CEDA
COMMITTEE FOR ECONOMIC DEVELOPMENT OF AUSTRALIA

Sustainable Queensland

Volume 3

Water infrastructure

Nick Apostolidis

Building corporate sustainability

Andrew Griffiths and Martina Linnenluecke

Environment and ecotourism

Elizabeth Saxon and Tony Charters

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CEDA INFORMATION PAPER 90

About this paper

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About the authors

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Nick has over 30 years experience in the water industry. Nick's particular interest is in world trends in water, water strategy and integrated water management. He has been involved in some of the most significant water management projects in the world.

He has authored more than 100 technical publications.

Andrew Griffiths is a Professor at the University of Queensland Business School and academic director of the school's corporate sustainability program. Andrew's research areas include business impacts of climate change and corporate sustainability strategy. He has co-authored three books, The Sustainable Corporation (1998), Sustainability (2000) and Organizational Change for Sustainability (2007). Andrew is recipient of the Academy of Management Best Paper Award (Organizations and Natural Environment Interest Group). His work has been published in leading international journals, including The Academy of Management Review and Journal of Management Studies.

Martina Linnenluecke is a doctoral student at the University of Queensland Business School. Her research explores how organisations strategically adapt to global climate change and develop adaptation and resilience to extreme weather events. Martina is recipient of a Smart State PhD Research Grant and recipient of a University of Queensland International Research Award.

Elizabeth Saxon is currently a Senior Tourism Analyst and Project Manager for Tony Charters and Associates. She specialises in the social aspects of environmental management in tourism.

She has doctoral qualifications in sustainable tourism where her project involved working with operators on the ground to develop triple bottom line reporting frameworks that integrate environmental and social aspects into business planning.

Elizabeth has seven years experience in ecotourism and sustainable tourism projects. She has worked with ecotourism operators to develop environmental management plans; at senior levels in environmental management in local government; and in sustainable tourism at the state government level. In these roles she has managed projects within the Queensland Ecotourism Plan, the Cities for Climate Protection Program, National Tourism and Conservation Partnerships Initiative and the National Parks Pricing Study.

Tony Charters was originally trained as an environmental scientist. He went on to specialise in protected area planning and management (at Masters Level) focusing on nature based recreation and World Heritage Management. Tony now has over 25 years experience in nature based recreation and sustainable tourism planning, development and management across the public, private and non government sectors.

In various executive positions on international and national boards, associations and committees, he has provided representation and strategic advice on tourism industry development, the sustainable management of world heritage and protected areas, and the interface between the two. This experience has given him a thorough understanding of the tourism network of government, private sector, not for profit and industry organisations.

About CEDA

CEDA (the Committee for Economic Development of Australia) connects leaders of Australian organisations to promote Australia's economic development.

CEDA's activities: CEDA holds more than 250 events, seminars and chief executive roundtables each year, and publishes a range of research papers.

CEDA's mission: CEDA's research and forums identify and explore issues that influence the nation's long-term economic and social development.

CEDA's reach: CEDA draws its members, which number around 800, from businesses, universities, governments and the not-for-profit sector. During 2007 CEDA's economic and business events attracted more than 22,000 people.

CEDA's independence: CEDA advocates policy in the national interest, rather than lobbying on behalf of special interest groups. It is staunchly non-partisan. CEDA's funding comes from membership, events, grants and sponsorship.

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Foreword

CEDA is proud to present the third and final volume of our state-based research project, Sustainable Queensland. This project has examined the various aspects of Queensland's exponential growth rate and the sustainability of this growth.

The first volume examined the demographic changes underpinning Queensland's growth, particularly in the south-east corner, and highlighted the increasing need for skilled labour.

The second volume tracked the infrastructure boom, and the complex and controversial alternatives for financing and managing infrastructure development.

This final volume focuses on the impact of population growth on Queensland's natural resources and environment, and the opportunity for private sector involvement.

Nick Apostolidis, Director of GHD and one of Australia's leading experts on water infrastructure, provides a comprehensive assessment of long-term solutions to water security across the urban, industrial and agricultural sectors.

Andrew Griffiths and Martina Linnenluecke critically review the concept of corporate social responsibility (CSR) in the context of achieving a "sustainable Queensland". They argue that government, companies and communities need to take a collective approach if effective capabilities are going to be realised.

Tony Charters and Elizabeth Saxon conclude with an insightful paper on the mutual engagement of business and government to appropriately value, manage and conserve Queensland's natural resources. Of particular importance to the State's eco-tourism industry will be the expediency with which new initiatives to reduce and mitigate climate change impact are undertaken.

The input from all the previous authors, the Queensland Research Committee and the project chairman, Professor Ken Wiltshire AO, has been outstanding and I would like to thank them for their exceptional work. I would like to also acknowledge the valuable financial assistance from Bond University and GHD in bringing Volume 3 to print.

This project has been warmly received by CEDA trustees, the wider community and the media.
I commend this last volume to you.

David Byers
Chief Executive Officer, CEDA

1 Key messages

Water infrastructure

Queensland's population is projected to grow by 1.54 million people in the next 20 years, potentially reaching 7.1 million by 2051. For the state to continue to prosper, it needs to meet current and future water demand – urban, industrial and agricultural – while minimising environmental impact.

The urban water demand in South East Queensland (SEQ) is of greatest concern, given its large population base, growth prospects and persistent drought conditions.

Queensland's supply is heavily reliant on surface water. In the face of uncertainty about climate change and future rainfall, a prudent long-term strategy would be to diversify the sources of water by introducing more climate independent sources.

The Queensland government has adopted a portfolio approach which addresses both supply and demand side issues. This will create a more robust water supply system, and reduce the risk associated with over-reliance on a single water source.

Supply side solutions used in this approach include a series of projects – including the Western Corridor Water Recycling Scheme and the Tugun Seawater Desalination Plant – with a combined capacity of about 340 gigalitres (GL).

The demand side measures are intended to lessen demand for water by 20 to 30 per cent. Apart from the cost savings, these measures will help minimise the ecological footprint of future development.

This proposed combination of demand and supply side solutions will be sufficient to accommodate the extra 1.3 million people and industrial demands projected to occur by 2051.

There is scope for further expansion of Queensland's irrigation sector, given increasing water availability and the cap on diversions in the Murray–Darling Basin. Queensland is well placed to expand exports of agricultural products to meet the growing demand for food and bio-fuels in China, India and South-East Asia. Subject to various constraints, a doubling of agricultural production worth more than $2 billion is feasible.

Building corporate sustainability

There is a general appreciation that "business as usual" is not conducive to the development of long-term sustainable industries, economies or communities. While much debate has centred on the costs of corporate compliance, there is sufficient empirical evidence to show that embracing sustainability concepts can enhance performance.

Building a "sustainable Queensland" will require joint corporate, industry and community engagement. The ability to take the long-term view will be especially critical in decisions relating to the development and expansion of infrastructure, and the impact this has on natural environments.

Finding the balance between economic, environmental and social imperatives will require leadership – not only from executives within private enterprise, but through government policies which constructively reward and encourage shifts towards sustainable practices.

Environment and ecotourism

The rapid population growth patterns in Queensland will inevitably affect the natural environment. There will be increasing pressure on natural resources – land, air and water – as well as the ecosystem services that maintain the quality and availability of these resources. The maintenance of natural areas, such as national parks and protected areas, will be critical to the wellbeing of all species and the preservation of natural heritage.

Balancing Queensland's population growth with open space requirements and natural area networks will require planning frameworks enforced by development legislation. Cooperative arrangements between the public and private sector will facilitate innovative management models which best leverage natural resources while conserving and enhancing natural areas.

For business, opportunities will arise from conservation and climate change initiatives, as well as rising consumer support. Recognition of the synergy between natural area management and climate change response, and the valuation of ecosystem services, will assist government in capturing and channelling appropriate funding for future conservation programs.

2 Water infrastructure

BY NICK APOSTOLIDIS

Introduction

With droughts in the south and floods in the north, Queensland is certainly a land of "droughts and flooding rains". For the state to continue to prosper it will require the development of sustainable solutions that meet the current and future water needs of the urban, industrial and agricultural sectors.

Queensland will indeed be judged to be a smart state if the solutions it implements not only meet our current needs but those of future generations. While this may seem a daunting challenge to address in the current environment, if done well the state has a wonderful opportunity to create many more opportunities for future generations. Indeed, Queensland's tropical climate presents it with the opportunity to make water resource availability a competitive advantage.

With about 40 per cent of Australia's surface water resources and 10 per cent of the country's sustainable yield of groundwater resources, Queensland is well placed to secure future urban and irrigation development. This is at a time when the Murray-Darling Basin, representing 70 per cent of the nation's irrigation development, has been capped and action is required to reduce current allocations even further. The massive resource available in the Burdekin, Fitzroy, Mitchell and the Gulf alone make the total resource in the Murray-Darling Basin seem modest by comparison.

The Queensland government has accepted the challenge and committed to invest more than $11 billion of capital works over the next five years to secure the water needs of Queensland. In addition to this commitment, many local governments and industries are also investing to improve water security of the state.

This report provides a high-level assessment of the current and future water needs of the state, the proposed capital investment program, the water management policies and their long-term sustainability, and benchmarks these against other states and international performance.

For the purposes of this report the assessment presented herein assumes the $11 billion capital works committed by the government will be implemented.

What do we mean by sustainable water infrastructure?

The concept of sustainable development is now more than 20 years old. The Brundtland Commission produced the often-quoted definition of sustainable development:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

From a societal point of view, sustainability involves maintaining a balance between environmental, economic and social and cultural values for present and future generations. Within this definition, water infrastructure will be judged to be sustainable if it:

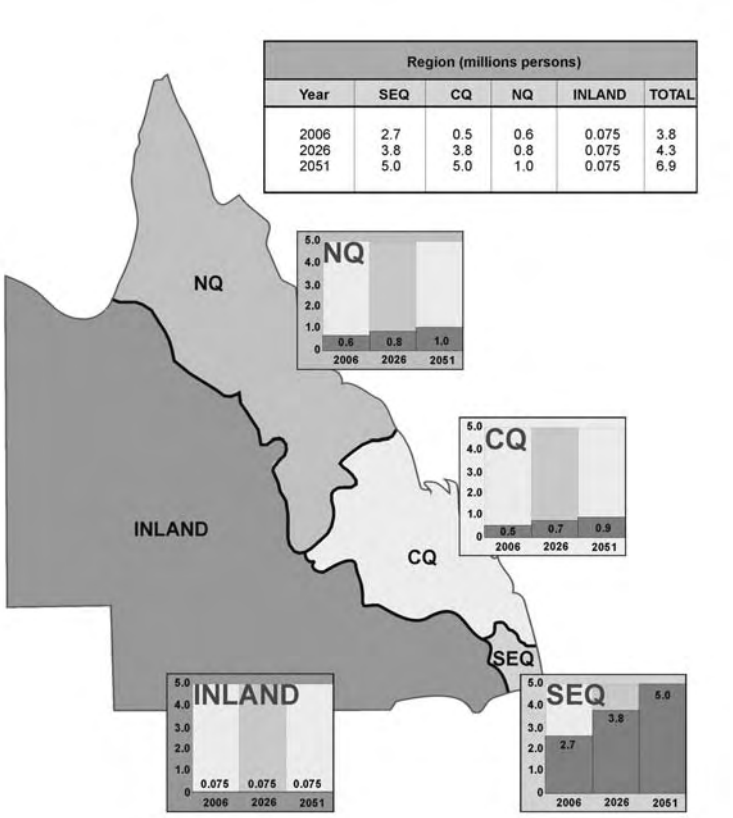
- meets the present and future water needs of communities, industry and agriculture;
- is delivered, operated and maintained efficiently and economically over its life cycle;
- maintains environmental and cultural assets valued by the Queensland community; and
- provides for contingencies in meeting future risks of droughts, floods and climate change.

Current and future water demands

Population projections

In CEDA's *Sustainable Queensland Volume 1* it was projected that the population of Queensland would grow by 1.5 million (or 40 per cent) over the next 20 years and by about 3 million over the next 40. The majority of this population growth is set to

FIGURE 1: PROJECTED POPULATION GROWTH IN QUEENSLAND



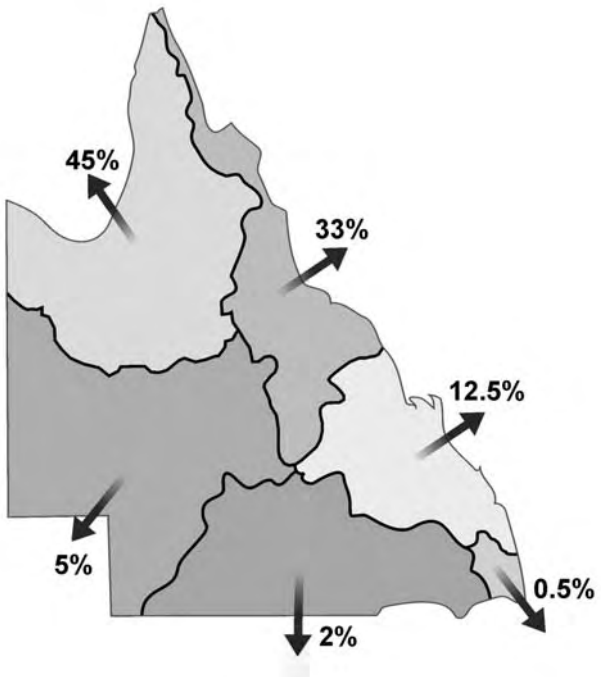
occur in the south-east corner of the state, which is currently experiencing the worst drought for more than 100 years. Figure 1 provides a break-up of the current and projected population for the major regions in Queensland.

How much water do we have in Queensland?

Despite the current drought in the south, Queensland has abundant fresh water resources. The average annual run-off from Queensland is about 160,000 GL (Australian Water Resources Audit 2000) or about 40 per cent of the total annual run-off from the entire Australian continent. In addition, it is estimated that the state's groundwater resources have a reliable yield of about 2400 GL[1] or 10 per cent of Australia's total.

Figure 2 shows the total annual run-off contribution from Queensland's major river basins. As can be seen the majority of the water resources are located in the northern river catchments discharging to the Gulf of Carpentaria and the east coast north of Rockhampton. The actual figures and percentages can vary considerably from year to year. The El Nino effect can have a significant influence on the long-term variability of rainfall in the state.

FIGURE 2: MAJOR RIVER BASIN CONTRIBUTIONS TO AVERAGE ANNUAL RUN-OFF

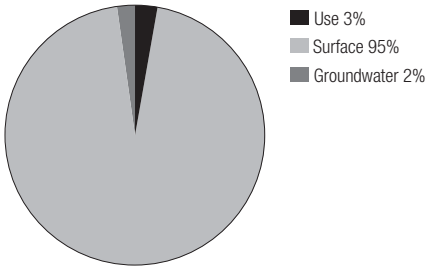


The annual run-off from the catchments in South East Queensland (SEQ), where two-thirds of the population is located, represents less than 0.5 per cent of the state's annual average run-off. The key message from these statistics is that Queensland has abundant sources of fresh water but they are located long distances from current major urban and agricultural users. In addition, these sources of fresh water exhibit significant variability.

How much water do we use in Queensland?

Queensland uses about 4600 GL,[2] representing less than 3 per cent of the total annual run-off and groundwater supplies within the state. Figure 3 shows the amount of water used in comparison to the available surface and groundwater supplies.

FIGURE 3: SUMMARY OF WATER USE IN QUEENSLAND

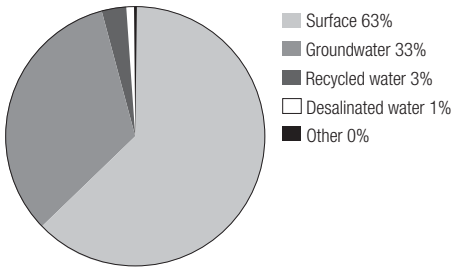


Of the 4600 GL extracted for consumptive use annually 3000 GL is sourced from surface supplies and 1600 GL from groundwater. In addition to the above, increasing amounts of recycled and desalinated water are being sourced to supplement urban and industrial uses. Other sources include water harvested from rainwater tanks and grey-water recycling.

Figure 4 shows a break-up of the different sources of water used in Queensland. The values in this figure include the Gold Coast Desalination Plant and the Western Corridor Water Recycling Scheme[3] that are currently under construction.

While a very small proportion of the surface sources are being utilised, the situation is different for groundwater. Up to 60 per cent of the available groundwater is used for agriculture, mining and urban applications. The 2000 Land and Water Resources Audit reported that of the 53 groundwater basins in Queensland about 23 were extracting close to or more than the sustainable yield. With the onset of the drought the situation is likely to have worsened.

FIGURE 4: SUMMARY OF WATER SOURCES USED IN QUEENSLAND

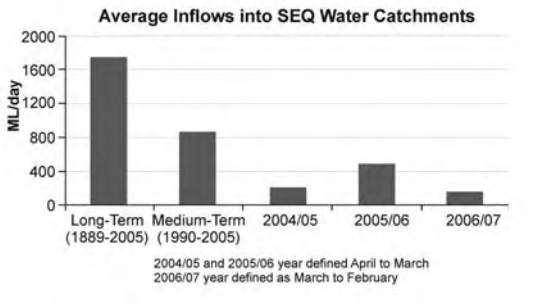


What impact will climate change have on existing water resources?

A good illustration of the potential impacts of climate change can be seen in the stream flow records observed in SEQ catchments. Figure 5 shows annual streamflows into the SEQ catchments based on data dating back 110 years. It shows that for the last 110 years annual inflows have averaged 620 GL. Annual streamflows since 1995 have averaged about 300 GL and the last three years 100 GL. How much of this phenomenon is natural and how much is attributable to climate change is very difficult to assess at this stage. The science is by no means precise and it is most likely that there is a combination of natural variability and some greenhouse-induced climate change. However, this apparent step change phenomenon appears to be evident across Australia, corresponding to a relatively wet sequence from 1950 to 1980 and a dryer sequence since the '80s, with severe drought in the last five years.

The key message from this trend is that we may no longer be able to use history alone to plan future water infrastructure. Furthermore, critical supplies such as for urban areas and power generation facilities should incorporate some climate independent supplies as a contingency measure against such changes in climate in future. It needs to be recognised that the impacts on run-off can be considerably greater than the corresponding changes in total rainfall predicted by climate models. It is interesting that regional climate model predictions tend to be more reliable in Queensland than in South-East Australia where there are far weaker correlations with phenomenon such as El Nino.

FIGURE 5: ANNUAL STREAMFLOW RECORDS IN SOUTH EAST QUEENSLAND



SOURCE: WATER FOR THE FUTURE, QUEENSLAND GOVERNMENT, 2007

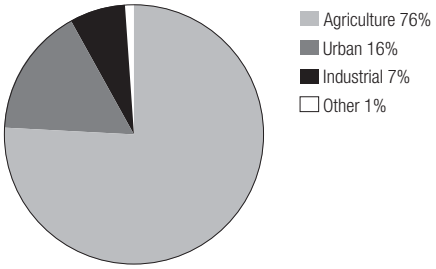
The appropriate contingency factor for climate change in Queensland is difficult to assess at present. Long-term climate change predictions[4] by CSIRO suggest that the annual rainfall is likely to reduce by about 13 per cent by 2030 and 18 per cent by 2050 across Queensland. The resultant reductions in run-off from the lower rainfalls are estimated to be up to 15 per cent by 2030 and 25 per cent by 2050.

Figure 4 clearly shows that Queensland is heavily reliant on climate dependent sources and a prudent long-term strategy would be to diversify the sources of water by introducing more climate independent sources as insurance against drought and climate change.

How is water used in Queensland?

