Stress and Coping in the Fly-in Fly-out Workforce', p. 33.

Some links have been made between risk factors experienced by military and FIFO families, however, for the purposes of this literature review, the differences in psychological impacts, period of absence and nature of social support, are considered significant enough to avoid comparison.[147]

3.4.4 Volunteering

No specific research has been undertaken into the impacts of FIFO on additional costs associated with volunteering, or more specifically, volunteer emergency services provision.

Research into declines in volunteerism has been undertaken across a number of sectors.[148] It should be noted that in 2005, all Australian State and Territory volunteer fire services reported declines in volunteer numbers over at least a five year period.[149]

3.5 Health Impacts

The majority of Australian studies into the health of mining employees have focussed on employment-related outcomes such as workplace safety or performance, and there is very little anecdotal or empirical evidence regarding impacts of Fly-In/Fly-Out (FIFO) on partners' health.[150]

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[147] Watts draws links between the experience of FIFO and military families [Watts, *Best of Both Worlds?*, p. 48].

[148] See, for example, D. Ironmonger, *The Economic Value of Volunteering in Western Australia*, <http://www.community.wa.gov.au/NR/rdonlyres/2587FC6D-8384-47A1-956A-9A81E20B434D/0/VolunteeringinWA.pdf>, West Perth, Department for Communities, 2009 (Accessed 30 June 2010) ; J. McLennan & A. Birch, 'A potential crisis in wildfire emergency response capability? Australia's volunteer firefighters', <http://www.aemvf.org.au/site/_content/resource/00000097-docsource.pdf>, *Environmental Hazards*, Vol. 6, 2005, pp. 101-107 (Accessed 30 June 2010); and M. Paull, *Barriers to Volunteering by Newcomers in Wheatbelt Towns in Western Australia*, <http://www.volunteeringwa.org.au/Assets/images/File/Better_Connections_research_report.pdf >, West Perth, Volunteering WA, 2009 (Accessed 30 June 2010).

[149] McLennan & Birch, 'A potential crisis in wildfire emergency response capability?, p. 103.

[150] A. Baker, K. Heiler & S. A. Ferguson, 'The Impact of Roster Changes on Absenteeism and Incident Frequency in an Australian Coal Mine', *Occupational and Environmental Medicine*, Vol. 61, No. 1, pp. 43-49; M. Pinnock & D. Cliff, *Working Time Arrangements in the Resources Sector in the 21st Century – The Employer Perspective*, Brisbane, Queensland Mining Council & Minerals industry Safety and Health Centre, 2001; T. Maher, 'Understanding and Managing the Safety Hazards of Shiftwork and Extended Working Hours*, IQPC's 2nd Conference on Best Practice Rostering and Shiftwork*, Sydney quoted in S. Clifford, *The Effects of Fly-in/Fly-out Commute Arrangement and Extended Working Hours on the Stress, Lifestyle, Relationship and Health Characteristics of Western Australian Mining Employees and their Partners: Preliminary Report of Research Findings*, Perth, School of Anatomy and Human Biology, The University of Western Australia, 2009, p. 40; C. Bofinger, S. Cobbin, D. Cliff & T. Horberry, *Work Breaks and Rest Periods*, <http://www.hstrust.com.au/MessageForceWebsite/Sites/326/Files/MISHBofinger_2005_WorkBreaks20390.pdf>, Brisbane, Coal Services Health & Safety Trust, Mineral Industry Safety & Health Centre, University of Queensland, 2005.

In contrast to the paucity of Australian studies, the health impacts of FIFO on employees working on oil and gas rigs in Britain, Norway and the Gulf of Mexico have been relatively well documented. Overseas research has found that male FIFO employees in the British oil and gas industry were more likely (than Daily Commute (DC) employees performing comparable jobs) to:[151]

- Smoke;
- Consume a high-fat diet;
- Be overweight;
- Have elevated cholesterol levels;
- Experience gastrointestinal problems;
- Report musculo-skeletal disorders; and
- Report sleep problems.[152]

Caution must be exercised in blind application of these findings to a Western Australian (WA) context, as significant differences in job requirements, rosters and work site characteristics exist between the British oil and gas industries and the Australian mining industries.

There are many anecdotal claims that FIFO has negative impacts on WA mining employees, leading to an elevated risk of high stress levels, depression, binge drinking, and recreational drug-use.[153] Anecdotal evidence from WA claims that WA FIFO mining employees are more like to binge drink or use recreational drugs than comparable DC employees.[154]

However, the most recent study into health impacts of FIFO revealed that:

> *FIFO and extended working hours did not lead to poor quality relationships, high stress levels or poor health, on average in the long-term; there were generally no*

[151] Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 2 & 40.

[152] See also I. M. Light & M. Gibson, 'Percentage body fat and prevalence of obesity in a UK offshore population', *British Journal of Nutrition*, Vol. 56, No. 1, 1986, pp. 97-104; S. R. K. Coleshaw & R. A. Harris, *Assessment of Medical Status of the Offshore Population*, <http://www.hse.gov.uk/research/otopdf/1997/Oto97057.pdf>, London, Health and Safety Executive, 1997 (Accessed 12 August 2010); K. J. Mearns & L. Hope, *Health and well-being in the offshore environment: The management of personal health*, <http://www.hse.gov.uk/research/rrhtm/rr376.htm> London, Health and Safety Executive, 2005 (Accessed 12 August 2010); K. R. Parkes, 'Psychosocial aspects of stress, health and safety on North Sea installations', *Scandinavian Journal of Work and Environmental Health,* Vol. 24, 1998, pp. 321 – 333.

[153] Clifford, *Preliminary Report of Research Findings*, p. ii.

[154] S. Mangan, 'Mining boom keeps families apart', *ABC Rural Radio*, 19 August 2006; T. Potts & S. Potts, 'FIFO – Flying Into Family Obstacles – A personal view', *AusIMM Bulletin*, 2003, pp. 67-68; Wolfenden, 'Fly-in fly-out family study highlights domestic stress', *ABC News Online*, 5 June 2002 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 2; Tucak, 'Fly In/Fly Out takes its toll on mine workers'; J. Wade, 'Well paid, but happy?', *Australian Mining*, <http://www.miningaustralia.com.au/news/well-paid-but-happy>, 26 June 2007, (Accessed 14 June 2010).

significant differences in these characteristics between FIFO and Daily Commute employees, or between the FIFO sample and the wider community.[155]

3.5.1 Alcohol Management

A 1998 audit reported that 84 per cent of Australian FIFO camps had bar facilities, and almost all had an alcohol management policy and/or random breath tests.[156] The Australian Mines and Metals Association attributed climate, remoteness, long work hours, family separation and a lack of counselling facilities as possible reasons for mining employees' substance abuse.

Anecdotal evidence suggests that mining employees, and FIFO employees in particular, drink at unhealthy levels. Keown's study of Goldfields mining employees were 'slightly, but statistically significantly' more likely to engage in risky drinking than men in the wider WA community.[157] Contrary to the anecdotal evidence, Keown's study found FIFO mining employees were less likely to drink at risky levels than Direct Commute employees. Furthermore, risky drinking behaviour was less prevalent amongst professional employees than skilled employees and unskilled employees, and less prevalent amongst principal employees than contractors. Alcohol consumption was not linked with age or roster length in the Goldfields study.

A 1997 study of alcohol consumption patterns at two Pilbara mining-related worksites found the frequency and quantity of alcohol consumption at both mining-related worksites was greater than that nationally, but the proportion of workers drinking in the top risk categories was similar. The study indicated that 'although the prevalence of uncontrolled drinking did not differ between the mining-related workers and the national sample, there is evidence to suggest that norms for acceptable consumption were higher for this workforce'.[158]

Evidence from Queensland FIFO production mining employees found employees drank as often during work and leave periods (a median of 2 days per week), but drank more per day during the leave period (median four standard drinks per day).[159]

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[155] Clifford, *Preliminary Report of Research Findings*, p. ii.

[156] Australian Mines and Metals Association, *Long Distance Commuting: A Road Well Travelled*.

[157] Keown, *Digging Deep for Better Health*, p. 8; Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 41. See also National Health & Medical Research Council, *Australian Guidelines to Reduce Health Risks from Drinking Alcohol*, <http://www.nhmrc.gov.au/publications/synopses/ds10syn.htm>, National Health & Medical Research Council, 2009 (Accessed 5 August 2010).