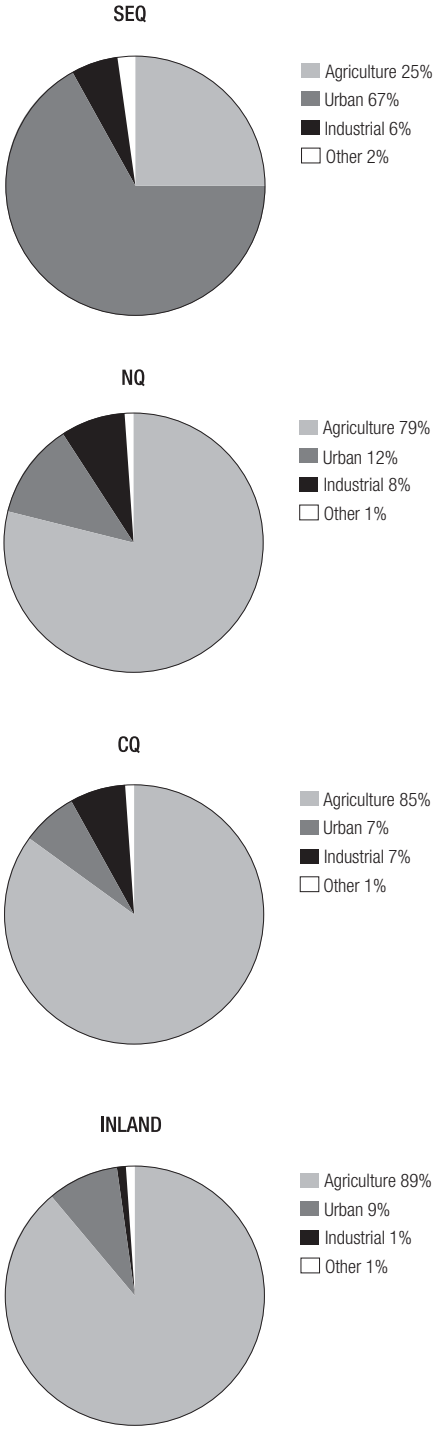
Figure 6 provides break-up of water use in Queensland for all sectors.[5] As can be seen, agriculture accounts for about 76 per cent of total water use, urban demand for about 16 per cent and industrial/mining use about 7 per cent.

FIGURE 6: WATER USE IN QUEENSLAND



The break-up varies across the major regions. In SEQ the majority of the water is used for urban and industrial purposes while in the remaining regions most of the water is used for agricultural purposes. The variability in water use is shown graphically in Figure 7.

FIGURE 7: WATER USE IN MAJOR QUEENSLAND REGIONS



Future water demand

Urban water demand

Figure 8 summarises the projected annual urban water demands[6] for the major regions in Queensland. As expected, urban water demands in SEQ dominate due to the much larger population base. Nevertheless, all regions, with the exception of inland regions, are forecasting significant increases in water demand to meet future population growth.

There has been a considerable amount of work done to predict future water demand in SEQ. The demands shown in Figure 8 take into consideration:

- continuing implementation of demand management practices;
- application pricing regimes that encourage water conservation;
- leak reduction through pressure control and the identification and elimination of leaks; and
- introduction of water-sensitive urban design principles in the creation of new developments.

The pre-drought per capita water demand was based on 300L/capita/day. The values shown in Figure 8 are based on 250L/capita/day.[7]

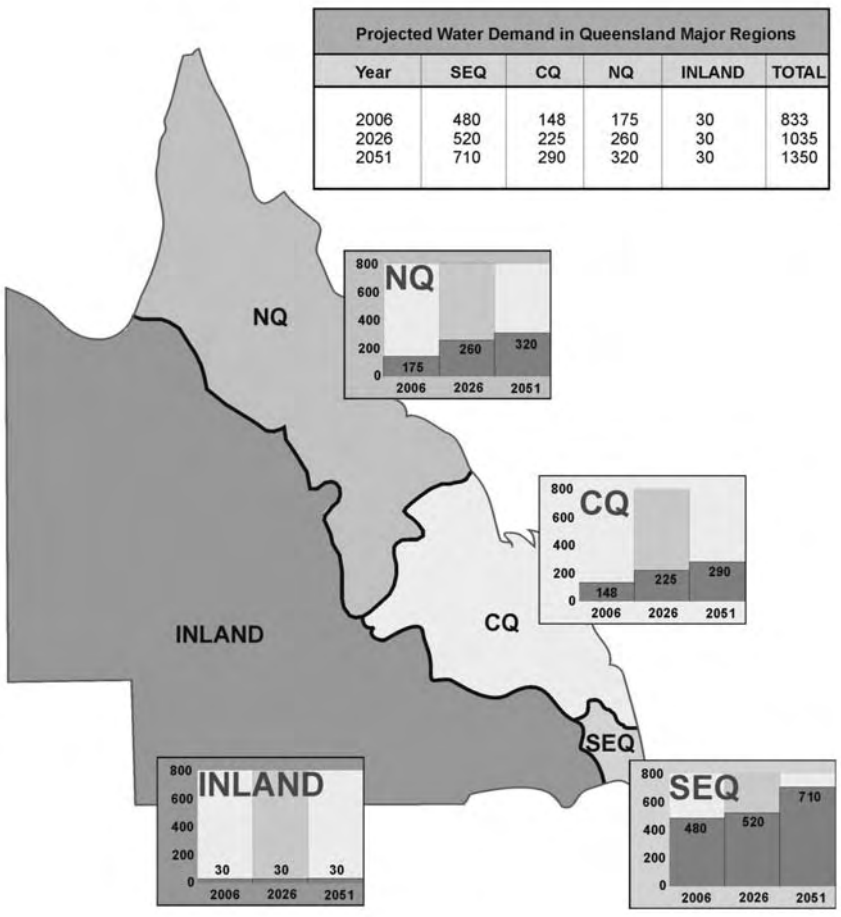
The water demand projections for the remaining regions are based on the pre-drought estimates and can be considered conservative for the purposes of this report.

Non-urban water demand

While it is a relatively straightforward process to estimate the urban water demand, it is much harder to predict non-urban uses (agriculture, industrial, tourism) as they very much depend on the type of industry and agriculture, and market factors such as commodity prices.

Demand for groundwater in Queensland is primarily from irrigation, stock and domestic purposes. Water demand was projected for the

FIGURE 8: PROJECTED WATER DEMAND IN QUEENSLAND MAJOR REGIONS



Australian Water Resources Audit 2000 for the years 2020 and 2050 in each Groundwater Management Unit (GMU). Based on the collective projections for all GMUs in the state it was predicted that groundwater use would remain between 1800 GL/yr and 2000 GL/yr in 2020 and 2050. It was thought at the time that one of the major potential markets to increase this potential would be the tourist industry, particularly in the north-eastern coastal zone of Queensland. However, since this assessment strong urban growth fuelled by the resources boom and the drought have intervened and it is likely that higher rates of groundwater development will occur to meet future demand for urban and irrigation development.

Surface water demands in Queensland currently come from irrigation (2171 GL), urban (593GL) and industrial (267GL) users. Future requirements are currently being assessed in the major use areas, with the formulation of Water Resource Plans (WRPs). Nevertheless, some insights into possible growth scenarios can be gained by a consideration of national drivers and trends.

Australia-wide irrigated agriculture accounts for approximately 26 per cent of the total gross value (50 per cent of profit) of production from agriculture, which was estimated at $28.3 billion before the drought (ABS Water Account, 2000). It is estimated that the value through processing beyond the farm gate is three to four times the value of the irrigated agriculture industry.

Trends in agriculture indicate that current growth industries include dairy, wine, cotton and horticulture, challenging the traditional perception of wool, wheat and beef as Australia's largest export earners. Prior to the current drought an estimated 18,000 GL of water was used to irrigate over 2.1 million hectares (ha) throughout Australia (NLWRA 2000). This represented an increase in area of 430,000 ha or 27 per cent on the area irrigated in the previous decade. Over the same period water usage for irrigation increased by 7000 GL/yr, or 70 per cent Australia-wide. In fact, Queensland's total water use grew by 88 per cent (130 per cent surface water and 36 per cent groundwater) in this period, largely due to increases in irrigation. Basins exhibiting most growth included the Border, Brisbane Burdekin, Burnett, Condamine–Culgoa, Fitzroy, and Warrego Rivers. If this growth rate is projected for Queensland into the future it will mean an increase in use of about 3000 GL, or a doubling of use over the next 20 years. However, Queensland's relative abundance of unallocated water compared to other states could mean it will attract even higher growth in irrigation development.

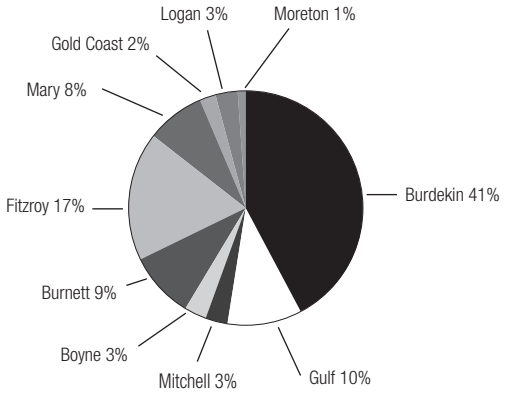
Queensland has 150 million ha of farmland of which only 0.16 million ha is irrigated. Accordingly, while not all farmland has suitable soil types for irrigation, land is unlikely to be a limiting factor when it comes to expansion of irrigation development into the foreseeable future. Transport infrastructure and water supply will be important factors. Prior to the current drought most of the growth in the areas of irrigated land occurring in New South Wales (especially in the Murray-Darling Basin) and Queensland (especially in the Burdekin). Prior to the cap on diversions in the Murray-Darling Basin water use for irrigation was growing at between 100 to 200 GL each year. If we were to see this scale of growth move from the fully allocated Murray-Darling Basin into those catchments in Queensland with large amounts of unallocated water, this could lead to a doubling of Queensland's irrigation sector in 10 to 20 years, worth more than $2 billion at the farm gate. The adjustment processes going on in NSW's over-allocated systems are also likely to add to the pressures for growth in Queensland. (The total value of irrigated agriculture is around $9 billion with Queensland accounting for about $2.25 billion).

Scope for growth

Based on current water resource planning it is estimated that the state has presently about 2000 GL of unallocated water (UAW). Unallocated water is defined as water that is available for consumptive use after allowing for the needs of the environment and the sustainable maintenance of the resources.

Figure 10 summarises the break-up of UAW. It shows that the majority of this water is in the Burdekin, Fitzroy, Burnett and Gulf river basins.

FIGURE 9: SUMMARY OF UNALLOCATED WATER



Based on the potential high growth in demand for irrigation water discussed already, of up to an additional 3000 GL over the next 20 years, these figures suggest that while there is significant scope for increased irrigation development, careful planning will be required to avoid over-allocation and constraints on security for urban and other industries. Consequently, an expansion in irrigation consistent with a 50 per cent increase in water use, or 1500 GL, is likely to be a more sustainable growth trajectory, taking into account likely increased urban demands arising from population growth. Of course, this assumes current levels of irrigation efficiency. Adoption of best practice irrigation technology and water use practices could generate on-farm improvements in water efficiency of as much as 25 per cent. There is also scope for reducing off-farm system losses, although Queensland has a higher proportion of piped irrigation distribution than the Southern Murray-Darling Basin.

Indeed, Queensland has an opportunity to plan for the future of its irrigation sector to avoid the mistakes evident in the Murray-Darling Basin.

A key requirement is to ensure adequate drainage infrastructure and recharge control to minimise salinity and water-logging problems, while protecting wetlands and groundwater systems.

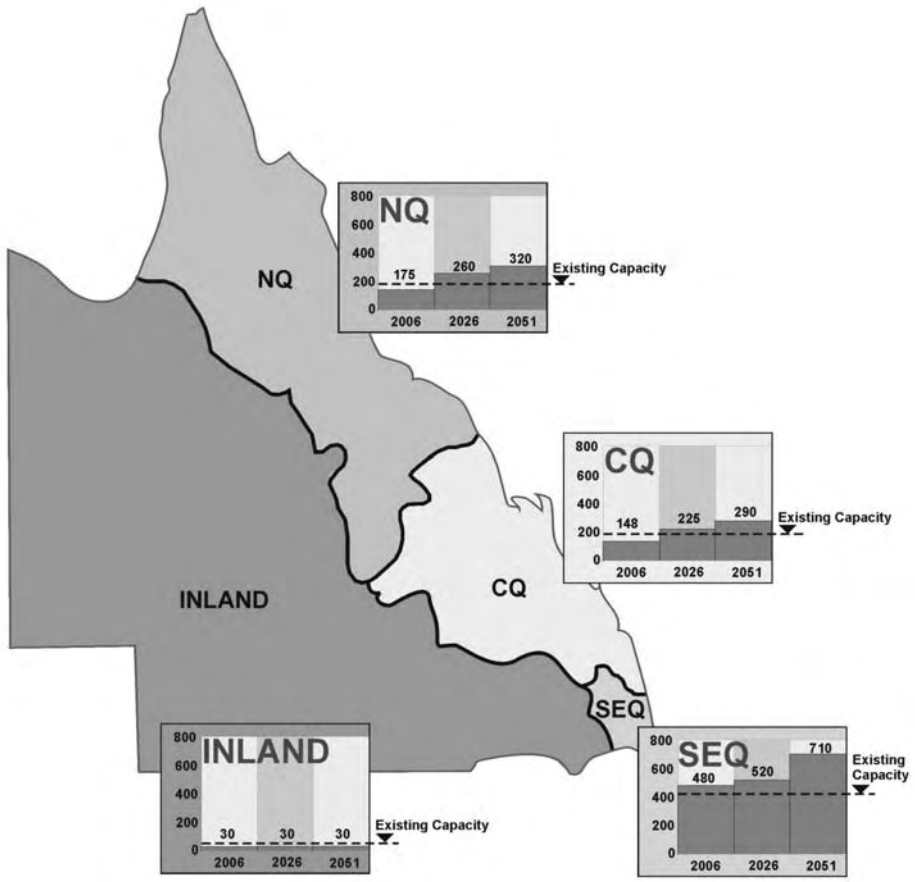
Existing system capacity

Urban systems

Figure 10 provides a snapshot[8] of the capacity of the existing urban water supply systems (GL per annum) relative to the projected demands.

Not surprisingly, the SEQ region is in the worst situation and thus the focus of most attention. It would be safe to say that the SEQ community now values water more than it did in the past and while it may be prepared to tolerate the current water restrictions, it will not be as tolerant in the future if the same situation were to be repeated. The community now appreciates there are significant social disruption costs associated with lack of water and is demanding and prepared to pay for a higher level of water supply security in future.

FIGURE 10: SUMMARY OF EXISTING SYSTEM CAPACITY AND DEMANDS



Generally, the remaining regions in Queensland, while close to reaching water supply capacity, must have sufficient time and water supply sources nearby to meet future water demands. There are clearly exceptions to this, as there are many smaller communities such as Agnes Waters, Rolleston, Dingo, Claremont, Chinchilla, and so on, which are facing severe water shortages.

Non-urban systems

With the exception of mining and industrial users, the non-urban sectors operate on a different level of service. Most agricultural users have an allocation for water based on average climatic conditions. However, the actual allocation they receive depends on climate and thus the amount of water that is available to be allocated in accordance with the water resources plan for the river system. This is especially the case in unregulated rivers. In the case of supplemented supplies, or regulated systems with storages, irrigators can enjoy higher reliabilities of supplies. This is particularly important for irrigation of permanent plantings such as orchards, other tree crops and vineyards, which demand high security water.

Most of the WRPs in Queensland have been completed or are nearing completion and take into consideration water needs for agriculture, industry, urban users and the environment. Queensland is fortunate in that most of its irrigation infrastructure was developed in the late 1960s and 1970s and does not have the over-allocation problems being experienced in the Murray-Darling Basin.

Queensland has 31 established irrigation districts with 7,868 customers covering a total area of 399,947 ha. Of this, only 163,947 ha is currently irrigated with 2225 GL of water entitlement. Thus with current usage at 2171 GL surface water, these districts are close to committed, even though less than half the land is developed. Accordingly, the capacity for expansion of irrigation will require new greenfield developments close to available supplies of unallocated water or further augmentation of supplies in, or adjacent to, existing irrigation schemes. In addition, increased productivity can be expected from the existing development through the uptake of more efficient irrigation practices. The state government's Rural Water Use Efficiency Initiative, which commenced in 1999 has already assisted in saving an estimated 180 GL of water, equating to hundreds of millions of dollars in enhanced productivity. A further benefit from this initiative is the reduction in run-off of nutrients and pesticides to waterways and coastal waters.

The economics of new irrigation development in the state will be driven, as elsewhere, by the profitability of enterprises and the costs of development, including costs of water. Only irrigation based on high value crops and horticulture is likely to afford the cost of new large-scale public and/or private water infrastructure, such as dams, channels and pipelines. However, there is also scope for expansion based on farm-water harvesting, as currently occurs in the cotton industry. Further adjustment is also likely to take place in terms of conversion of existing less profitable enterprises such as sugar cane to higher value crops.

In addition to allocated water for irrigation, water harvesting is a significant source of water for irrigation in the state. This involves pumping flood flows into off-stream storages. Some of these storages on western floodplains can approach 500 GL (the volume of Sydney Harbour) in capacity. The regulation and planning of these systems can be extremely difficult given the huge variability in flood flows and the difficulty of assessing downstream impacts. This has become a significant source of controversy in the case of "Cubby Station" on the Condamine–Balone. One of the stated objectives of the National Water Security Plan is to review the water plans in the Murray-Darling Basin and to re-assess sustainable yield determinations on a common basis across state borders. Both the Queensland and NSW governments have agreed in principle to this approach.

The capacity of the state's groundwater systems to support future growth is more limited. The estimated annual sustainable yield of the state's groundwater resource is 2500 GL, of which 1800 GL is currently being used, leaving up to 700 GL for future growth in use. Sustainable yield is defined as the groundwater extraction regime, measured over a specified planning timeframe that allows acceptable levels of stress and protects the higher value uses associated with the total resource. However, it should be noted that over half the GMUs have sustainable yield estimates based on very limited data. In addition, the Queensland government is part of the national program to cap and pipe the Great Artesian Basin. This is expected to bring usage within sustainable limits in future and potentially free up resource for further development.

System connectedness

One of the key issues concerning system capacity, for both urban and rural demand, is the question of balancing demand and availability of resource through inter-catchment transfers. The Queensland government is exploring the feasibility of such

options, including a pipeline from the Burdekin to the South East. Major projects like the Southern Regional Pipeline Project are already underway to connect different demand and supply centres in a water supply grid. This is an important part of managing risks to future water security by regional climate impacts and population growth away from future water sources. However, at some point transport costs become uneconomic compared to climate independent supply options, such as desalination and recycling. These are now being actively pursued in Queensland as part of a broad portfolio of options for managing risk to future water security.

In the future greater consideration will need to be given to surface water and groundwater interconnections. This is necessary to avoid double counting in allocation planning for highly connected systems and to provide for conjunctive use. The potential also exists for managed aquifer recharge schemes using stormwater and recycled water. A number of significant groundwater recharge works have already been commissioned, including in the Lower Burdekin, Lockyer Creek and tributaries and Callide Creek.

The interconnectedness of Queensland's water supply system will also enhance opportunities for operation of the water market, ultimately enabling trade between urban and rural systems, as well as between different urban systems.

Sustainable solutions to future water needs

Urban and industrial sector

SOUTH EAST QUEENSLAND

The Queensland government[9] has adopted a portfolio approach for addressing the present and future water needs of South East Queensland.[10] This approach involves a comprehensive suite of measures that address both supply side and demand side issues. Few places in the world have adopted as comprehensive an approach as SEQ.[11]

Figure 11 depicts the portfolio approach adopted for meeting the additional water needs for South East Queensland over the next 40 years.

The advantage of the portfolio approach is that it will result in a much more robust water supply system to cope with future population growth and climate change impacts. It also has benefits from a risk management perspective in that the region would no longer rely as much on one major source of water.

The demand side measures currently being implemented include:

- public education on wise use of water;
- a comprehensive rebate program that encourages households to install water-saving devices and appliances;
- a pricing regime that encourages water conservation;
- improved regulations that require new developments to embrace total water cycle management principles;
- subsidised advisory services to households and small businesses to improve water efficiency;
- a water efficiency labelling scheme;
- water main leak detection and control;
- drought management plans that extend the life of the water supply scheme during extreme climatic periods; and
- improved institutional arrangements that allow use of rainwater tanks, grey water recycling, and so on at the household level.[12]

The combined effect of the above measures is to reduce the demand for additional sources of water between 20 to 30 per cent. Looking at it in another way it avoids the need to build another desalination plant or major water recycling scheme such as the Western Corridor. Apart from the economic benefits, these demand side measures also help minimise the ecological footprint from future development.

FIGURE 11: SUMMARY OF DEMAND AND SUPPLY SOLUTIONS FOR SEQ FOR NEXT 40 YEARS

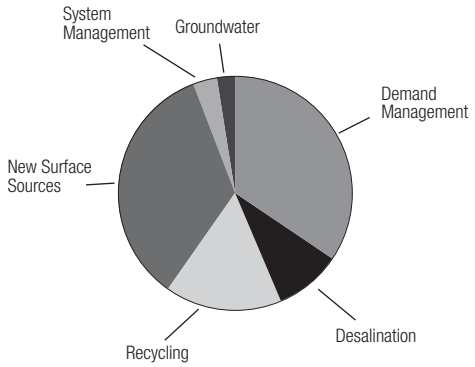
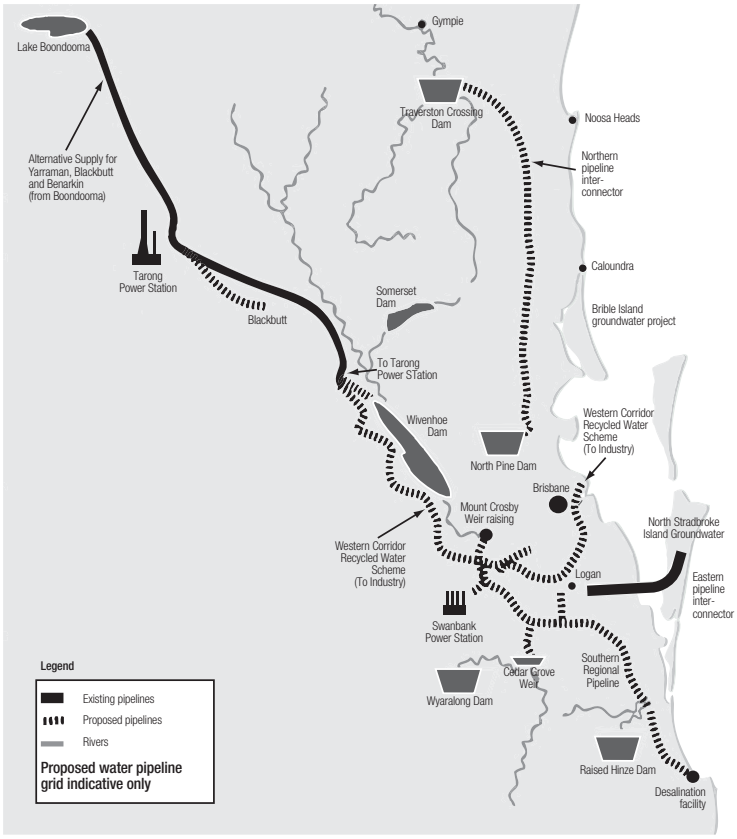


FIGURE 12: PROPOSED WATER SUPPLY WORKS FOR SOUTH EAST QUEENSLAND



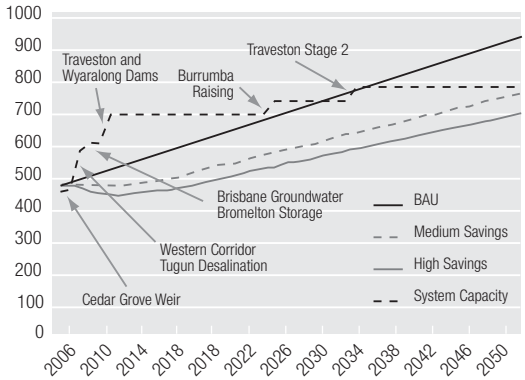
However, demand side measures alone are not sufficient to meet the region's future water needs. Supply side solutions are required to deliver the region an appropriate level of water supply security. The supply side solutions include a series of projects with a combined capacity of about 340 GL. These are listed below and shown in Figure 12:

- Western Corridor Water Recycling Scheme (85 GL)
- Tugun Seawater Desalination Plant (43 GL)
- Traverston Crossing Dam (150 GL)
- Wyaralong Dam (21 GL)
- Ceder Grove Weir/Bromelton Storage (16 GL)
- Eastern Connector (8 GL)
- Brisbane Groundwater Supply (8 GL)

In addition to the above water supply augmentation works, the efficiency and connectivity of the water supply system will be improved through the regional water grid.

Figure 13 shows the projected water demand for SEQ over the next 45 years and the capacity contribution from the proposed augmentation works.

FIGURE 13: CAPACITY IMPACTS OF PROPOSED WORKS



As can be seen the combination of demand and supply side solutions proposed for SEQ will be sufficient to accommodate the extra 1.3 million people and industrial demands projected to occur by 2051.

Potential risks to this strategy could be one or all of the following scenarios:

- climate change impacts are far worse than current predictions;
- the demand side solutions are not as effective in reducing the water demands as hoped; and
- SEQ becomes such a desirable place to live that even more people wish to settle in the region.

The effect of any or all of the above scenarios will be to bring forward (i.e. before 2051) the need for additional sources over and above those listed above. In such circumstance the opportunities of additional sources will be reduced to some further water recycling and desalination. By that date the region will have gained very good operational experience with the proposed scheme, and with the water grid in place should be able to readily accommodate the development of such additional sources of water should the need arise.

On the other hand, it may be equally possible that the drought breaks and the region will have a surplus of infrastructure for some period of time. In a climate change world it will be necessary to have a proportion of the sources that are independent from climate as insurance. They will provide the added water supply security now demanded by the community.

CENTRAL QUEENSLAND

Central Queensland includes the industrial and port facilities at Gladstone and the tourist and regional centres of Hervey Bay, Bundaberg and Rockhampton, as well a series of smaller towns and much of the agricultural sector. The region currently generates $36 billon of exports representing 20 per cent of the exports from Queensland.

The current water resources strategy for Central Queensland suggests most urban areas in this region have sufficient water supply capacity to meet present water demands;[13] however, the projected growth in population will require the existing water resources to be augmented.

Generally most of the urban areas would be able to meet the 2051 demand gap by utilising the unallocated water identified earlier in this report. For example:

- Gladstone will be able to meet its water demands by accessing more water from the Fitzroy River;
- Rockhampton has sufficient supply from the Fitzroy River;
- Hervey Bay[14] is proposing to raise Lenthals Dam (their existing primary water supply) and any further water can be accessed from the Burnett River; and
- Bundaberg would be able to source additional water from the Burnett River.

Despite the availability of surface water sources for these urban areas, it would be prudent for each urban centre to consider implementing elements of the SEQ portfolio strategy to make them more robust to climate change impacts in the future.

NORTH QUEENSLAND

The situation in North Queensland is similar to Central Queensland. The major urban centres of Cairns, Townsville and Mackay have sufficient water resources to meet current urban/industrial demands but will require augmentation to meet projected growth to 2051.

Generally, the additional urban demands in this region can be met by utilising the unallocated water in nearby river systems. Under the current water resource plans the strategies for securing the water supplies of the three major urban centres in this region are as follows:

- Cairns proposes to source additional water through additional allocation from the Baron River and the Mulgrave aquifers.
- Townsville has an allocation from the Burdekin Scheme to supply its future water supply.
- Mackay proposes to raise Kinchant Dam and/or possibly an extra allocation from the Burdekin Scheme to meet its future water needs.

Most of the above urban centres, in particular Mackay,[15] would benefit by adopting elements of the SEQ portfolio strategy. Scope exists in Townsville and Cairns to implement more aggressive demand management practices as their per capita water use is much greater than that of SEQ.

INLAND

The combined population of the inland urban communities is predicted to remain static over the next 50 years at about 75,000 people. The majority of people live in small townships and on farms supporting agricultural activities and mining.

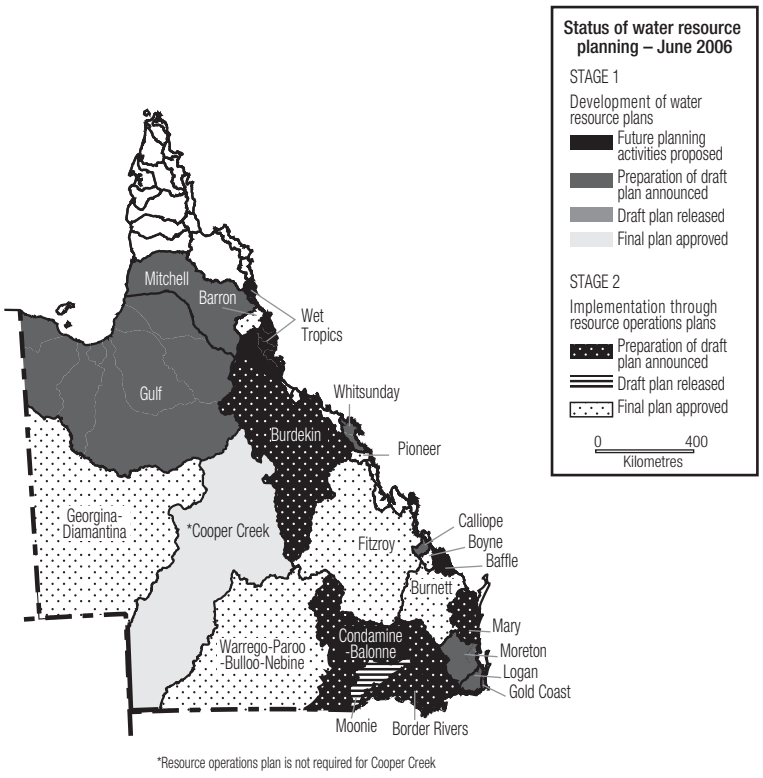
The urban water needs of these communities represent a very small proportion of the water use associated with the agricultural and other industry activities on which these regional economies depend. As discussed already, unallocated water is available in a number of inland systems, particularly to the north for irrigation and other development. The location of future development will depend on transport infrastructure and soils, as well as water.

The biggest challenge facing the inland regional communities is potential reduction in water availability due to climate change, thus impacting on the viability of agricultural and mining activities they rely on for their livelihood. Based in the current water resource plans for these areas there is some unallocated water (surface and groundwater) to support more agriculture and mining activities and also for more urban water needs. However, more work is required to assess the potential impact from climate change to help effectively plan for any further development.

Agricultural sector

With a cap on diversions in the Murray-Darling Basin and the availability of water resources in Queensland, there is scope for further expansion of the state's irrigation sector. Subject to environmental constraints, soil types and infrastructure costs, this could see a doubling of agricultural production worth more than $2 billion. Compared with other states, Queensland is better placed to expand exports of irrigated agricultural products to meet the growing demand for food and bio-fuels in China, India and South-East Asia. Queensland is also well placed with its port and airport infrastructure to capitalise on the proximity of these growing markets.

FIGURE 14: STATUS OF WATER RESOURCE PLANNING IN QUEENSLAND



*Resource operations plan is not required for Cooper Creek

WATER USE EFFICIENCY

Queensland has a higher proportion of more efficient spray and drip irrigation, compared to flood or furrow irrigation, than Victoria or NSW, but less than South Australia. However, there is still scope for improving on-farm water use efficiency and the government funds an active incentive program to assist in the uptake of more efficient irrigation practices. It is reasonable to assume that on-farm efficiency improvement in the order of 25 per cent can be made in future.

WATER PLANNING

Future investment in irrigation and other water-dependent industries, including power generation, will depend on secure property rights underpinned by a rigorous and transparent water allocation planning system. Queensland is reasonably well advanced with the preparation of WRPs, with over 60 per cent of the state covered by approved plans. However, there are still a large number of resource operations plans to be completed. Figure 14 shows the current status of planning. A further consideration is that a number of WRPs will shortly come up for review. It will be important for the government to streamline these processes over time to avoid an impact on investor confidence, which will arise from incomplete or constantly changing plans. A key objective of the planning system should be to maximise opportunities for trade to enable water to move to its highest value uses. As both urban and rural systems approach full allocation a free market in water will be important in assisting structural adjustment, which will inevitably continue to be a feature of the agricultural sector. In South-East Australia water trade has significantly reduced the cost impacts of the current drought on the irrigation sector. This has resulted from cropping farmers deciding not to plant, but achieving a financial return from temporary sale of water to farmers with permanent plantings.

Summary of total water balance for Queensland

A scenario analysis was carried out to examine the total water balance for Queensland under different climate change and water resource development conditions. The different scenarios evaluated included:

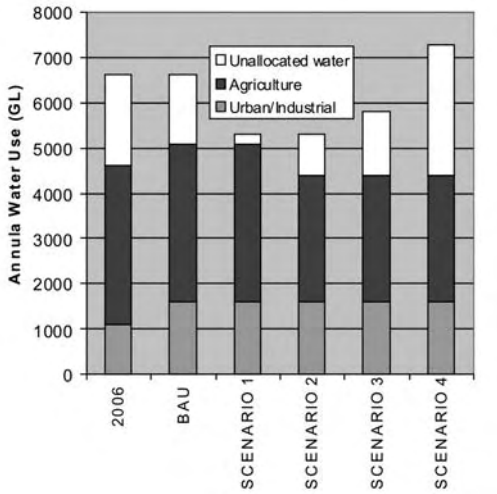
- Business as Usual 2051 – This assumes no major changes to mean annual inflows and current irrigation practices and no growth in irrigation, but projected growth in urban and industrial demand.
- Scenario 1 – Assumes a 25 per cent reduction in mean annual run-off[16] (due to climate change) and no change to irrigation practices and no growth in irrigation.
- Scenario 2 – Assumes a 25 per cent reduction in mean annual run-off and state-wide irrigation efficiency program implemented to reduce irrigation demand by 25 per cent.
- Scenario 3 – Assumes a 25 per cent reduction in mean annual run-off, state-wide irrigation efficiency program to reduce demand by 25 per cent and the development of an additional 500 GL water resources.[17]
- Scenario 4 – Assumes a 25 per cent reduction in mean annual run-off, a state-wide irrigation efficiency program to reduce demand by 25 per cent, and the development of an additional 1000[18] GL of water resources.

The results from this analysis are summarised in Figure 15.

The results from the scenario analysis show that:

- Under current irrigation practices and historical climate conditions, there are sufficient water resources to meet all urban, industrial and agricultural demands projected for 2051. Moreover, there will be some 1500 GL potentially available for further development.

FIGURE 15: QUEENSLAND WATER BALANCE SCENARIOS



- If climate change causes the mean annual run-off to reduce by 25 per cent from the historical average, then the current unallocated water resources will only be sufficient to meet the projected urban and industrial demand with little opportunity for further development.

- The implementation of a state-wide irrigation efficiency program to save 25 per cent of use will potentially free up a further 750 GL of water for further development, which, even allowing for climate change impacts, could leave a total of 1000 GL or 30 per cent expansion in irrigation production, worth over $1 billion annually (Scenario 2).

- Scenarios 3 and 4 are similar to Scenario 2, except that they involve the development of a further 500 and 1000 GL of water resources beyond the current unallocated water estimates.

The key message from this analysis is that:

- The state has sufficient water resources to meet its future water needs for current agriculture and projected growth in urban and industrial demands, even assuming a 25 per cent reduction in resource availability due to climate change.

- Further development of the state's current unallocated water resources needs to happen in parallel with improved irrigation efficiency in order to allow for the potential doubling in growth of the agricultural sector, which is considered feasible by 2051, subject to other environmental constraints and infrastructure costs (Scenario 4).

- There is scope to develop further water resources with an extra 1000 GL, representing less than 7 per cent of the mean annual run-off, even after allowing a 25 per cent drop in run-off due to climate change.

How is Queensland placed relative to other states and countries?

This section assesses how well Queensland is placed in managing water compared to other states and countries using the sustainability measures defined earlier in this report. The assessment looks at urban, industrial and agricultural water management separately.

For convenience the measures have been abbreviated as follows:

- Ability to meet present and future water demands;

- Economic efficiency;

- Environmental stewardship; and

- Robustness to climate change.

For each of the above measures a simple A to E rating has been applied to give an indication of Queensland's ranking. The ratings comprise:

A The benchmark – among the best

B Very good – in the top quartile

C Average

D Poor – in bottom quartile

E Very poor – not addressing issue

Urban and industrial water management

Table 1 below compares Queensland's management of urban and industrial water supplies against other states and countries around the world.

Despite the current predicament of South East Queensland, Table 1 suggests that overall Queensland is very well placed in managing present and future urban/industrial water needs. This may seem a strange outcome in the midst of Level 5 water restrictions. However, it is important to recognise that significant funds have been committed to address the current problems. In fact, the delivery of the projects the government has committed to deliver will place Queensland in a leadership position. In a few years time Queensland will be able to point to:

- one of the world's largest advanced water recycling projects;

- new urban developments that offer among the lowest ecological footprint in the world such as the award-winning Pimpama Coomera scheme, the largest of its kind in the world;

- a major desalination plant (possibly more depending on climate change);

- among the best performing biological nutrient reduction plants in the world;

TABLE 1

SUSTAINABILITY MEASURES		COMPARISON WITH OTHER STATES		COMPARISON INTERNATIONALLY
Ability to meet present and future water demands	C	Average now dragged down by SEQ having to impose Level 5 water restrictions to meet present demands in SEQ. Once planned SEQ works implemented over the next 2 to 3 years Qld will be in a very strong position and achieve a B to A rating.	A	Very well placed (Only a very small proportion of available yield is currently being used. Use is generally within sustainable yield). The portfolio approach being implemented in SEQ will become a benchmark.
Economic efficiency	B	Among the best based on Water Services Association of Austrailia (WSAA) benchmarking.	B	Better than most in the world including private water companies. (Refer recent Office of Water Services (OFWAT) report).
Environmental stewardship	B	Among the tightest Water Quality (WQ) requirements in the world. Integrated approach to urban water management involving demand and supply side measures is delivering lower ecological footprint solutions than most other schemes in Australia.	B	Australia compares very favourably by world standards. Commitment to sustainability better than most countries in the world.
Robustness to climate change	A	Among the leaders. Water Authority security through diversity is a benchmark.	A	Australia appears to be one of the countries most affected by climate change. Measures being implemented in SEQ and Perth are world benchmarks.

- a world-class water quality improvement program delivered through the Healthy Waterways initiative;
- among the best experience in the world in managing water demand in a drought as well as implementing a raft of demand management initiatives; and
- largest uptake of rainwater tanks in an urban area and operational experience that comes with it.

These types of solutions are in increasing demand all over the world as other regions try to adapt to climate change as SEQ has had to. This provides the local industry with a once in a lifetime opportunity to create a strong local services industry capable of exporting the skills it has gained in delivering the above projects.

Agriculture water management

Table 2 below compares Queensland's management of agricultural water supplies against other states and countries around the world.

Table 2 shows that Queensland is well placed, both nationally and internationally, in terms of its irrigation management. This is partly due to the fact that Queensland is still in the development phase with respect to agricultural water supply and has not yet reached the point of over-use or over-allocation that has emerged in the southern Murray-Darling Basin. Queensland has taken steps to encourage improved irrigation efficiency before its rivers have reached high levels of stress. There are some questionmarks over the sustainability of harvesting overland flood flows in the west, including the Condamine–Balone.

Policy improvements

Despite the very positive outlook for Queensland's water industry there is scope for further improvement and investments by government. To take advantage of the opportunities identified in this report the following policies are recommended:

- **Invest more effort in long-term water resource planning for climate change**

While the government is well advanced with its water resource planning activities throughout the state, the process is dynamic and will require additional work to determine the adequacy of the current plans under a climate change environment.