[158] See R. Midford, A. Marsden, M. Phillips & J. Lake, 'Workforce alcohol consumption patterns at two Pilbara mining related worksites', *The Journal of Occupational Health and Safety - Australia and New Zealand,* Vol. 13, No. 3, 1997, pp. 267-274.

[159] R. Muller, A. Carter & A. Williamson, 'Epidemiological diagnosis of occupational fatigue in a Fly-In Fly-Out operation of the Mineral Industry', *Annals of Occupational Hygiene*, Vol. 52, No. 1, 2008, pp. 66; 70-71.

Gallegos' survey found that the perception of the mine environment as a hard-drinking one was generally not shared by her survey sample, though participants acknowledged its persistence amongst single workers, and those living residentially.[160]

3.5.2 Cardiovascular Disease

Mining employees in Queensland and New South Wales were screened for cardiovascular disease (CVD) risk factors in 2002.[161] A significantly higher proportion of the workforce were diagnosed with CVD risk factors of hypertension and being overweight, than men in the wider community and despite having similar exercise, diet and alcohol and tobacco consumption characteristics. Approximately 23 per cent of QLD and 50 per cent of NSW coal mining employees were diagnosed with high blood pressure.

Bofinger and Ham suggest that occupational factors such as noise, dust, shiftwork and related stresses are potential reasons for the significantly higher levels of hypertension amongst mining employees than men in the wider community.[162]

3.5.3 Health and Medical Services

No specific research has been undertaken into the impacts of FIFO on additional costs associated with health and medical services in the community. Anecdotal evidence suggests that many sites, due to their remoteness, provide medical facilities and services to their employees.

3.5.4 Mental Health

Clifford defines stress as:

> *an individual's cognitive, behavioural or physiological responses to situations considered to be personally important, taxing, challenging or threatening. The term 'stress' can also be used in a broad sense to describe depression and anxiety symptoms. Depression specifically refers to sustained low or negative moods and a lack of interest. Anxiety refers to sustained and exaggerated apprehension, worry or fear*.[163]

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[160] Gallegos, *Fly-in Fly-out employment: Managing the Parenting Transitions*, pp. 80-81.

[161] C. Bofinger & B. Ham, *Risk factors for heart disease among coal miners*, <http://www.hstrust.com.au/Untitled.aspx>, Brisbane, Joint Coal Services Health & Safety Trust, 2002 (Accessed 5 August 2010); C. Bofinger & B. Ham, *Elevated blood pressure among NSW coal miners – Extension Project*, <http://www.hstrust.com.au/MessageForceWebsite/Sites/326/Files/SIMTARS_Bofinger_2003_RiskFactorsforHeartDiseaseExtension_20226.pdf>, Brisbane, Joint Coal Services Health & Safety Trust, 2002 (Accessed 5 August 2010).

[162] Bofinger & Ham, *Risk factors for heart disease among coal miners*; Bofinger & Ham, *Elevated blood pressure among NSW coal miners – Extension Project*.

[163] Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 35.

Anecdotal evidence from WA claims that WA FIFO mining employees are more like to experience depression or commit suicide than comparable Daily Commute (DC) employees.[164]

The overall depression, anxiety and social impairment symptoms of approximately 500 Goldfields FIFO and DC mining employees were investigated to detect possible minor psychiatric disorders. 28 per cent of Goldfields mining employees scored above the cut-off point indicating a possible minor psychiatric disorder, which was threefold higher than an Australian community sample.[165] Amongst the Goldfields sample, the proportion of employees exceeding the cut-off score was not related to commute arrangement or occupation, but was significantly higher amongst employees working extended shifts (32.8%) and night shifts (33.0%) than those working shorter shifts (23.0%) and day shifts (25.0%), respectively.[166]

The same methodology as the Goldfields survey was used to access the psychological characteristics of British FIFO and DC oil and gas employees. Parkes found FIFO employees reported significantly higher levels of anxiety than a comparison DC group, but noted that increased anxiety may be due not only to the social separation associated with FIFO, but also the helicopter flights and undesirable and perceived dangerous environment of the offshore oil rig. This is in contrast to a previous UK study of oil and gas employees which found no difference in depression and anxiety symptoms between comparable FIFO and DC employees.[167]

Extended working hours can also be a source of fatigue,[168] thus reducing the amount and quality of leisure time that employees have to relax and spend with others.[169]

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[164] S. Mangan, 'Mining boom keeps families apart', *ABC Rural Radio*, 19 August 2006; T. Potts & S. Potts, 'FIFO – Flying Into Family Obstacles – A personal view', *AusIMM Bulletin*, 2003, pp. 67-68; Wolfenden, 'Fly-in fly-out family study highlights domestic stress', *ABC News Online*, 5 June 2002, quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 2; Tucak, 'Fly In/Fly Out takes its toll on mine workers'; Wade, 'Well paid, but happy?'.