TABLE 2

SUSTAINABILITY MEASURES		COMPARISON WITH OTHER STATES		COMPARISON INTERNATIONALLY
Ability to meet present and future water demands	A	Irrigation sector has scope for growth by up to 50% within existing sustainable yield. An issue will be the need for new development to move to where the water is in the north. Need to move to metering users on unregulated streams. ANCID benchmarking shows Sun Water (SW) Bundaberg and SW Burdekin-Houghton irrigation systems are the best performing, in terms of the percentage of years in which entitlements are fully delivered, with high reliability water delivered in 100% years and lower reliability water in greater than 90% years.	B	Very well placed (only a very small proportion of available yield is currently being used. Use generally within sustainable yield). Potential for exporting sustainable irrigation management systems.
Economic efficiency	B	Generally better than average	B	Better than most in the world
Environmental stewardship	B	Sun Water has implemented ISO14001 accreditation for their businesses and across its schemes, covering the majority of the irrigation scheme developments in Qld districts. WRPs are well advanced, together with approval of Regional National Resources and Mines (NRM) plans. A questionmark is the non-statutory status of NRM regional bodies. High proportion of more efficient irrigation technology. Rural Water Efficiency Program has saved 180 GL since 1999. Questionmark over the downstream impact of weather research programs on NSW wetlands.	A	Australia compares very favourably by world standards. Commitment to sustainability better than most countries in the world.
Robustness to Climate Change	B	Among the leaders. The Qld government has made a significant investment in assisting farmers manage climate risk with programs such as “Rainman”. Queensland does not have the extent of over-allocation problems faced by many of the irrigators in the Murray-Darling Basin.	A	Among the best in the world. The National Water Initiative currently being implemented by Council of Australia Governments (COAG) is considered internationally as a benchmark approach to water resource management. A B rating reflects the slow progress made in implementing the NWI. Once implemented it will deserve an A rating. The separation of land and water titles combined with the establishment of water trading has the potential to drive more efficient use of water for higher valued production. The recent commitment of $10 billion by the federal government to address water allocation and irrigation efficiency problems will place Australia in a much better position to address climate change impacts in future.

Future water resource plans need to identify appropriate contingencies for climate change well before they are likely to be required. The plans need to be closely monitored and regularly updated to allow early action in case there is a step change in the catchment hydrology.

In the absence of detailed analysis it may be prudent to factor in at least a 25 per cent reduction in yields for a dryer climate in future water planning in Queensland, as is being factored into water planning in other states, such as Western Australia.

- **Undertake additional research of the capacity of rivers and land systems in Northern Queensland to accommodate additional irrigation/industrial/urban development**

We currently use less than 3 per cent of the water run-off from the state's river systems. It is thus timely to critically assess the opportunities for further development. Given the projected population growth and dwindling water resources worldwide, Queensland has a unique opportunity to develop more irrigated agriculture to feed increasing populations in Australia and other parts of the world that are less fortunate.

This will require the preparation of a prospectus for potential future irrigation development, identifying no go areas and environmental constraints, as well as areas with suitable soils, climate and infrastructure and water availability for greenfield development.

- **Pursue regional planning strategies which encourage future development to locate near available water resources**

While the initiatives now underway for SEQ should meet the reasonable water demands through to 2051, the performance of these plans will need to be kept under constant review. In addition, positive steps need to be taken to plan for high population scenarios through policies that actively encourage new urban, industry and irrigation development to establish where water resources are more plentiful and can be developed sustainably. This will require some long-term thinking and rigorous assessment of the options for siting future growth. The regional approach to planning water infrastructure being embarked on by the Queensland government should facilitate this more strategic approach, but will require a strong statewide policy perspective to be maintained.

- **Build a local skill base and create an export industry for future generations**

The vast array of solutions being implemented in SEQ to address water supply security will be in demand all over the world as other regions try to adapt to climate change in the same way as SEQ has had to.

This provides the local industry with a once in a lifetime opportunity to create a strong local services industry capable of exporting the skills it has gained to other locations in Australia and the rest of the world. Singapore achieved this as part of its Four Taps policy to improve the water supply security in that country. If Queensland aspires to be the smart state it should do the same. It has a strong economy and the talent and resources to do it.

This will require:

- leadership that is prepared to back the capability of the local industry;
- smart purchasing arrangements that promote local industry development;
- establishment centres of excellence and business hubs; and
- local industry proudly promoting its achievements throughout the world.

- **Promote the capacity of Queensland to accommodate sustainable growth better than most other states**

With the heightened awareness in water, now is a good time to promote Queensland and its capacity to accommodate growth sustainably better than most states.

Endnotes

1 Total yield is about 2800 GL. Of this, about 2400 the salinity levels are less than 1000 mg/L.

2 The 4600 GL figure is the 2000 estimate water use. It has been used because it is more representative of pre-drought water demand conditions.

3 Queensland currently recycles about 15 per cent of its urban water supplies. With the completion of the Western Corridor Water Recycling Scheme this will double the value to 30 per cent.

4 These climate models are still in the development stage, so some caution is warranted in using these predictions.

5 Based on 2000 estimates.

6 The values shown in Figure 8 for SEQ are the medium demand management scenario projections.

7 The government preferred target is now 230L/capita/day.

8 The values in Figure 10 represent the broad picture for the regions. Within each region there are communities that present a different story to the total picture. For example, towns such Agnes Waters-Seventeen Seventy are facing severe restrictions even though the overall water supply situation for Central Queensland is adequate from a supply availability perspective.

9 Includes local authorities and bulk water agencies.

10 In the author's opinion the approach adopted for addressing the water needs of SEQ will provide a blueprint for other urban areas throughout the world facing similar water shortages.

11 Other regions that have adopted a similar approach include Perth, Singapore and Israel to a lesser degree.

12 Until recently regulations prohibited the use of rainwater tanks and grey water recycling within urban areas.

13 There are quite a few small towns in the region experiencing severe water shortages.

14 Hervey Bay has implemented many of the demand management initiatives being implemented in SEQ. They are among the leaders in Australia in water loss reduction and pressure control. Almost all the wastewater effluent in Hervey Bay is used to supply to sugar cane irrigators surrounding the city.

15 Mackay currently relies on surface and groundwater for its water supply. Rasing the dam will provide some added security but the next source of water is not easily accessible and will require a step up in marginal cost and increase in ecological footprint to source.

16 The reduction is unlikely to be uniform across the state, but is used here to illustrate the point.

17 This will increase the amount of water extracted from the state's surface sources from 4.2 per cent to 5.3 per cent of mean annual run-off.

18 This will increase the amount of water extracted from the state's surface sources from 4.2 per cent to 6.9 per cent of mean annual run-off.

3 Building corporate sustainability

BY ANDREW GRIFFITHS AND MARTINA LINNENLUECKE

Summary

This paper examines the emergence of the relationship between environmental, social and economic approaches to sustainability and their applicability to Queensland. Individually these three approaches have had long and distinct histories with genealogies tracing back to political economy, natural history and social welfare. While this paper acknowledges that sustainability as a concept is neither new nor recent, having been a component of many indigenous cultures, its emergence in industrialised economies has shifted from its "ownership" by counter movements in the 1960s to mainstream orthodoxy in the 2000s. In other words, it is no longer controversial to extol the virtues of balancing economic, social and environmental goals.

In this paper, we trace the evolution of the concept of sustainable development. We argue that while this concept is appropriate at a general level for Queensland, government, companies and communities need to engage in the dynamic process of building corporate sustainability as a means of generating the capabilities for a Sustainable Queensland. We conclude with some implications for policy on pursuing sustainability.

From sustainable development to corporate sustainability

The concept of corporate sustainability originates from the broader concept of sustainability. This concept has its origins in the 1950s and 1960s, when discussions commenced about the interrelationships between population growth, resource use and resulting pressures on the environment (Kidd 1992). Over time a number of different academic and political influences have shaped current understandings of sustainability. These included the conservation movement of the early 20th century, the environmental and counter-technology movements in the 1960s and 1970s (e.g. Ben-David 1975; White 1996), the "no growth" philosophy which emerged in the 1970s (e.g. Daly 1974; Meadows, Meadows, Randers & Behrens 1972), the discipline of ecology (Riddell 1981), as well as concepts relating to resource use and environmental degradation (Kidd 1992).

During the 1980s public awareness also increased about social issues such as human rights, the quality of life and the vast number of people living in absolute poverty, especially in less developed countries (Robertson 1996; Sharma & Aragón-Correa 2005). Pressure increased for new approaches to environment and development, and integration of environmental protection with a development that would ultimately lead to the alleviation of poverty. At the official level the concept of sustainability was spread in 1987 on a global basis through the report *Our Common Future* by the World Commission on Environment and Development (WCED), an entity of the United Nations also known as the Brundtland Commission (Robertson 1996).

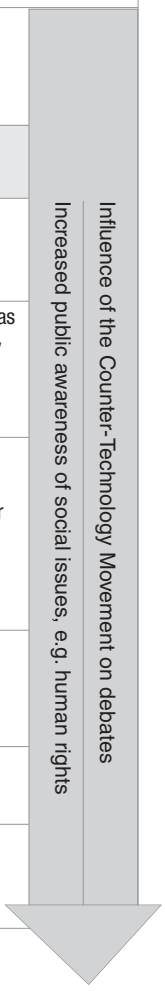
The WCED related sustainability to environmental integrity and social equity (WCED 1987) as well as to corporations and economic prosperity by coining and defining the term "sustainable development". The definition by the WCED states that:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987: 43).

Table 1 traces the historical emergence of the concept of sustainability and sustainable development. It was after the release of the Brundtland definition of sustainable development that we see the United Nations commit to an action plan to achieve sustainable development at the Rio Earth Summit in 1992. Running in parallel in 1988, the United Nations established the Intergovernmental Panel on Climate Change (IPCC) to assess the impacts of global warming. The impact of the commitment to the principles of sustainable development by the United Nations was felt at both government policy and the corporate sector levels. For example, the Australian government ratified the UNFCCC on 30 December

TABLE 1 DEVELOPMENTS IN THE UNDERSTANDING OF SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT

DATE	EVENT	DEVELOPMENT OF UNDERSTANDING
1848–1878	Publications by Mill (1848), Marsh (1864) and Malthus (1878) outline the possibility of global changes through human activity	The publications provide early theories on growth, abundance and the exhaustibility of resources; Marsh's *Man and Nature* is widely regarded as the origin of the Conservation Movement.
1896	Arrhenius calculates the effects of an increasing concentration of greenhouse gases in the atmosphere	Development of a scientific basis for predicting the greenhouse effect (Houghton 2004).
1900–1945	First and Second World War, Great Depression	Conservation Movement; wise use of soil and water, retention of native forests.
1953	Release of Bowen's book *Social Responsibilities of the Businessman*	Initiation of academic studies and discussions on corporate social responsibility.
1957	Revelle and Suess publish on the rise of carbon dioxide (CO_2) in the atmosphere	Beginning of the climate change debate. Ongoing measurements of the atmospheric CO_2 concentration start in Hawaii (Weart 1997).
1962	Carson's book *Silent Spring* suggests that pesticides are building up to dangerous levels	Emergence of the early Environmentalist Movement; focus shifts from the conservation of resources to the preservation of environmental quality.
1968	The article "The Tragedy of the Commons" (Hardin) and the book *The Population Bomb* (Ehrlich) address the problem of population growth	Several publications on the state of the environment increase public awareness of environmental issues.
1970	First Earth Day	Beginning of Mainstream Environmentalist Movement
1972	Release of *Blueprint for Survival* (Goldsmith) in advance of the 1972 UN Conference on the Human Environment in Stockholm, Sweden	"Sustainability" and "sustainable development" become major themes and alternative concepts to "expansionism".
1972	UN Conference on the Human Environment; leads to the establishment of the UN Environment Programme (UNEP) and several national environmental protection agencies	Identification of environmental degradation as a serious threat to development, particularly for those living in absolute poverty.
1972	The Club of Rome publishes *Limits to Growth*, taking up some of the predictions made by Malthus (1878)	Emergence of "no growth/slow growth philosophy", advocating economic systems without further growth (Daly 1973, 1974), or even a reduction in both economic activity and population limits.
1973	OPEC oil crisis	
1973	Publication of Daly's book *Toward a Steady State Economy*	
late 1970s	Views emerge that alternatives to economic growth exists and that some form of sustainable development is possible (e.g. Coomer 1979)	Concepts such as "eco-development" or "alternative development" supersede the "no growth/slow growth philosophy".
1984	Publication of Freeman's book Strategic Management: *A Stakeholder Approach*	Foundation of the Stakeholder Theory.
1985	Meeting of the World Meteorological Society, UNEP and the International Council of Scientific Unions on the issue of climate change	Climate change moves up the political agenda.



1987	Report *Our Common Future* released by the World Commission on Environment and Development (WCED, founded 1983 by the UN) integrating social, economic and environmental considerations	The WCED report states that: "*sustainable development is development that meets the needs of the present without com-promising the ability of future generations to meet their own needs*" (p. 43).
1988	Intergovernmental Panel on Climate Change (IPCC) established to compile research on climate change	Assessment of global warming and a broad range of climate change related topics; first report serves as basis for negotiating the UN Framework Convention on Climate Change (UNFCCC).
1992	Earth Summit; the United Nations Conference on Environment and Development (UNCED) is held in Rio de Janeiro, resulting documents are the "Agenda 21", the Rio Declaration, the Statement of Forest Principles, the UNFCCC, and the UN Convention on Biological Diversity	Use of the terms "sustainable development" and "sustainability" throughout the "Agenda 21" documents (an action plan to achieve worldwide sustainable development), however the terms are not further defined or explained (United Nations, 1992).
1995	World Business Council on Sustainable Development is established (WBCSD 2007)	The WBCSD states that sustainable development can be achieved via the "*three pillars of economic growth, ecological balance and social progress*".
1997	Adoption of the Kyoto Protocol (an agreement made under the UNFCCC) by most industrialised nations (United Nations 1997)	Parties to the Kyoto Protocol are required to achieve "sustainable development" via the limitation and reduction of greenhouse gas emissions.
1997	Elkington publishes *Cannibals with Forks*	Introduction of the Triple Bottom Line concept for measuring organisational success, this includes the measurement of environmental and social performance besides economic success.
1997	Global Reporting Initiative launched which sets a framework for reporting on economic, environmental, and social performance	
1999	Establishment of the Dow Jones Sustainability Index (DJSI) to track the performance of the global sustainability leaders	The definition by the DJSI states that "*corporate sustainability is a business approach that creates long-term shareholder value by embracing opportunities and managing risks deriving from economic, environmental and social developments* (DJSI 2007)".
2000	United Nations Millennium Summit	Agreement on the *Millennium Development Goals* by world leaders; goals are set to combat poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women.
2002	World Summit on Sustainable Development held in Johannesburg	The World Summit suggests "partnerships" between community organisations and businessesas as approach to achieve sustainable development.
2005	Kyoto Protocol enters into force on 16 February 2005	The Kyoto Protocol sets the legally binding goal to reduce greenhouse gas emissions of at least 5% from 1990 levels in the commitment period 2008–2012.
2006	Millennium Ecosystem Assessment Report is released (Millennium Ecosystem Assessment 2005)	The report outlines the need for "sustainable development" and "sustainable resource use".
2007	Publication of The Economics of Climate Change: *The Stern Review* (Stern)	The report adopts the following definition of sustainable development: "Future generations should have a right to a standard of living no lower than the current one" (p. 42). This definition does explicitly not include the need for the exact preservation of the natural environment and resource endowments. Rather, the current generation should not consume or damage the environment in a way which would result in worse life chances for future generations. The report stresses the importance and role of adaptation to climate change as part of sustainable development.
2007	Bali Roadmap	Countries who have both ratified and not ratified Kyoto agree to set goals to reduce emissions of GHGs. Australia ratifies Koyto.

SOURCES: GLOBAL SUSTAINABILITY TIMELINE (2001), IISD (2006), KIDD (1992) AND AS INDICATED IN TABLE.

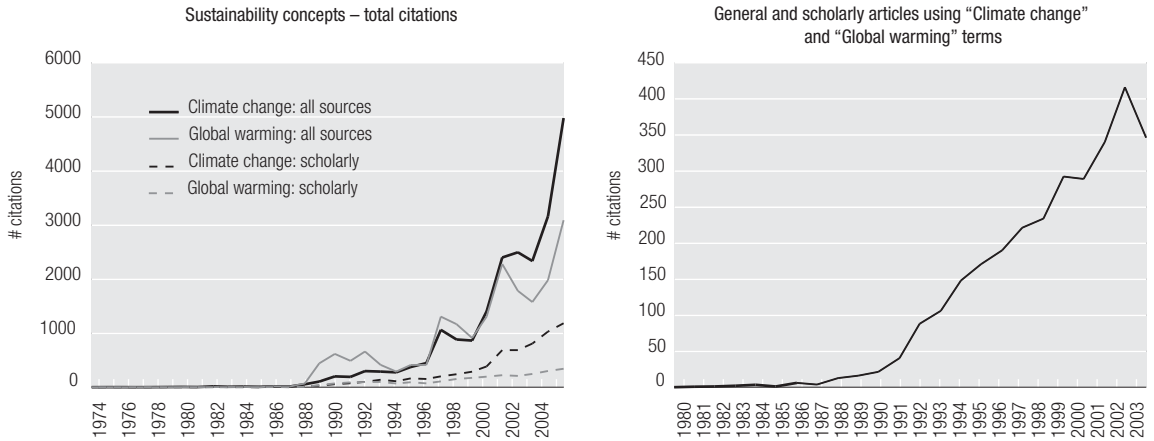
1992. The principles espoused in the Convention still underpin many of Australia's strategic and policy initiatives in relation to greenhouse gas emissions. The *National Greenhouse Response Strategy* (NGRS) was released in 1992 as a strategic tool for Australia's long-term commitment to climate change. The Australian government also adopted a plan for national strategy on sustainable development.

In 1997 the Kyoto Protocol was adopted by most industrialised nations and entered into force on 16 February 2005. The Kyoto Protocol linked for the first time, the two streams of sustainable development and climate change. It reaffirmed the objectives and principles of the UNFCCC and specified legally binding targets which commited parties to limit or reduce their greenhouse gas emissions levels. The main feature of the Protocol was the requirement that parties included in Annex 1 ensure that they meet agreed greenhouse emissions targets. (United Nations 1997, Article 3 of the Kyoto Protocol. These targets are set in relation to 1990 emissions levels for the specified commitment period of 2008–2012.). The target set for Australia was 108 per cent of the 1990 emissions level, due to its dependence on fossil fuels (Jones 2002). Most other countries were required to reduce 1990 emissions levels by about 5 per cent (United Nations 1997, Annex 1 of the Kyoto Protocol).

However, in 1997 Australian public policy on climate change altered significantly, with the Commonwealth government's refusal to ratify the Kyoto Protocol. It would take the election of the Rudd Labour government in 2007 to change this position. Up to this point, the public policy line was that Kyoto did not provide an effective long-term method of reducing greenhouse gas emissions. In particular, the Commonwealth government argued that without the participation on the United States, India and China, the Protocol was unworkable and that "an effective global framework to address climate change needs to include commitments from all major emitters" (Hare 2001). In place of the Kyoto Protocol, the Commonwealth government introduced in 1998 the National Greenhouse Strategy (NGS). The NGS stresses the need for an integrated approach to climate change by Commonwealth, state and local governments and promotes industry and community participation in addressing climate change (Commonwealth Government 1998).

In February 2006, the Council of Australian Governments (COAG) announced that it would adopt a new national "Climate Change Plan of Action" and establish a "high-level inter-jurisdictional Climate Change Group to oversee the implementation of the Plan's recommendations" (COAG 2006). Several forces have now turned the debate on climate change in Australia from a side issue to a central part of Australia's social and economic development. These include the efforts of COAG; the release of the Stern Report (2006) on the economic consequences of climate change; the popularisation of the debate via Al Gore's movie *An Inconvenient Truth*; the report released by the Australian Business Roundtable on Climate Change;[1] the release of the 4th Assessment Report by the Intergovernmental Panel on Climate Change in 2007 and the new Australian Labour Government's decision to ratify the Kyoto Protocol in November 2007. Figure 1 traces the popularity of the terms in the business press. In effect, these reports all argue that for the nations of the world to sustain their economic prosperity and to reduce the negative impacts of climate change, governments

FIGURE 1 SUSTAINABILITY AND CLIMATE CHANGE, POPULAR AND BUSINESS PRESS



should seek early intervention to address climate change. Delaying action will increase costs to business, the economy and the community. In other words, there is an urgent need to act and address climate change issues from a public policy and corporate approach, in order to create sustainable economies and communities.

The Australian Government commissioned a business taskforce to examine the creation of an emissions trading market. In response to these issues the Prime Ministerial Task Group on Emissions Trading was established in 2006 and made strong recommendations for Australia to create/join an emissions trading market for 2011. Since the acceptance of this report, at APEC the Howard government achieved the Sydney Declaration for aspirational goals to reduce greenhouse gas emissions (non-binding) and announced the creation of a national system for Renewable Energy targets. This change in policy direction has now been cemented in place by the Rudd Labour Government's decision to ratify the Kyoto Protocol as one of its first actions in Office in November 2007. This change in policy assured Australia would be welcome in attempting to negotiate and influence the next round of agreements for post Kyoto. This can be seen in the position that Australia took in the Bali Roadmap – that industrialised countries need to account for greater emissions reductions whilst paving access for countries like China and India.

While the policy debate in Australia has slowly followed the global debate, which has made a link between the concepts of sustainable development and climate change, it has been a coalition of business and green groups that have made links between economic development and social and environmental development. In 1995, the World Business Council for Sustainable Development was established. It sought to operationalise the concept of sustainable development as being the balancing of the three pillars of economic growth, ecological balance and social progress. This was further popularised by Elkington (1997) as the Triple Bottom Line – that corporate and organisational success should include environmental and social performance, as well as economic.

We can therefore see that over the last 20 years the concept of sustainable development at a policy level has been linked to debates on climate change. Furthermore, we can see that over this time attempts have been made to operationalise the term "sustainable development". Typically, it has been argued that organisations and governments need to achieve:

- economic growth;
- ecological balance; and
- social progress.

In the next section we will explore how these approaches have been developed into a dynamic approach – corporate sustainability – as a means of encouraging organisations and communities to engage in the process of sustainability.

Corporate sustainability

Based on the WCED definition, as well as on influences from the strategy and management literature, a variety of different understandings emerged about sustainability in relation to organisations, also referred to as "corporate sustainability". These understandings vary on the degree to which corporate sustainability is limited to economic aspects of the organisation (Banerjee 2001; Dyllick & Hockerts 2002; Gladwin, Kennelly & Krause 1995b), or is broadened to include environmental concerns and social issues (e.g. Dunphy, Griffiths & Benn 2003). Generally, the following understandings of corporate sustainability can be identified (outlined in greater detail in the next sections):

- economic sustainability;
- environmental sustainability;
- social sustainability; and
- a holistic understanding of sustainability including environmental, social and economic issues.

Corporate sustainability as economic sustainability

The term "corporate sustainability" has been used in the traditional strategy and management literature to refer to the economic performance, growth and long-term profitability of organisations (Porter 1985). The major assumption behind this understanding of sustainability is that the firm operates in the interests of its owners – the shareholders – through maximising their wealth (Grant 2005). From this perspective it becomes imperative for management to expand consumption of the firm's products and services in order to increase profits. Ecologically and socially desirable investments that do not directly benefit the firm's shareholders should not be undertaken (Friedman 1970; Levitt 1958) as they lead to inferior returns compared to other businesses (White 1996). Several studies have shown, however, that engagement with

the natural environment can enhance a firm's performance and contribute to a competitive advantage (Hart & Ahuja 1996). This suggests that the realisation of economic sustainability alone is not sufficient for the overall sustainability of corporations and industries. This broadening of the understanding of corporate sustainability is regarded as the most important departure from orthodox management theory (Gladwin, Kennelly & Krause 1995a). Many commentators suggest that for organisations the continuous development towards corporate sustainability necessitates a shift away from economic prioritisation (Russell, Haigh & Griffiths 2006).

Corporate sustainability as ecological sustainability

The second understanding of corporate sustainability, ecological sustainability, is based on the premise that organisations and industries are not separate from the natural environment but are located and operate within it (e.g. Sharma 2003). Organisational activities can have a significant negative impact on the environment, for example, through the emission of waste (Hart 1997) or the exploitation of natural resources (Stead & Stead 2004). In turn, environmental quality can impact on business activities, as evidenced through the impact of climate change (Winn & Kirchgeorg 2005). There is general agreement that radical shifts in business practices and strategic thinking are necessary to bring about a lasting reversal of current levels of environmental destruction (Hart 1997). Central to the understanding of ecological sustainability is therefore the challenge for organisations and industries to move beyond pollution control or prevention and to operate within the carrying capacity of ecosystems by minimising resource use and their ecological footprint (Sharma 2003).

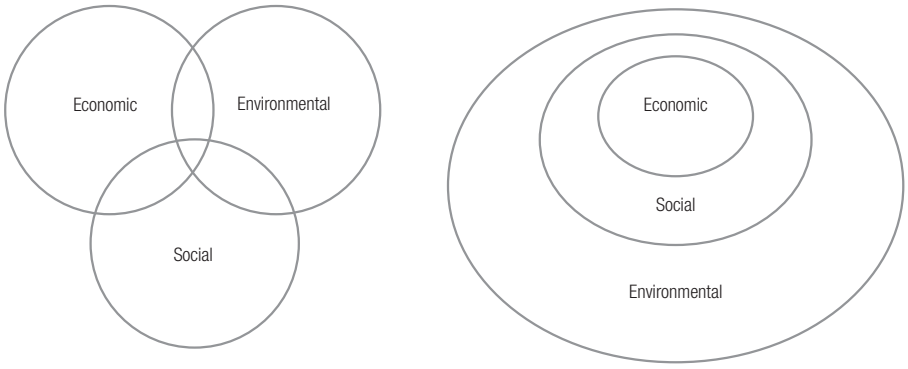
Corporate sustainability as social sustainability

The recent attention towards social sustainability results from trends such as globalisation and privatisation, requiring businesses to assume wider responsibilities towards various stakeholder groups and the social environment in which they operate (Dunphy et al. 2003). Numerous studies have been published on business-related social issues (e.g. Wood 1991), including product safety, occupational health and safety, discrimination, business ethics, fraud, corporate philanthropy, minority concerns, community welfare and stakeholder demands (Carroll 1979; Preston 1985; Shrivastava 1995a). More recently, several new concepts, such as "corporate social sustainability" (Dyllick & Hockerts 2002) and "socially sustainable businesses" (Gladwin et al. 1995a), have emerged. In general, social sustainability means an organisation or industry which (1) pays attention to its internal staff development; (2) attempts to deal proactively with its community base; and (3) engages with its stakeholders. It is progressively linked to a holistic approach towards corporate sustainability, to be reviewed next.

A holistic understanding of corporate sustainability

The holistic understanding of corporate sustainability results from an integration of the previous perspectives (Dyllick & Hockerts 2002). The connection between the three perspectives is also reflected in the works of Dunphy et al. (2003) and van Marrewijk (2003). For organisations, this

FIGURE 2: MODELS OF HOLISTIC UNDERSTANDINGS OF SUSTAINABILITY



SOURCE: ADAPTED FROM STEAD & STEAD (2004)

implies the need to simultaneously improve social and human welfare while reducing their ecological footprint and ensuring the effective achievement of organisational objectives (Sharma 2003). While some scholars assume that corporate sustainability is only achieved when an organisation considers these three perspectives (Bansal 2005; Dyllick & Hockerts 2002), others have adopted a broader systems approach and argued that organisations should consider interrelations with their environments on various dimensions, such as the individual, organisational, political-economic, socio-cultural and ecological-environment levels (Starik & Rands 1995). For example, Figure 2 demonstrates two models for considering corporate sustainability. The first figure suggests that it exists at the intersection of economic, ecological and social factors – that is an approach based on Triple Bottom Line. The second approach suggests that economic and social systems are embedded in environmental systems and that therefore environmental health is of absolute importance to creating a sustainable future.

The diversity of theoretical definitions and different approaches outlined in the last sections are summarised in Table 2 and demonstrate the variety in understanding the concept of corporate sustainability.

Challenge of building corporate sustainability

We argue that achieving corporate sustainability is a challenge that will increasingly occupy the attention of CEOs, community leaders, policy leaders, change agents and key stakeholders. As can be seen by the diverse debates and understandings of what constitutes sustainability, the path forwards will be protracted, noisy and tough. The resolution to fundamental dilemmas involved will come primarily not through words but through the actions of those corporations, communities, governments and industry players who see opportunities inherent in the emerging ethos of sustainability. This ethos is already apparent with increasing pressure from communities, governments, shareholders and political interest groups to change wasteful and destructive practices. In other words, there exists an increasing desire by many in the current generation to preserve a sustainable lifestyle for future generations.

So it is imperative that the issue of how to implement corporate sustainability be engaged quickly and in a practical way that appeals to managers, policy leaders and community decision-makers. Can we chart a practical path, a series of

TABLE 2: DIVERGENT UNDERSTANDINGS OF CORPORATE SUSTAINABILITY IN THE LITERATURE

	BUSINESS	ENVIRONMENTAL	SOCIAL	HOLISTIC
Main understanding	Expansion of markets and consumption	Reduction of consumption and environmental impact	Supporting social outcomes	Integration of economic, environmental and social aspects
Priority	Long-term profitability, growth, and economic performance (Peteraf 1993; Porter 1985; Yeoh & Roth 1999)	Environmental integrity as priority	Valuing and understanding people	Understanding the organisation as part of a larger system (Gladwin et al. 1995b; Starik & Rands 1995)
Approach towards growth	Continual ('sustained') growth of the organisation is the major objective	No growth, slow growth, organisations must not have adverse effects on the environment, focus on qualitative developments and conservation of environment (Daly 1973; Hart 1995)	Organisational activities must not negatively affect society and/or disadvantage people, importance of equity (e.g. intra-generational, intergenerational, across class and gender barriers, between countries)	Quality of life and environmental quality rather than economic growth
Focus	Focus on profit maximisation for shareholders (Friedman 1970; Levitt 1958; White 1996)	Focus on the environment; reduction of resource consumption and ecological footprint	Focus on people, society, different stakeholder groups (Freeman 1984; Starik & Rands 1995)	Focus on simultaneously achieving economic, social and environmental goals (Dunphy et al. 2003)

concrete steps, that will help organisations and communities thrive while strengthening the developing capabilities of their workforce members? Can we continue to re-create organisations and communities that contribute to a rich and varied community life, that sustain and renew the biosphere, while providing economic certainty?

As we identified in the review, building corporate sustainability can lead to sustained long-term performance for communities and businesses. It requires the consideration and integration of two alternate approaches to viewing sustainability – social and ecological – besides the traditional focus on economic sustainability alone. Issues relating to human sustainability draw on research undertaken in the disciplines of strategic human resource management, community and stakeholder engagement and change management. Issues relating to ecological sustainability draw upon the disciplines of strategic, economic and environmental management. It is argued that these two issues, when combined within organisations, create a powerful drive towards sustained long-term performance.

Towards a sustainability model

The remainder of this paper outlines a comprehensive sustainability phase model that allows communities, governments and corporations to track their corporate sustainability performance (see Figure 3). As a tool, the phase model allows meaningful comparisons to be drawn between organisations, industries and communities, helping to assess current commitment to and practice of social and ecological sustainability and assisting managers, policy and community leaders in capitalising on the benefits of moving towards more sustainable practices in both areas. Dunphy et al. (2007) provides a detailed description of each of theses phases, along with a checklist of capabilities associated with them.

The phases are:

- rejection;
- non-responsiveness;
- compliance;
- efficiency;
- strategic proactivity; and
- the sustaining approach.

Rejection: involves an attitude on the part of an organisation, government or community that all resources – people, community infrastructure and the ecological environment – are there to be exploited for immediate economic gain. Negative impacts of activities are ignored and costs externalised to others. While efficient in the short term through the externalisation of costs, we do not see it as leading to sustainability. Instead, these practices result in exploitative relationships, alienation and community and environmental degradation. We tend to see such actions in rogue states or in communities that have ineffective governance mechanisms. Some corporate entities may also be willing to pursue such strategies.

Non-responsiveness: usually results from lack of awareness or ignorance rather than from active opposition. The government, firm and/or community concentrates on "business as usual" and ignores issues of sustainability. In the process the managers, policy and community leaders who adopt this approach fail to invest in appropriate infrastructure, skills and resource protection that provide the foundations for a sustainable future. Such an approach usually relies on running down natural capital and leaving "hard choices" to future generations. It also runs contrary to long-term policy and strategic awareness of organisations and governments. The drought and introduction of water restrictions in South East Queensland has demonstrated an effective way to mobilise public support. Through simple and effective public information campaigns, members of the public have shifted from being non-responsive to playing a significant role in generating water efficiency outcomes. Awareness of electricity consumption, introduction of smart meters and the use of greenhouse gas efficiency ratings for appliances could have a similarly significant impact on reduction of greenhouse gases.

Compliance: focuses on reducing the risk of sanctions for failing to meet minimum standards as an employer or producer. Changes are primarily reactive to growing legal requirements and community expectations for more sustainable practices. Here corporate strategies relating to social sustainability focus on policies of legal compliance plus benevolent paternalism with the expectation of employee loyalty in return. Current business and community practices also focus on achieving minimum compliance standards. This approach, while technically abiding by the "law" does not create the basis for a sustained future. However, it is this framework that directs government and corporate actions on sustainable development.

An assumption is made that business and communities are compliant with rules and regulations. Quite often compliance helps establish the baseline capabilities in monitoring and collecting information which then enables

organisations to make leaps beyond current sustainability practices. Compliance, however is associated with cost and represents the "least cost" basis of government policy. For example, compliance in itself is not sustainable and government policy for a host of economic and political reasons, fails to deliver "stretch targets to business and communities". Where compliance activities form both stretch targets or can be linked to innovative programs such as those found in the Sustainable Industries Division of the Queensland EPA, then opportunity exists to shift organisations from their compliance orientation to efficiency and beyond targets.

Efficiency: reflects the growing awareness on the part of policy-makers, business managers and community representatives that there are real advantages to be gained by proactively instituting sustainability practices. In particular, these practices are directed toward reducing costs and increasing operational efficiency. Some organisations capitalise on these cost savings and reinvest them in their employees to achieve sustainable longer term gains by building the appropriate cultures and human systems that support value-adding and innovation. For example, the Queensland government has introduced its ecoBiz program, which has had considerable success at reducing and eliminating waste and using these cost savings to build an employee and technical skill base of Queensland enterprises. Through participation in this program, Queensland businesses have had success in reducing their own greenhouse gas emissions. The new innovation focus has led to huge cost savings, reduced ecological impacts and enhanced the reputation of these enterprises.

There also exist several excellent examples of organisations that are generating new business opportunities by shifting from traditional to innovative sustainable practices. Scott Elsom, the CEO of Sala Homes, an innovative Queensland business, has identified a market opportunity for providing cost-effective sustainable living housing designs and communities. Sala Homes applies sustainability principles to the design and construction of its homes. In doing so, they are creating sustainable lifestyles for people, reducing the ecological footprint of houses by reducing their carbon emissions and increasing water efficiency. They are now expanding to create a sustainable business model. Furthermore, Sala Homes has forged connections with producers of sustainable building materials and are influencing their supply chain to further implement sustainable practices.

Strategic proactivity: emerges when sustainability is used to seize merging opportunities, for example, by improving competitive advantage and positioning the firm and or nation as a leader in sustainable business practices. BP has adopted such a strategic approach to sustainability. As one of the world's largest extractive resource-based companies and energy producers, BP has strategically repositioned itself to be seen as moving "beyond petroleum". They have incorporated these goals into their corporate strategies. While BP is in the early stages of the sustainability journey the company is being positioned as an industry leader. At a national level, countries such as Germany and Sweden have pushed to ecologically modernise their industry and develop an economy based on creating sustainable products and services.

Another Queensland business, Rockcote, which specialises in the creation of paints, coatings and internal and external textures, has shifted its whole basis of operations to adopt a strategic approach to sustainability. In the process Rockcote have:

- created a sustainable design centre which generates its own energy needs, recycles and has closed its water loop;
- set up a waste-free factory and formed partnerships with other eco-friendly organisations in the same geographic area;
- placed a high value on employee input and ownership of the program to generate homegrown sustainability and eco-efficiency initiatives;
- created a new range of eco paints, carbon sequestrating renders and a focus by the research and development section on eco products; and
- started up an eco-factory – that is a factory designed on principles of eco-efficiency – paying attention to reduced energy consumptions, reduced waste and water usage.

The sustaining approach: reflects an internalisation of sustainability and actively promotes the emergence of a society that supports the ecological viability of the planet and its species. It contributes to just, equitable and democratic social practices and human fulfilment. There are few organisations that embody this ideal. To date, those most cited include Ben and Jerry's Homemade Ice Cream, Patagonia and Interface; yet these are not public companies, rather they are relatively small and privately owned. And they have not always been able to maintain the advances they have made. However, evidence is emerging of innovative companies that are implementing sustainability practices in a range of operations. In Queensland, as we have seen, Sala Homes and Rockcote are two enterprises striving to

develop sustainable products and services and also formulate new sustainable entrepreneurship business models. Others such as the North Australian Pastoral Company (NAPCO) bring stakeholders into the organisation, build reputational capital, build the capability of the workforce and contribute to ecological and community regeneration. These organisations are building corporate sustainability.

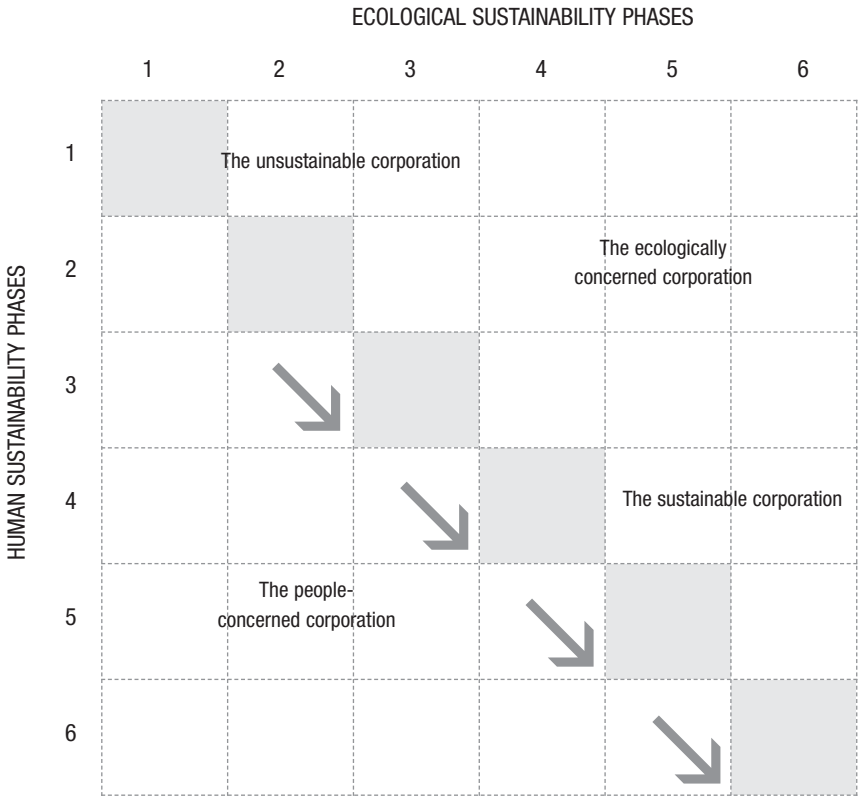
The phase model represents an ideal model type that an organisation, community or industry would only seek to approximate. The model comes with a set of indicators that allow managers, policy and community leaders to chart where they are on the path, assess what actions are needed to capitalise, in a business sense, on the current phase and plan the next logical move forward (for example, in anticipating increased compliance standards or identifying strategic opportunities). A particular strength of the model is the balance it provides in emphasising both the social and ecological bases of a comprehensive approach to sustainability. In particular, the emphasis on social sustainability provides an important role in strengthening intellectual capital needed to create a modern knowledge-based society that is a prerequisite for democracy to flourish.

Implications for Sustainable Queensland

There generally exists little disagreement that "business as usual" is not conducive to the development of long-term sustainable industries, economies or communities (Senge & Carstedt 2001). When it comes to the natural environment and the relationship between ecological health and social wellbeing it is apparent that the consequent degrading of the natural environment is a dangerous situation that poses significant challenges to national governance of economic systems. However, while debates on corporate environmentalism and sustainability have centred on the costs of corporate compliance, recent empirical evidence shows that corporate, industry and community engagement with sustainability can enhance economic performance (Hoffman 1999; Sharma & Vredenburg 1998).