[165] G. Andrews, *The Mental Health of Australians*, <http://www.health.gov.au/internet/main/publishing.nsf/Content/78CA239BC007B0ADCA2572880002E508/$File/mhaust.pdf> Canberra, Mental Health Branch, Commonwealth Department of Health and Aged Care, 1999 (Accessed on 12 August 2010); Keown, *Digging Deep for Better Health*, p. 6.

[166] Keown, *Digging Deep for Better Health*.

[167] M. Gann, U. Corpe & I. Wilson, 'The application of a short anxiety and depression questionnaire to oil industry staff', *Journal of the Society of Occupational Medicine*, Vol. 40, No. 4, pp. 138-142; K. R. Parkes, 'Mental health in the oil industry: A comparative study of onshore and offshore employees', *Psychological Medicine*, Vol. 22, No. 4, pp. 997-1009 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 36.

[168] Queensland Government Natural Resources and Mines, *Guidance Note for Management of Safety and Health Risks Associated with Hours of Work Arrangements at Mining Operations*, Brisbane, Queensland Government, 2001.

[169] Muller, Carter & Williamson, 'Epidemiological diagnosis of occupational fatigue', pp. 63-72; Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 2.

3.5.5 Recreational Drug Use

Despite industry-wide drug testing in the minerals and resource sector, the influx of drugs into a community via well-paid FIFO workers is a commonly expressed community fear, and prevalent in much of the media.[170]

There is anecdotal evidence, including a spokesperson from the National Drug Research Strategy, suggesting that some WA mining employees who previously smoked cannabis now use amphetamines during their leave periods to avoid detection by workplace drug tests, as amphetamines are cleared from the body within 3 days.[171]

Many mining companies screen their employees for evidence of recreational drug use,[172] however, the rate at which employer tests detect drug use is not publically available, and tests are limited in their usefulness.[173] Self-report data regarding drug use by Australian mining employees is not available, presumably due to the unreliability of survey data.[174]

3.5.6 Road Safety

No specific research has been undertaken into the impacts of a FIFO and DIDO workforce on additional costs associated with road safety strategies.

On average, WA Direct Commute (DC) employees have a 25 minute journey home after each shift, while FIFO employees have a 2.5 hour journey from the mine site accommodation to the city airport at the end of the work period, not including potential delays leaving site, or travelling between the airport and their personal accommodation.[175]

The potential risks of driving home while fatigued are reflected in the WA Government Code of Practice for Maximum Working Hours which provides different recommendations for FIFO and DC mining employees.[176] Additionally, the Code of Practice for Maximum Working Hours recommends a limit of 13 hours of work and travel per day for FIFO

[170] Watts, *Best of Both Worlds?*, p. 111.
[171] A. G. Verstraete, 'Detection times of drugs of abuse in blood, urine, and oral fluid', *Therapeutic Drug Monitoring*, Vol. 26, No. 2, pp. 200-205; Tucak, 'Fly In/Fly Out takes its toll on mine workers'.
[172] Australian Mines and Metals Association, *Long Distance Commuting: A Road Well Travelled*,; R. Nicholas, S. Allsop, C. Calogero, M. Phillips & N. Ormonde, *Alcohol and drugs in the workplace: Issues, trends, and practices*, Perth, Chamber of Mines & Energy WA, Western Australian Drug & Alcohol Authority & National Centre for Education & Training on Addiction, 1996, quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 42.
[173] Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 42.
[174] Ibid., p. 42.
[175] Ibid., p. 24.
[176] Commission for Occupational Safety & Health, *Code of Practice: Working Hours*, Perth, Western Australian Department of Consumer and Employment Protection, 2006 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 24.

employees, thereby necessitating a shorter shift or travel the following day if they have a lengthy journey home from the city airport at the end of the work period.