Many of the papers in this series have pointed to the seemingly rational but shortsighted consequences of short-term decision-making that does not build in the longer term view of sustainable development. This particularly relates to:

FIGURE 3: THE SUSTAINABILITY CHANGE MATRIX



SOURCE: DUNPHY, GRIFFITHS AND BENN 2007

- rapid growth in Queensland's population and the consequences of this growth in terms of infrastructure, employment and economic expansion;

- the need to develop, expand and build new infrastructure to keep pace with the growing population and the impact this has on natural environments and standards of living;

- outmoded models of infrastructure funding and the need to incorporate more than minimum standards of environmental and social impacts into these projects;

- the need to protect biodiversity and ecological systems; and

- the need to address the contradictory impacts of climate change on different industrial and regional areas – for example on the tourism or coal industries.

However, significant opportunities exist to create entrepreneurial and new sustainable business models. Several government programs already in existence provide the basis for generating sustainability change. Many of these, including the clean coal and carbon sequestration research activities, should continue. Positive initiatives include:

- experimentation with distributed energy systems, the use of smart energy meters, reduction in air conditioning cycle times (characteristics found in the Solar cities program) as a means of providing the public and community with information to act upon increasing their own energy efficiency;

- the creation of sustainability programs for schools, community groups and churches that include water efficiency measures; the creation of distinct change capabilities within the government or an outsource business opportunity for specialist sustainability practitioners to assess and assist these community groups establish and maintain their needs;

- ramping up the change capabilities and funding arrangements of existing innovative programs – such as the ecoBiz program and providing an effective means to disseminate their findings;

- creation of a business-focused Sustainability Change Centre that provides academic leadership, policy advice and entrepreneurial examples to address and deal with corporate sustainability practices;

- the use of procurement practices to influence supply chains that take into account a range of sustainability practices; and

- the creation of innovative sustainable programs aimed to facilitate collaboration among small companies and community groups to develop entrepreneurial eco services and products.

Such initiatives represent the tip of the iceberg in generating a link between corporate sustainability and impactful sustainability outcomes.

Conclusion

In this paper we have argued that the creation of a Sustainable Queensland will increasingly rely on the engagement of business, industry and community with the concepts of corporate sustainability. We have noted that over time the definitions of sustainability have been diverse but that debate now centres on an acceptance of corporate sustainability as consisting of a balance between economic, environmental and social issues. The creation of a Sustainable Queensland requires the adoption of a holistic approach to corporate sustainability. The single-minded pursuit of short-term profitability for shareholders or owners does not justify a "couldn't-care-less" approach to people and the planet. The prevailing economic value of unlimited and unending growth is the ideology of the cancer cell. Living within the natural limits of the Earth's resources and exercising responsible resource stewardship is a universal requirement for all of us, individually and collectively.

We have also noted that there exists a rapid and compelling rationale for communities and corporations to embrace corporate sustainability. We are at an interesting point where we have choices; the challenge for managers, community and policy leaders is to act with integrity, standing with courage for the planet, for a healthy society and for future generations. Leadership in this front, will come from not only executives of organisations – large and small – but also through government policy and decision makers that constructively reward and encourage shifts towards the embracement of sustainability.

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Endnotes

1 The Business Roundtable is comprised of BP Australia, AIG, Origin Energy, Swiss Re, Visy Industries and Westpac. The Australian Conservation Foundation also worked with the Roundtable and research was provided by the CSIRO and Allen Consulting Group.

4 Environment and ecotourism

BY ELIZABETH SAXON AND TONY CHARTERS

Overview

This paper examines the likely effects of current patterns of population growth on Queensland's natural resources and designated natural area network.

The key messages for the business community include the need to:

- support planning and development designs that maintain the natural area and open space network and advocate cooperative public–private management models for protected areas;
- continue to improve the efficiency of resource use and waste management practices, engaging in immediate action to drastically reduce greenhouse emissions;
- conduct risk assessments and scenario planning to help adapt business activities to climate change effects, especially where core business involves a high dependence on natural resources or natural areas;
- look for business opportunities arising from ecological services and climate change; and
- take advantage of rising consumer support by aligning business policies and activities where possible with conservation and climate change initiatives.

There are also some key messages for government, including the need to:

- ensure that development legislation and planning frameworks include open space requirements and the expansion of natural area networks;
- take advantage of innovative management models based on cooperative arrangements with the private sector to assist in leveraging resources to conserve and enhance our protected area network;
- continue to improve the efficiency of resource use and waste management practices, engaging in immediate action to drastically reduce greenhouse emissions;
- provide a supportive, quality controlled investment and business environment for initiatives focused on adapting to and reducing climate change impacts;
- consider the creation of a fully audited and credible carbon offset program that directs money collected into the protection of Queensland's climate change hotspots;
- recognise the synergy between protected area management and climate change responses. Consider a proactive strategy of expanding and increasing the connectivity of the protected area estate as a means of carbon sequestration and improved conservation outcomes; and
- recognise the value of ecosystem services provided by protected areas – consider the development of formal valuation mechanisms that allow this value to be captured and channelled into funding ongoing acquisition and management of protected areas.

Introduction

The rapid population growth patterns currently being experienced in Queensland will inevitably affect the natural environment. There will be increased demands and pressures on natural resources such as land, air and water, as well as the ecosystem services that assimilate wastes and maintain the health, quality and availability of these resources. There will also be impacts on wildlife populations, distribution and biodiversity as pressures on habitats and contact with humans and human settlement increase.

The health, diversity, distribution and nature of our parks, open spaces and natural areas will also become important considerations, both for the health and active wellbeing of our communities and the preservation of our natural heritage.

The first part of this paper provides a very broad overview of the expected key pressures on Queensland's natural resources from population growth patterns. It covers land use; atmosphere and

energy; fresh water; coastal and marine resources; ecosystem services; flora, fauna and biodiversity. Discussion in this section has purposefully been kept brief. Firstly, the environmental impact of population growth is a very broad topic, difficult to cover in any depth in such a short paper. Further, it has been assumed that most of these direct pressures are commonly recognised in the business community. Lastly, as detailed environmental and scientific information is easily accessible from the Queensland State of the Environment Reports, it seems unnecessary to labour the details here.

Attention has instead been given to the second section, in which the less understood relationships and dynamics between population growth, recreation, tourism and our designated parks and protected areas are discussed. The second section provides an overview of the values, distribution, key users and management of our parks and protected area network and how population trends may affect these relationships. It examines broader contextual issues including economic and social trends, as well as climate change implications. Finally, the role of non-government organisations (NGOs), user groups and the tourism industry are considered. Specifically we consider their role in delivering a network of parks and protected areas that provide for the recreational needs of communities and visitors, deliver tourism revenue and protect our natural heritage.

Population growth and natural resources

Higher populations and urbanisation in Queensland will increase demand for undeveloped areas of land to support housing, infrastructure, agricultural, commercial and economic development. At the same time, undeveloped natural areas provide critical linkages and habitat for the conservation of Queensland flora and fauna, and key tourism and recreation assets. Natural areas provide a range of ecosystem services critical to the ongoing health and wellbeing of all living species, including waste assimilation and air and water quality maintenance.

The following section describes some of the key direct pressures on Queensland's natural resources and wildlife resulting from current population growth and demographic trends.[1] It also provides an outline of associated business responsibilities and opportunities.

Land

As indicated in the volume 1 of the CEDA series *Sustainable Queensland*, population growth continues to be concentrated in the south-east, urban and key regional centres of Queensland, as well as along the coastline. This growth is likely to bring a predictable increase in land-use demands for further residential, infrastructure, commercial and economic development in these and adjacent areas.

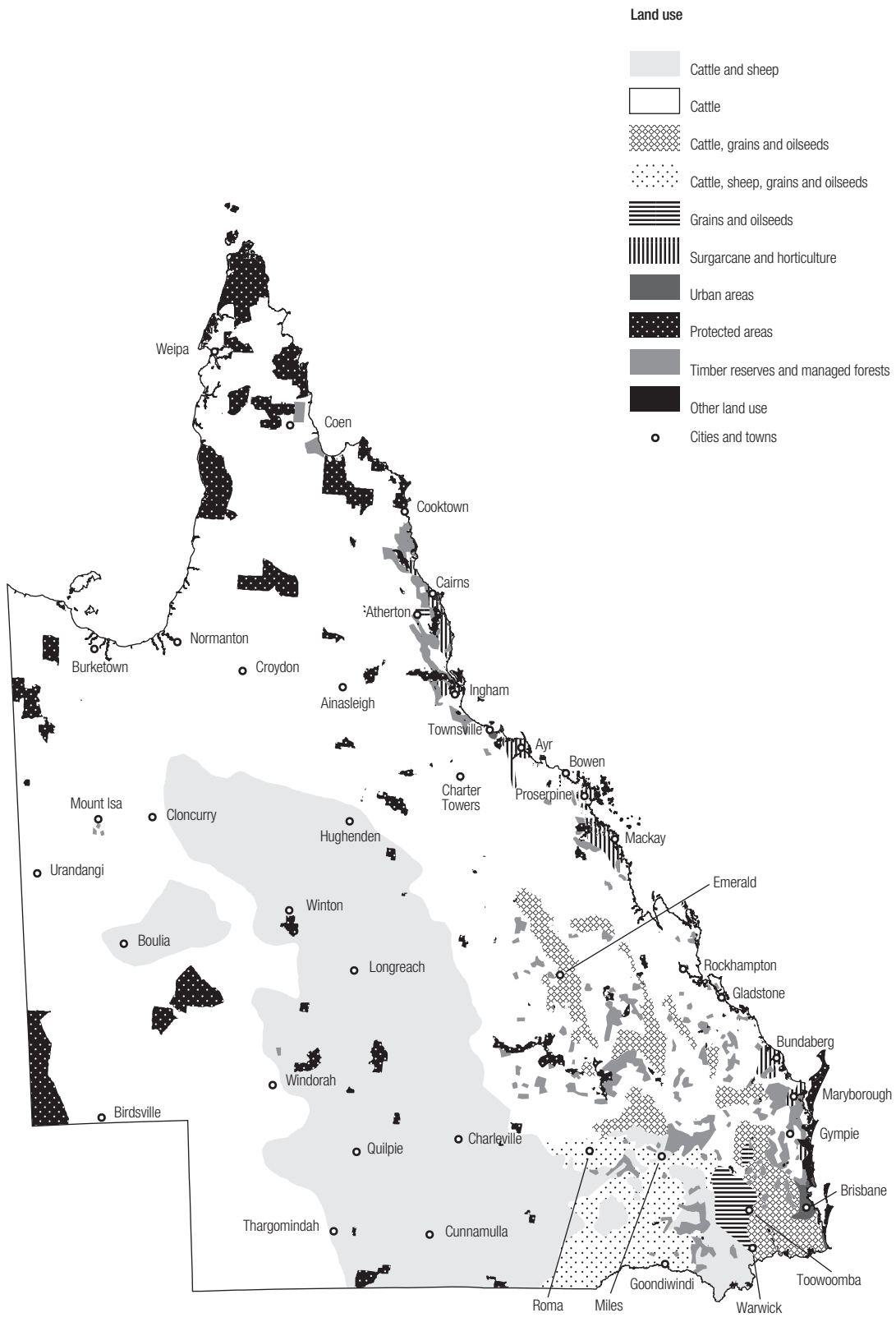
It is also likely to create a parallel demand for lifestyle, recreation, community and health related facilities and infrastructure (such as sporting facilities, active lifestyle centres, community centres, parks and open green spaces, bike paths, spas and gyms). This is due to:

- continuing urbanisation and higher urban population densities (which can create stressful and socially/environmentally detached lifestyles) (Queensland Government 2003);
- increased acceptance of the need to provide work–lifestyle balance opportunities (e.g. see Queensland's industrial relations policy and regulation) (Queensland Government 2007a); and
- the accepted need to provide recreation, health and community interaction opportunities for our rapidly ageing population (e.g. see *Queensland's Framework for Ageing,* Queensland Government 2002).

These demands will maintain pressure on developing those remaining unbuilt areas in close proximity to growth centres, and the supply of these sites will continue to become increasingly scarce. This will be offset to some extent by the higher density development patterns that continue to emerge in urban centres, delivering on the whole better ecological outcomes through reductions in resource inputs and waste (Queensland Government 2003). However, the rate of population and economic growth, our ongoing cultural preference for low density development (Queensland Government 2004), and our history of urban sprawl tends to indicate that the pressures on undeveloped areas will continue.

Importantly, the remaining supply of close proximity undeveloped sites is likely to include an increasing proportion of good quality agricultural areas, which are critical to the ongoing viability of primary industries. It is also likely to include an increasing proportion of the bushland, forest and wetland areas that are critical for the conservation of Queensland's biodiversity and that potentially contain significant tourism and recreation values.

FIGURE 1: LAND USE IN QUEENSLAND, 2003



SOURCE: QUEENSLAND GOVERNMENT 2003, *STATE OF THE ENVIRONMENT REPORT 2003*

Figure 1 illustrates the pattern of land use in Queensland as of 2003. It can be used to identify the undeveloped primary production areas in close proximity to identified growth centres and hence most under pressure from development. It also depicts some of Queensland's key undeveloped natural areas – our terrestrial protected area network, timber reserves and managed forests.

PRIMARY PRODUCTION

Urban sprawl and growth often force the relocation of primary producers adjacent to key population growth areas out to more regional locations. The continuing loss of good quality agricultural land to urban development is a continuing trend (see Table 1) and one of concern, given the increasingly stressed state and decreased productivity of agricultural land (see Table 2). However, Queensland management plans are increasingly recognising the need to protect open spaces and rural areas from urban encroachment and are making regulatory provisions for planning schemes to do this (see, for example, provisions for regional landscapes and rural production areas within the *South East Queensland Regional Plan*, Queensland Government 2005).

While demand for food, fibre and mineral outputs is primarily driven by global markets, population growth does stimulate the demand for imports, which need to be paid for by exports (in our case, primarily primary products) (CSIRO 2002). This indirect effect should not be forgotten when considering the relationship between population growth and land-use pressures on agricultural lands.

TABLE 1: GOOD QUALITY AGRICULTURAL LAND (GQAL) LOST TO OTHER USES FROM DEVELOPMENT

LOCAL GOVERNMENT AREA	AREA (HA) OF GQAL BEFORE DEVELOPMENT	AREA (HA) OF GQAL CONVERTED BY:		PERCENTAGE OF GQAL CONVERTED BY:	
		1995	2002	1995	2002
Brisbane	26 915	9 556	10 530	35.5	39.1
NORSROC[1]	111 254	10 087	13 069	9.1	11.7
SouthROC[2]	92 152	9 282	11 167	10.1	12.1
WESROC[3]	133 195	7 394	8 539	5.6	6.4
Total SEQ	363 516	36 319	43 305	10.0	11.9

1 NORTHERN SUB-REGIONAL ORGANISATION OF COUNCILS (CABOOLTURE, CALOUNDRA, KILCOY, MAROOCHY, NOOSA, PINE RIVERS, REDCLIFFE)
2 SOUTHERN REGION ORGANISATION OF COUNCILS (BEAUDESERT, GOLD COAST, LOGAN, REDLAND)
3 WESTERN SUBREGIONAL ORGANISATION OF COUNCILS (BOONAH, ESK, GATTON, IPSWICH, LAIDLEY, TOOWOOMBA)

SOURCE: QUEENSLAND GOVERNMENT 2003, *STATE OF THE ENVIRONMENT REPORT 2003.*

TABLE 2: SOIL FERTILITY AND SOIL CARBON

INDICATOR	NATURAL RESOURCE MANAGEMENT REGION		
	FITZROY	BURNETT MARY	QUEENSLAND MURRAY-DARLING
Nutrient balance	↓	↓	↓
Trend in soil fertility	↓	↓	↓
Trend in yield and product quality	↓	↓	↓

MODERATE CONDITION POOR CONDITION DECREASING ↓

SOURCE: QUEENSLAND GOVERNMENT 2003, *QUEENSLAND STATE OF THE ENVIRONMENT* 2003

Atmosphere and energy

Population growth increases energy demands, particularly for domestic use and transportation. In Queensland, the per capita consumption of energy is higher than the national average and continues to grow faster than the national rate (ABARE 2003). In 2003–04, for example, Queensland was responsible for 23 per cent of total national energy consumption (ABARE 2006) yet it only represented 19.4 per cent of the Australian population (ABS 2001).

This is exacerbated by lifestyle factors such as increased use of air-conditioning, larger residential living spaces and high-level use of personal vehicles (Queensland Government 2003). The latter is of particular significance as a total of 72 per cent of all air pollutants in South East Queensland are emitted by motor vehicles (Queensland Government 2006b). Also, as Queensland is responsible for approximately 23 per cent of the national consumption of petroleum products (ABARE 2006), the growing gap between domestic oil production and domestic requirements past 2010 may become an issue (CSIRO 2002).

It is now widely recognised that a continuation of these consumption and lifestyle patterns and of dependence on coal and oil as primary energy sources will create unsustainable levels of toxic and greenhouse gas emissions, worsen local air quality and exacerbate climate change effects (CSIRO 2002).

Air pollution is likely to continue to be pronounced in built-up, urban areas and those surrounded by mountain ranges where pollution can be trapped at lower levels for long periods (Queensland Government 2006a). Associated respiratory and other health problems may become more widespread and prominent as a result. High levels of pollution and congestion can also make destinations less attractive to domestic and international visitors, but more importantly, they can decrease the quality of life for the majority of the domestic population who live there.

Queensland is both a high energy consumer and a greenhouse gas emitter (generating approximately 26 per cent of national emissions)(Queensland Government 2004a) and these emissions are expected to continue to grow, given:

- an expanding mining and industrial base;
- a well-developed energy infrastructure;
- an increasing standard of living and affluence;
- population growth;
- long travelling distances; and
- expanding land areas for agricultural development (Queensland Government 2004a).

As part of the national and global climate change challenge the state needs to do its part in radically reducing greenhouse emissions, switching to cleaner forms of energy and improving energy efficiency across household, industry, business and government sectors. Aside from these emission reduction strategies, Queensland also needs to develop strategic plans to adapt to the now unavoidable and somewhat unpredictable changes we are likely to experience in climate and weather patterns. These include warmer temperatures, rising sea levels, changes in rainfall patterns, and increased storm and cyclone intensity (Queensland Government 2006b).

Adaptation strategies will be especially important for Queensland[2] as we have (Queensland Government 2005):

- major representation of high-risk ecosystems (e.g. reefs, tropical rainforest, wetlands and outback areas);
- high-level dependence on key risk industries dependent on these resources (e.g. agriculture, nature-based tourism and fisheries); and
- high concentrations of population resident severe weather-prone regions (e.g. low-lying coastal population and resort centres; tropical and subtropical population centres)(Australian Government 2005).

Fresh water

Australia is one of the driest continents in the world. Queensland is currently experiencing its worst drought on record and water storage levels are low. Higher populations will increase the demand for fresh water and in Queensland urban users (manufacturing, electricity, water supply and households) consume approximately 57 per cent of total water in the state (Queensland Government 2003). In conjunction with rainfall patterns becoming more unpredictable, there is significant pressure to increase the efficiency of water capture, distribution, recycling, treatment, conservation and use (Queensland Water Commission 2007).

Increased population also increases the threat of water pollution from rubbish, oils, detergents and fertilisers entering stormwater drains, domestic wastewater systems and waterways.[3]

Coastal and marine resources

Coastal ecosystems and landscapes will come under increasing pressure as population growth is concentrated in close proximity to these areas.

Areas such as Moreton Bay provide a clear demonstration of the negative impacts on coastal and marine areas resulting from continued and rapid population growth (Queensland Government 2007b). These pressures include:

- increased recreational use (e.g. boating, fishing, swimming, snorkelling, motorised and non motorised water sports);
- increased commercial use (e.g. fishing, sand and coral extraction and aquaculture);
- increased urban development (e.g. run-off, sewage); and
- increased adjacent coastal development and infrastructure (e.g. related to recreation, marinas, accommodation and hospitality).

Fish stocks, in particular, are under pressure from population growth. Many of our fish stocks are considered overutilised and by international standards our waters are relatively unproductive (CSIRO 2002). Pressures from domestic population growth are likely to be further compounded by rising demand from developing countries which will take effect to some extent in international waters near Australia (CSIRO 2002). Recreational fishing efforts in key population centres along the coastline may also exacerbate this problem.

Ecosystem services

Waste assimilation and recycling are key ecosystem services. They help deliver and maintain the clean air, freshwater supplies, productive soils and marine environments that support the habitat, food and resource supplies required by human and other species.

Ecosystems have differing productive capacities and waste assimilation thresholds that are often difficult to predict (i.e. the degree of waste that can be assimilated before the system becomes overloaded). As human and economic activity increases, so does consumption of natural goods and services, and more waste is produced (CSIRO 2002). Consequently, so does the associated risk of productive and assimilative thresholds being breached.

Currently, we produce approximately 3,000 tonnes of solid waste each day just in the south-east corner of Queensland (Queensland Government 2006d). Higher populations mean more solid waste is generated and there is a demand for more and/or higher volume landfill sites. It also increases the risk of land and waterway contamination. This creates an additional pressure to reduce waste production and improve levels of reuse and recycling.

Increased volumes of grey and black water put pressure on the capacity of marine and other waterways to assimilate the waste products entering these systems. Run-off from more intensive or higher levels of industrial, agricultural and horticultural activity can also increase the risk of waterway contamination, eutrophication and changes in PH and turbidity levels. These changes can all affect water quality and the ability of waterways to support healthy ecosystems.

In addition, development patterns that significantly alter natural water courses and flows as well as topographical contours can increase the risk of disrupting ecosystem functions.

Flora, fauna and biodiversity

Queensland is Australia's most naturally diverse state with 13 terrestrial and 14 marine bioregions. There are over 1,000 ecosystem types providing habitat for approximately 66 per cent of Australia's animal species and 47 per cent of its plant species (Queensland Government 2003).

Population growth can have both positive and negative effects on flora, fauna and the conservation of biodiversity. Some of these are direct impacts, arising from increased contact between human populations and activities. Others are more indirect, arising from changing patterns of land use, popular and political attitudes towards conservation and policies regarding land-use planning and development assessment.

DIRECT EFFECTS OF POPULATION GROWTH

Generally speaking, urbanisation and urban sprawl tend to increase the level of wildlife disturbance via introduction of domestic pets/predators, road kill, increased noise, light and human contact (Wildlife Preservation Society of Queensland 2007). There is also an increased risk to wildlife caused by the transference of weed species and diseases into natural areas as human and vehicle traffic increases and buffer areas become smaller and fewer in number (Wildlife Preservation Society of Queensland 2004).

Most importantly, the land clearing associated with urbanisation is arguably one of the main causes of species extinctions. Undeveloped land buffers between developed areas and protected areas become smaller in size and natural corridors disappear (Wildlife Preservation Society of Queensland 2006).

There is also likely to be increased recreational activity as population increases – much of which occurs in natural areas (Queensland Government 2003). Poorly managed, these activities (such as mountain-bike-riding, horse-riding, hiking, camping, rock-climbing, four-wheel-driving) can all degrade landscapes and contribute to soil erosion, compaction and altered water courses (Tourism Queensland and Queensland EPA 2002). An increased incidence of human contact with marine and land-based wildlife can also be expected to occur (e.g. through four-wheel-driving on beaches, boat strikes, road kill). Poorly managed, this can also easily disturb wildlife distribution and numbers by affecting breeding and nesting patterns (Tourism Queensland and Queensland EPA 2002).

INDIRECT EFFECTS OF POPULATION GROWTH

Queensland aims to protect biodiversity through the protected area network (see Figure 1). This network aims to include representative and unique ecosystems as well as providing connectivity between key natural areas.

However, only 4.5 per cent of the state (of an accepted ecological target of around 15 per cent) is currently held in formal conservation reserves (Queensland Government 2003). Consequently, many of the remaining unprotected natural areas (which exist on both private and publicly managed lands) contain important representative ecosystems and provide critical habitat and natural corridors for flora and fauna. At a national level this may be as high as 70 per cent, or 500 million hectares (ha) of private non-urban land outside the reserve system (Figgis 2002).

This situation may be compounded to some degree by changing environmental conditions associated with climate change. Changes in climatic conditions can alter species composition and distribution as well as individual numbers. Many native species are considered likely to be particularly sensitive to the increased average temperatures of 1° or 2°C, projected under climate change scenarios (Australian Government 2007). Where they are unable to adapt to new conditions, population or species losses are likely to occur. This may, in turn, add to the importance of maintaining a wider network of natural areas to support the potential movement or relocation of species (Australian Government 2007).

Unfortunately, it is these unprotected natural areas, particularly those close to high growth centres, that are at the same time likely to be under the most pressure from population growth for residential, economic and infrastructure-related purposes. Some evidence of this trend can be inferred from Table 3, which illustrates how many major growth areas already lack remnant vegetation stocks and demonstrate poor representation of regional ecosystems (Queensland Government 2003).

POSITIVE TRENDS

The potential effects of population growth on flora, fauna and biodiversity discussed above represent ongoing management challenges across community, business and government sectors. Arguably, however, there is significant evidence of partnerships and initiatives across these sectors that represent positive responses to these challenges.

At the community level there are several trends likely to provide continued support to conservation objectives, including:

- a more environmentally conscious population, more active in environmental volunteering and membership of conservation organisations (Parker & Fitzharding 2006);
- high levels of interest from our ageing population and visitors in nature-based recreation and education activities (Tourism Queensland 2006);
- an increasingly organised, politically integrated, mobilised and experienced environmental movement (Parker & Fitzharding 2006); and
- the emergence of privately owned, managed and funded conservation reserves (e.g. the Australian Bush Heritage Fund and Wildlife Conservancy).

In the business and government sectors, there has been an increasing awareness of:

- the economic value of ecosystem services (evidenced by the continued development of markets for carbon and water consumption);
- the economic value of natural assets (e.g. for recreation and tourism);

TABLE 3: NATIVE VEGETATION

TERRESTRIAL BIOREGION	REMNANT NATIVE VEGETATION	EXTENT AND CONDITION OF NATIVE VEGETATION
North West Highlands	--	↓
Gulf Plains	--	--
Cape York Peninsula	--	↓
Mitchell Grass Downs	↓	↓
Channel Country	--	--
Mulga Lands	↓	↓
Wet Tropics	↓	↓
Central Queensland Coast	↓	↓
Einasleigh Uplands	↓	↓
Desert Uplands	↓	↓
Brigalow Belt	↓	↓
South East Queensland	↓	↓
New England Tableland	↓	↓

KEY: REMNANT NATIVE VEGETATION

NO CHANGE -- DEGRADING ↓

GOOD
70–100% OF THE BIOREGION WITH REMNANT

MODERATE
40–70% OF THE BIOREGION WITH REMNANT

POOR
0–40% OF THE BIOREGION WITH REMNANT VEGETATION

KEY: EXTENT AND CONDITION OF NATIVE VEGETATION

NO CHANGE -- DEGRADING ↓

GOOD
0–20% OF REGIONAL ECOSYSTEMS IN THE BIOREGION CONSIDERED ENDANGERED OR OF CONCERN

MODERATE
20–50% OF REGIONAL ECOSYSTEMS IN THE BIOREGION CONSIDERED ENDANGERED OR OF CONCERN

POOR
50–100% OF REGIONAL ECOSYSTEMS IN THE BIOREGION CONSIDERED ENDANGERED OR OF CONCERN

SOURCE: QUEENSLAND *STATE OF THE ENVIRONMENT REPORT 2003*

- triple bottom line corporate and government responsibility and image (e.g. the ongoing development of triple bottom line monitoring and performance reporting frameworks (Nolan 2007); and

- the business of environmental management (i.e. the growing number of business opportunities related to services, products and technologies focused on environmental health and assessment and improved efficiencies in resource use and waste minimisation) (Perkins 2006).

What does all this mean for business in Queensland?

The impact on ecological sustainability from current population and demographic trends in Queensland may largely depend on the extent to which the above pressures are considered and proactively managed within the planning, policy, management and operations of the state government and business and industry sectors. In this context the focus is on the responsibilities and opportunities for business in Queensland.

BUSINESS AND CORPORATE RESPONSIBILITIES

Organisations around the world are recognising the value and business sense of taking responsibility for assessing and managing the environmental impacts of their activities. The objective of triple bottom line performance is increasingly integrated into corporate plans. Triple bottom line reporting continues to expand as a mechanism for meeting public demand for transparency and accountability (Environment Australia 2004).

Businesses involved in urban design, landscaping and construction, as well as infrastructure, transport, waste and water, will be particularly important in building a sustainable natural environment in Queensland.

Broad considerations include:

- resource efficiency and employment of best practices;
- life cycle and supply chain management;
- participation in certification and quality assurance systems;
- adoption of a triple bottom line approach to performance assessment;
- incorporation of economic valuation of ecosystem services and natural assets;
- investment and support of relevant research, development and technology;
- internal training and education;
- efficient logistics and distribution systems;
- flexible working structures that limit unnecessary travel;
- development of partnerships with NGOs and research bodies; and
- ethical investment choices.

More specific considerations include:

- environmental building design;
- accessible design and facilities;
- energy efficient technology;
- use of renewable and clean energy sources;
- water saving and recycling technologies;
- efficient waste management systems;
- high levels of reuse and recycling; and
- minimal packaging, processing and cold storage.

BUSINESS OPPORTUNITIES

In 2003–04 the environmental management services industry in Queensland was estimated to be worth approximately $1.3 billion (Queensland Department of State Development and Innovation 2006). This sector includes:

… technologies products and services that:

- *prevent, mitigate or reverse negative impacts on the natural environment;*
- *reduce ecological and human health risks;*
- *improve business and industry efficiency; and*
- *reduce business risk and enhance public reputation and competitive advantage* (Queensland Department of State Development and Innovation 2006).

Population growth and the associated need for improved environmental management and conservation in Queensland can only provide impetus for further growth in these industries. Similarly, increased pressure for improved water conservation and energy efficiency stimulates associated industries.

New niche opportunities can also develop. Climate change responses have opened up niche business opportunities in the development of carbon offset schemes and may arguably support the expansion of private protected areas as carbon sinks.

Designated natural areas

To this point the discussion has focused primarily on the effects of population growth on specific natural resources – land, water, air, ecosystem services and wildlife. More broadly we also need to consider the effects of population growth on our network of designated natural areas (i.e. recreational parks, terrestrial and marine protected areas and world heritage areas).

This is a much more complex and important issue than it may first appear, with the value of parks and protected areas frequently understated and the corresponding business dimension too often neglected in regional planning, business and development decision-making.

FIGURE 2: QUEENSLAND TERRESTRIAL PROTECTED AREAS

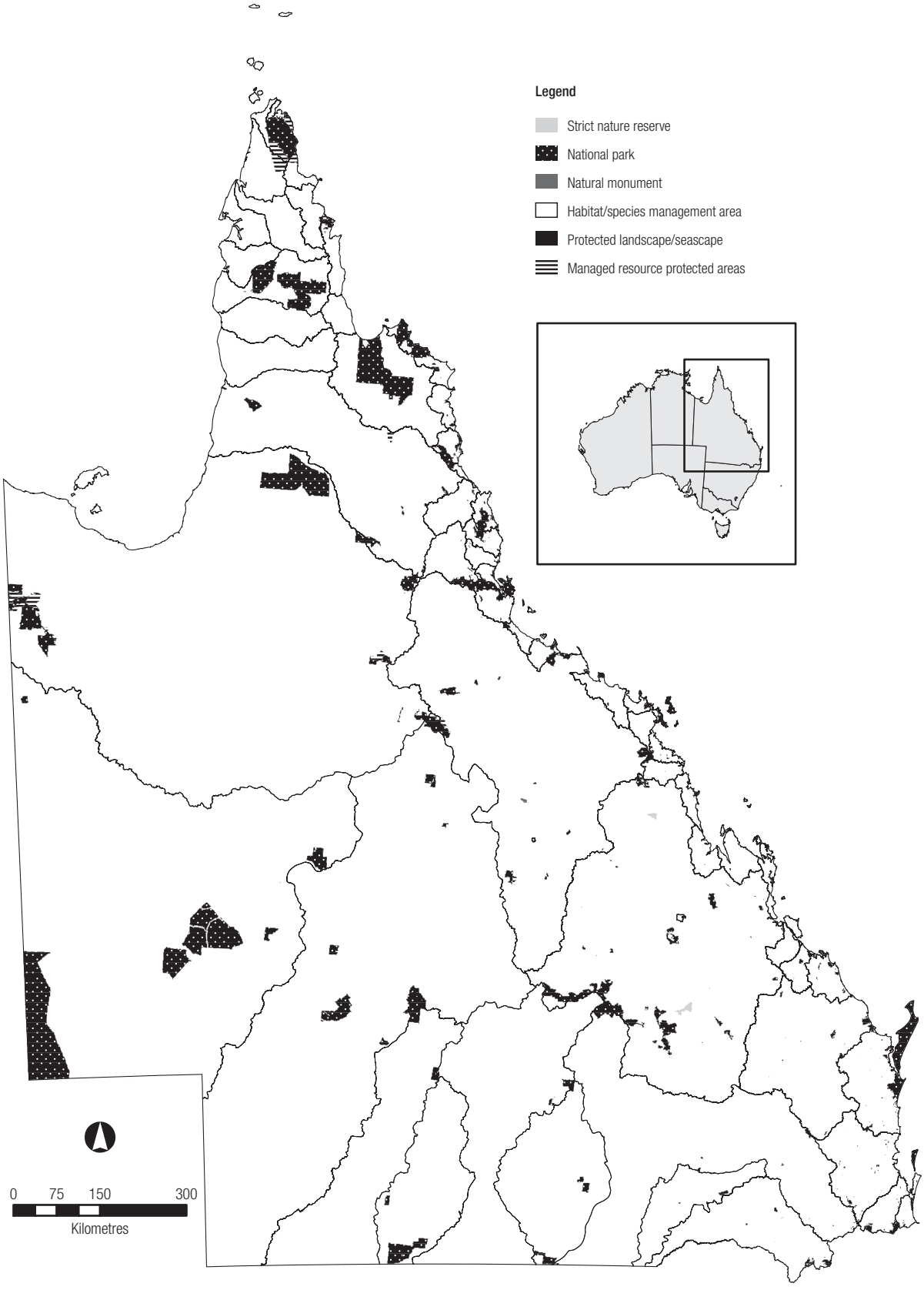


FIGURE 3: NOT-FOR-PROFIT QUEENSLAND CONSERVATION RESERVES

The Queensland network of parks and protected areas

Figure 2 shows the distribution of Queensland's terrestrial protected areas. A total of 7.1 million hectares are protected under the *Nature Conservation Act 1992* (Boyland 2005). This land area is spread across 435 protected areas. In addition, as the inset shows, there are seven marine parks stretching down the entire eastern coastline covering 5,243,111 ha (i.e. Cairns, Hervey Bay, Mackay/Capricorn, Moreton Bay, Townsville/ Whitsunday, Trinity Inlet and Woongarra marine parks).

There are also several conservation reserves owned and managed by not-for-profit organisations. Bush Heritage Australia, for example, currently owns over 700,000 ha across Australia, 506,357 ha of which are in Queensland. The Australian Wildlife Conservancy currently owns 917,000 ha across Australia, 180,175 ha of which are in Queensland reserves. The total area held in protection in non-government reserves is around 1.5 m ha. The location of these reserves is illustrated in Figure 3.

The value of Queensland's parks and protected areas

The system of parks and protected areas represent significant conservation, recreational and tourism values. For example, they:

- form the hub of our conservation and environmental education efforts;
- are important health and recreation resources for local residents; and
- are key economic assets as nature-based tourism destinations.

CONSERVATION AND ENVIRONMENTAL EDUCATION

The system of designated natural areas aims to conserve the biodiversity of flora and fauna as well as a representative sample of the variety of landscapes, ecosystems and habitats indicative of the state.

The intrinsic, heritage and bequest values of these areas are widely recognised – particularly with reference to Queensland's five existing World Heritage sites (i.e. Great Barrier Reef, Wet Tropics, Riversleigh Fossil Site and Fraser Island, Gondwana Rainforests of Australia). The scientific and educational values of these areas are also important. Nature-based research activities focused in these areas can provide:

- an understanding of and access to resources and processes that may be applied to the development of new and improved products and services;
- baseline environmental data that can provide indicators of ecosystem health, water and air quality and the effects of environmental changes and human induced pressures (such as climate change); and
- research data that may be used to better understand and conserve various species and ecosystems for the benefit of future generations.

Finally, these areas are also often the key focus for the provision of environmental education information, interpretation and experiences, as well as hands-on fieldwork for environmental professionals (e.g. education and information centres and research stations).

HEALTH AND RECREATION

Parks and protected areas provide important opportunities for recreation, relaxation, social interaction and leisure activities. The contrast of largely undeveloped and natural environments provides a break from increasingly urbanised environments and fast-paced lifestyles.

These areas offer opportunities for social interaction (e.g. picnics and camping) and contact with nature (e.g. bushwalks, nature photography and incidental encounters with wildlife) – both of which are important in maintaining a healthy lifestyle. Natural areas also provide for a range of recreational activities such as walking, cycling, horse-riding, canoeing, snorkelling, diving and other soft and hard adventure activities, as well as important health and recreation benefits and opportunities.

NATURE-BASED TOURISM

Population growth can also be expected to contribute to increased domestic and international tourism (CSIRO 2002). Higher Queensland populations will directly increase intrastate travel. Improved access, transport and communications resulting from economic development will also attract a higher proportion of visitors from interstate and internationally.

Natural areas are key tourism assets. A review of tourism marketing materials quickly confirms this point. Queensland's wide array of iconic natural areas, including the Daintree rainforests, the Great Barrier Reef, the Whitsundays, Fraser Island, Noosa National Park, Lamington National Park, Carnarvon Gorge – to name a few – underlines the inter-relatedness of nature and tourism. Each of these areas plays a vital role in the tourism industry of Queensland and Australia.

Parks and protected areas provide the same recreational opportunities and health related benefits to tourists as they do for local residents. In addition, they generate significant income to the state's economy. Queensland's tourism industry is currently contributing $8.4 billion to the Queensland economy and accounting for 5.8 per cent of the state's gross state product (GSP) (Queensland Treasury 2004). Tourism in protected areas is a significant contributor to this industry. For example, state-managed protected areas attract over 16 million visits a year (Queensland Government 2006c), while the Great Barrier Reef alone attracts an average of 1.8 million visitor days and generates approximately $4.2billion per year in tourism revenue (Great Barrier Reef Marine Park Authority 2004).

Protected areas, landscapes and wildlife are key tourism attractions for both domestic and international visitors. For example, in 2006 (Tourism Queensland 2006):

- There were 2.3 million *domestic* visitors to Queensland who participated in one or more nature-based activities (1.3 million of these went to national or state parks). Fifty-six per cent of all domestic visitors were Queensland residents and 27 per cent of these were from Brisbane. This reflects an average annual growth rate of 4 per cent of nature-based visitors since 2002. In the year ending 2004 around 25 per cent (approx $10 billion) of total domestic visitor overnight expenditure was accounted for by nature-based tourists.

- There were 1.4 million *international* visitors to Queensland who participated in one or more nature-based activities (up to 1.2 million of these are likely to have visited national or state parks). Twenty-two per cent of visitors were from Japan with UK and Europe the next most common point of origin. This reflects a 6.8 per cent average annual growth rate in the number of nature-based visitors since 2002, with the average international nature-based visitor to Australia spending $86 per day (Tourism Queensland 2006). In the year ending 2005, across Australia, around 70 per cent ($8.3 billion) of total international visitor expenditure was accounted for by nature-based tourists (Tourism Research Australia 2005).