As noted previously, typically the employer organises and pays for transportation to and from the worksite and for worker accommodations and other services at, or near, the worksite.[177] This has potential benefits for worker occupational health and safety, and in general, resource companies are very cognisant of the health risks associated with shiftwork.

3.5.7 Tobacco Smoking

Recent surveys found approximately one quarter of Australia male mining employees and men in the wider Australian community are current smokers.[178]

Keown's study of Goldfield mining employees found a relatively high incidence of smoking amongst shift workers (40%) compared to permanent day shift employees (25%). A greater proportion of DC employees were smokers (34%) than FIFO employees (25%), and smoking rates differed between unskilled (30%), skilled (42%) and professional (26%) employees.

3.5.8 Weight and Obesity

Keown's study of Goldfields male mining employees reported that approximately 48 per cent described themselves as overweight.[179] This proportion is roughly equivalent to that of male Australian adults (53.8%).[180]

The high incidence of overweight and obese employees within the Goldfields mining employee data is consistent with other studies of Australian mining workforces. Bowfinger and Ham's study of male coal miners in Queensland and New South Wales found two thirds reported being overweight or obese.[181] A study of Queensland FIFO employees

[177] Storey, 'Fly-in/Fly-out: Implications for Community Sustainability', p. 1161.
[178] Keown, *Digging Deep for Better Health*, p. 10; Muller, Carter & Williamson, 'Epidemiological diagnosis of occupational fatigue', p. 66; Bofinger & Ham, *Risk factors for heart disease among coal miners*; Australian Bureau of Statistics, *National Health Survey (2004-2005): Summary of Results*, 2006 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 49.
[179] Keown, *Digging Deep for Better Health*, p. 6. For further information about links between shiftwork and obesity, see K. R. Parkes, 'Shift work and age as interactive predictors of body mass index among offshore workers', *Scandinavian Journal of Work and Environmental Health*, Vol. 28, No. 1, 2002, pp. 64-71.
[180] Australian Bureau of Statistics, *National Health Survey (2004-2005): Summary of Results*, 2006 quoted in Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 49. As noted by Clifford, the Goldfields data should be regarded as an estimate, and not accurate data [Clifford, *Effects of Fly-in/Fly-out Commute Arrangements*, p. 49].
[181] Bofinger & Ham, *Risk factors for heart disease among coal miners*.

found the employees' mean Body Mass Index (BMI) value was 29 (overweight) and 35 per cent of employees were obese (i.e. BMI value ≥ 30).[182]

The difficulties in implementing regular physical activity training or mitigation programs for shiftworkers has been noted by researchers.[183]

3.6 Conclusions

Research to date has focussed more closely on the impact of shiftwork (or Fly-in/Fly-out (FIFO) rosters) on individuals. The broader impacts on the Western Australian community, not just those associated with the mining industry but those communities where FIFO workers reside, are not well understood. Those studies which have focussed on a mining community have a tendency to focus on the relationship between a mining company and the residents of a mining town.

More generally, research focusing on the impacts to the Local Government sector in Western Australia (WA) is lacking, and in the case of FIFO, the potential costs or benefits to Local Government are not well understood. As noted earlier, there is almost no evidence available on the impacts of FIFO outside of the Pilbara region (while acknowledging that they probably experience the greatest impacts). Further work needs to be done to improve the level of information available about Local Government in WA.

There are a minimal number of studies which examine community sustainability issues, although recent journal articles have noted the need for further research in this area, and Storey's 2010 article should be seen as a positive step forward. Stronger partnerships between research institutions, mining companies, and State and Local Government would provide a more detailed and comprehensive picture of current FIFO practices. A move away from the use of anecdotal evidence to a well-documented evidence base should see better outcomes, and improve long-term sustainable community planning.

In conclusion, while there is a significant amount of negative publicity given to FIFO in the WA media, a stronger evidence base is needed to confirm the veracity of these claims. Furthermore, the research indicates that many mining companies are working proactively to improve the working conditions and experience of their employees, and the benefits experienced by some individuals and families should not be overlooked.

[182] Muller, Carter & Williamson, 'Epidemiological diagnosis of occupational fatigue', p. 69.
[183] M. Härmä, 'Ageing, physical fitness and shiftwork tolerance', *Applied Ergonomics*, Vol. 27, No. 1, 1996, p. 29.

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