Queensland enjoys an extremely high standing in international circles for its nature tourism. Recently, for example, the Great Barrier Reef Marine Park Authority received the Best Destination Award from the prestigious international Tourism for Tomorrow Awards (Great Barrier Reef Marine Park Authority 2007). Additionally, the proactive development of the Queensland Ecotourism Plan by the Queensland government (originally developed in 1997 and revised in 2002) demonstrates the significant place of nature tourism in Queensland.

The management of Queensland parks and protected areas

The conservation, recreation and tourism demands on parks and protected areas continue to pose a management challenge. Additionally, there are considerable calls for the reservation of more lands and waters to be added to the protected area estate and for improved management. In a recent submission to the Senate Inquiry into Resourcing of National Parks, the National Parks Association of Queensland stated that:

Protected areas have a considerable distance to go before being considered comprehensive, adequate or representative. Only about 6.5 per cent of the land area of all endangered regional ecosystems so far mapped in Queensland are inside protected areas (including Resource Reserves and excluding Nature Reserves) (National Parks Association of Queensland 2007).

In terms of the adequacy of Queensland's protected area system, Paul Sattler, an expert in reservation assessment and previous senior officer of Queensland Parks and Wildlife Service (QPWS) considers that:

In terms of management of the protected area system, Queensland is only ranked as fair … A much greater effort is required for Queensland to build both the comprehensiveness of its protected area system across bioregions and to improve the standard of management … The results of this evaluation are of concern with Queensland ranking seventh out of Australia's eight State and Territory jurisdictions (Sattler 2005).

Des Boyland, a former executive of QPWS, suggests:

There are undoubtedly sound economic and even social reasons underpinning new (protected area estate) management strategies introduced to reflect Government policy. Some of these strategies are not widely accepted by the community, resulting in a lack of support. A major challenge is that political parties do not believe the environment is a high priority for the broader community compared to other issues. Community apathy is a significant hurdle to overcome and changing attitudes are a major challenge for the conservation movement (Boyland 2005).

The budgetary pressures related to the vast infrastructure needs of Queensland as it responds to significant population growth, the resources boom and prolonged drought do not help the case for significant increases in funding for park acquisitions and management. Similarly the very contemporary call on state governments to release lands for housing in high growth areas in response to the lack of housing affordability puts further pressure on bushland areas. There is also a real risk that the response to climate change may result in a further shift of resources away from developing a representative conservation estate and towards monoculture-based tree-planting programs. However, there are also opportunities for expanding the conservation estate if offset program criteria stipulate conservation and not just carbon sequestration benefits.

In addition to the limited financial capacity to expand the conservation estate, there is the issue of increased pressure being placed on existing reserves by a growing population. Inappropriate or overuse of protected areas by the local community, tourists and recreationalists can threaten the integrity and health of the ecosystems and landscapes that have been reserved. Additionally, pressure placed on protected areas through activities that occur on the boundaries can similarly devalue protected areas. Such impacts can include feral animal introduction, weed infestation, fire, dumping of waste, road kills and firewood collection. Diminishing the environmental value of these reserves clearly threatens their conservation potential as well as diminishing their recreation and tourism values.

These areas are being conserved to protect their intrinsic values, enhance environmental awareness and enable current and future generations to experience and enjoy them.

In a response to the people pressures associated with protected areas, managers have developed a suite of tools and approaches to balance protection, use and presentation of protected areas. Typically management approaches for protected areas include:

- identifying and monitoring indicators of ecological and social carrying capacities;
- providing appropriate infrastructure to maintain and improve the resilience of the environment and to channel and confine activities to appropriate areas (without losing the undeveloped nature and atmosphere of the areas);
- controlling and providing equitable access to various user groups;
- encouraging and enforcing appropriate practices by visitors, recreationalists and commercial operators; and
- securing resources for research, monitoring, education, enforcement, management and maintenance activities.

There are a range of challenges associated with these approaches.

Firstly, ecological carrying capacity and threshold effects are variable across different environments and difficult to determine. Identifying social carrying capacity (i.e., when the levels and types of use begin to generate perceptions of overcrowding, a loss of natural surroundings and atmosphere, a loss of a sense of community ownership and community

space) is equally difficult and laden with value judgements. Identifying the contribution to overall impacts associated with different user groups is also complex, especially given their often cumulative nature. In reality the primary impacts associated with managing protected areas derive from human activity and use, either directly on the protected area or adjoining the protected area. The principal management focus is therefore directed to protected areas that are undergoing such pressures. In many cases remote protected areas require minimal management, as without human use or interference nature generally manages quite well.

Secondly, with issues such as an ageing population, health services, water infrastructure management and climate change dominating political agendas, there is less likelihood of threshold increases in public funding towards the management of parks and protected areas.

Tourism industry involvement

Australia's tourism industry fundamentally depends on the natural environment and its wildlife. The essential link between Australia's natural and cultural heritage and its success as a tourism destination is its greatest competitive advantage. With the serious challenges presented by climate change, particularly in the International Panel on Climate Change (IPCC)-declared hotspots of the Wet Tropics, South East Queensland together with the Great Barrier Reef, there is a need to develop meaningful responses. Collectively these natural assets generate billions of dollars in tourism trade.

It is evident that the nature-based tourism industry recognises the value of parks and protected areas as key tourism assets and is taking the lead in developing sustainable practices. The nature-based and ecotourism sector carries a significant responsibility of behalf of Queensland's tourism industry as a whole. So much of Queensland's total tourism industry is derived from is natural heritage. City hotels, restaurants and transport services in cities and towns like Cairns, Townsville, Airlie Beach, Hervey Bay, Sunshine Coast and even the Gold Coast are heavily based upon visits to national parks. The responsibility carried by operators working directly in protected areas is significant. In essence, they carry responsibilities for operating in a sustainable way for both themselves and their broader industry. Similarly, if tourism on protected areas was severely affected through a major natural catastrophe the broader tourism industry would also be significantly affected.

In recognising the potential and strength and potential of the ecotourism market, Queensland has been very proactive in encouraging the development of the industry and its standards. The Queensland government has provided significant support to the development and management of industry schemes that support professional ecotourism standards.

Ecotourism Australia, the peak representative body for nature-based operators, runs the national Eco-Certification program to assist operators to work to best practice standards and improve their triple bottom line performance. Eco-certification provides a means for both protected area managers and nature tourism consumers to recognise and support operators who demonstrate best practices. The scheme provides three levels of increasingly stringent certification (nature-based, ecotourism and advanced ecotourism). The program is applied separately to accommodation, attractions and tour components of operations and independently audited. Table 4 shows the number of Queensland tours, accommodation products and attractions currently certified under each category of the program.

TABLE 4: NUMBER OF CERTIFIED OPERATORS IN QUEENSLAND

PRODUCT TYPE	NATURE-BASED CERTIFICATION	ECOTOURISM CERTIFICATION	ADVANCED ECOTOURISM CERTIFICATION
Tours (190 in total)	14	62	114
Accommodation (29 in total)	1	5	23
Attractions (15 in total)	0	6	9

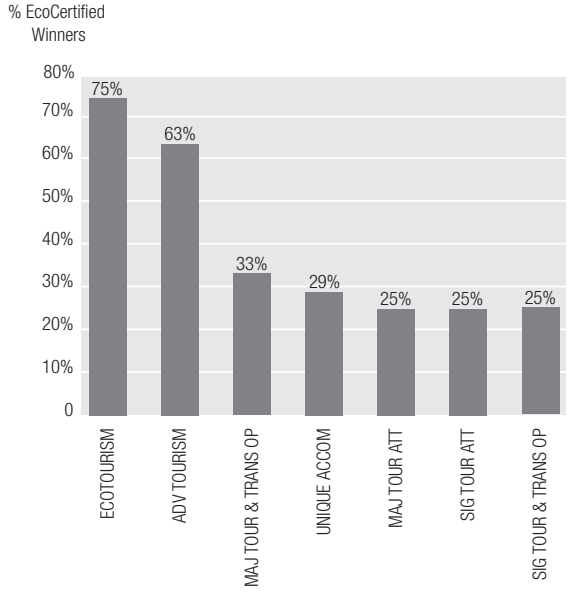
Assisted by the proactive support of Tourism Queensland and the Great Barrier Reef Marine Park Authority (GBRMPA), Queensland holds approximately 40 per cent of Australia's Eco-certified products.

Under the GBRMPA High Standard Tourism Program, operators are given a 15-year permit tenure (rather than the normal six-year tenure) and marketing benefits. The Eco-certification program is a world first and highly regarded internationally.

The industry's commitment to best practice can also be seen in the results of state and national tourism award programs. Regarded as the premier tourism award scheme in Australia, recognition at this level is highly sought after. While it could be anticipated that Eco-certified operators would perform well in their own tourism award category, the more notable aspect is the success of Eco-certified operations in other categories. The success of Eco-certified

operators in categories such as adventure tourism, major attractions, accommodation and tourism and transport is commendable (see Figure 4).

FIGURE 4: PERCENTAGE OF WINNERS WHO HOLD ECO-CERTIFICATION WHO WON STATE AND NATIONAL TOURISM AWARDS (ACROSS SEVEN KEY CATEGORIES) 2004



Ecotourism Australia has also established key partnerships that pursue conservation objectives. In November, 2003, for example, a Memorandum of Cooperation for the Development of a World Heritage Tourism Program and Fund was signed by UNESCO World Heritage Centre and Ecotourism Australia. The partnership sees Australian Eco-certified operators contributing to a series of initiatives, including donations to the World Heritage Fund, mentoring roles to operators in developing nations and professional development opportunities.

Key benefits arising from such initiatives include building stronger and more sustainable businesses and the increased confidence of protected area managers in the tourism industry's capability to operate in protected areas.

External influences

Our designated natural areas are also being affected by trends and influences stemming from broader environmental issues and economic change.

ENVIRONMENTAL ISSUES

Climate change is the major international issue that will affect each of the protected area values discussed above in some way. Conservation values will be affected as species and ecosystems attempt to adapt to changing climatic conditions – landscape and seascapes, plant and animal species composition and distribution are likely to change, with some elements collapsing or species disappearing entirely. This may in turn affect tourism and recreational values as the availability, quality and diversity of attractions in nature-based tourism destinations may be altered (e.g. coral bleaching on the Great Barrier Reef or loss of species in the Wet Tropics).

Changes in climatic conditions and more extreme weather may also affect the accessibility, safety, comfort and appeal of pursuing recreational activities (particularly in northern cyclone prone areas). It may also alter the timing and nature of seasonal tourist flows (regionally and internationally) and the viable destination product mix. For example, alternatives to some marine tourism activities may need to be developed by operators in response to altered environmental assets or weather conditions.

Climate change also exacerbates the management challenges discussed above. Changing environmental conditions may make user-related impacts more difficult to identify, isolate and quantify. Infrastructure may become even more important to guard against erosion, species loss, habitat loss, heatwaves and flooding. Infrastructure will also be important to maintain safe visitor transportation and access and protect against severe weather conditions. This need for additional infrastructure, monitoring, maintenance, repair and environmental rehabilitation will put even more pressure on already limited resources.

ECONOMIC INFLUENCES

Energy markets have a direct influence on transport costs and hence travel and recreation decisions. Rising fuel prices are likely to result in increased numbers of visitors and concentrated use of those parks and protected areas closest to key urban areas, with relatively less pressure placed on more remote nature-based destinations.

Natural resource markets more generally are evolving to more appropriately incorporate the economic value of the benefits of ecosystem services and the costs of carbon emissions. The value of ecosystem services provided by natural areas, including carbon absorption and storage, water treatment and recycling and temperature control are becoming more recognised in economic terms.

Examples include the emergence of carbon permits and trading schemes and the development of water markets. Together with amassing research indicating the economic value of tourism and recreation in protected areas, these trends should see higher economic values placed on these areas – at least over the medium term.

Population growth and designated natural areas

Population growth is likely to have several effects on the current state of Queensland parks and protected areas. These include higher levels of demand for social and recreational activities and nature-based experiences; higher expectations regarding environmental standards, products and services; and improved ease of access to parks and protected areas.

Higher demand for social and recreational activities

There are several social, demographic and cultural trends that contribute to an increased focus on "wellbeing" products and services (i.e. related to health, relaxation and fitness). These include:

- increased popular acceptance that work performance and productivity is linked to healthy and socially connected lifestyles;
- increasing demand and provision of flexible working arrangements related to attaining a "work–life" balance;
- an increased number of households comprising older singles and couples without children, facilitating higher disposable incomes and more free time; and
- an ageing population, who live longer and lead more active lifestyles.

Concentrated population growth and urbanisation also help create demand for wellbeing products and activities as they increase exposure to congestion, crowding, noise, pollution and a faster paced and more stressful living environment. In turn, social and environmental interactions can become more difficult to access and a sense of connection more difficult to maintain. Similarly, the density of urban settlement is increasing (Queensland Environmental Protection Authority 2003). As densities increase, access to private spaces, such as backyards, diminish. Parks and reserves take on a more important function. This applies to both urban and regional parks.

Parks and protected areas provide opportunities for social interaction and active pursuits. Population growth is therefore likely to create higher usage of these areas by day-tripping recreationalists.

Higher demand for nature-based experiences

Protected areas also provide opportunities for relaxation, education and contact with nature. Open space, fresh air, peace and solitude provide an escape from the concentrated development, noise and crowding of urban environments. The increasing popularity of day spas and nature-based retreats illustrates the perceived rest and relaxation benefits of natural areas.

Unique flora, fauna and landscapes also provide for experiences of nature which are increasingly rare. The opportunity to connect with nature and learn something new is attractive to a population that possesses an expanding environmental consciousness.

Population growth is hence likely to create increased pressure on parks and protected areas that offer environmental education, interpretation, rest and relaxation opportunities – particularly those closest to urban centres.

Higher expectations of product quality, services and facilities

The public is likely to continue to expect that parks and protected areas will simultaneously provide for conservation, education, rest and recreation activities. However, there are limits to the levels and types of use that can be sustained within conservation objectives. Also, conservation objectives will differ according to the sensitivity, uniqueness and level of protection afforded to the specific area.

In addition, each user group is likely to have different perceptions of what constitutes a "quality" nature-based experience. For example:

- the levels of crowding acceptable for social and recreational activities may not be acceptable for rest and relaxation pursuits;
- appropriate wildlife, landscape and flora interactions which can be sustained within conservation objectives may differ from the types of interactions desired (e.g. wildlife handling, management of activities such as swimming with dolphins etc); and
- infrastructure and additional services can be seen to enhance the visitor experience for some user groups and detract from the "natural",

undeveloped atmosphere of the area for others (e.g. development of cafés, canopy walks, lodges within protected areas).

Higher levels of environmental awareness and the increased usage expected to result from population growth are also likely to generate higher expectations regarding conservation, environmental standards, educational opportunities, access and the quality of facilities, infrastructure and services offered. This will magnify the management challenges discussed earlier.

Improved accessibility to parks and protected areas

Population growth and urbanisation are accompanied by improved transportation networks and infrastructure, for example, better and expanded road systems, airport development, improved public road and rail transport systems, and more regular and/or direct services.

This is likely to increase the accessibility of parks and protected areas to local residents, as well as for domestic and international visitors. Again, this is likely to increase the pressure on natural areas and the challenges involved in maintaining their ecological integrity and attractiveness.

A sustainable future for Queensland's designated natural areas

As outlined, Queensland's protected areas are currently facing unprecedented pressures and threats which demand response. The nature of these threats varies from global environmental influences through to highly localised impacts. In the end, solutions inevitably come back to money and a preparedness to change existing land management practices. Queensland has the capacity to establish which ecological systems need protection and the extent of protection required. We need to develop innovative ways of funding their expansion and management. Rather than expecting significant increases in budget allocations to face these pressures and threats, it is proposed that innovative solutions be examined that seek new sources of revenue/resources.

There are five key dimensions to securing a sustainable future for Queensland's natural areas: the climate change response; valuation of ecological services; the tourism industry role; the recreation user's role; and the role of philanthropy and non-government protected areas.

Climate change responses

Perhaps the greatest threat over a sustainable future for Queensland's protected areas is that posed by climate change. Warnings of significant species loss in bio-regions such as the Wet Tropics, the effective death of the Great Barrier Reef through coral bleaching, widespread damage to forests, wetlands and marine systems through increased severe cyclones and serious impacts to coastal Queensland through sea level rises paint an extremely worrying scenario. The time scale of these potential futures ranges from 15 to 50+ years. In a world where ten-year forward planning is rare the concept of planning for 50+ years outcomes is almost impossible to imagine. However, the changes to global climate that we are currently experiencing present a very serious threat. More immediate pressures posed by population growth just add to the negative equation.

There is a real risk that the gloominess associated with predicted climate change impacts will overwhelm the community, resulting in either no response or half-hearted responses based on a belief that it is a helpless situation. The reality is that climate change poses both a threat to, and a potential opportunity for, protected areas.

Clearly even under conservative scenarios outlined by the IPCC many of Queensland's protected areas and wildlife will suffer. Even at the 1–2° C increase range, 80 per cent of the Great Barrier Reef is bleached, and vertebrate animals of the Wet Tropics lose 90 per cent of their habitat (The Climate Institute 2007). An adaptation strategy will be essential to deal with the realities of climate change impacts that are already in train and currently irreversible. Adaptation strategies would deal with issues such as rising sea levels, more frequent storm surges and cyclonic wind/flood damage, prolonged drought and more frequent fire. Concurrently, emissions reduction plans must be developed to reduce the impacts of climate change. As a society, Queensland and Australia must reduce its ecological footprint. That Australia represents just 1 per cent (International Energy Agency 2001) of the carbon emissions generation globally is not sufficient reason for inaction.

However, there is a positive side to this situation. There are opportunities for Queensland to embody the Smart State philosophy in relation to its climate change response and protected area management. Protected areas already play an important role in sequestration of carbon. This role could be dramatically increased through a deliberate and proactive strategy of acquiring and rehabilitating degraded lands, establishing connectivity between islands and including them in the protected area estate.

Similarly, climate change provides opportunities for the expansion and better management of the protected area estate. In the early phase of climate change mitigation there will be a strong focus on carbon offsets. As low carbon technology improves and consumer behaviour is modified, reliance on offsets will presumably diminish. In the meantime (which may be decades) there are opportunities for protected area managers, both government and non-government, to expand their land holdings and deliver credible carbon offsetting programs. Such a scheme would have numerous benefits, including:

- increase on the stock of protected areas in Queensland;
- potential income generation from offsetting programs;
- ecosystem repair, restoration, adaptation;
- improved water quality and reduced siltation;
- increased stock of lands for recreation and tourism;
- establishment of wildlife corridors and connectivity between reserves;
- improved reputation for innovation and environmental initiatives; and
- consumer support – the credibility of protected area managers is significant, consumers would have faith in allocating offsets to such providers and they would feel good about supporting conservation projects.

Creation of a fully audited and credible carbon offset program that directs money collected into the protection of Queensland's climate change hotspots should be considered. Under this concept funds generated would be directed, for example, into catchment protection (particularly in riparian zones) and rehabilitation of habitats within the Great Barrier Reef, thereby reducing land-based pressures on the reef and improving its resilience to climate change. Such a scheme would deliver the benefits of capturing carbon through tree-planting, and, equally importantly, through catchment protection and reduced sedimentation and nutrient inflows into the reef lagoon. From a tourism industry perspective, such a scheme (if it involved collection of their carbon offsets) would also provide international and domestic tourists with a direct relationship between their travel and protection of the iconic resource they have been visiting. Queensland could link its climate change response to the symbiotic relationship between its natural heritage, tourism and climate change initiatives.

Valuing ecological services

Queensland's protected areas play a vital role in the collection and safe transmission of high-quality water for human consumption, agriculture and hydro-electric power generation. The value of protected areas in facilitating catchment and distribution of clean water is not fully recognised, or at least not fully valued. Ironically, if a utilities agency dams a creek or river system it is able to impose charges on consumers of water. Yet the dam is but a minor component of the total water collection system. Catchment areas of tens or even hundreds of thousands of hectares are required to collect large-scale reservoirs of water. Arguably this function alone, if charged on a 'volume collected' or 'volume stored' basis, would provide a continuous and potentially large financial return to the protected area management agencies involved. At a time when water is finally being valued more realistically and water conservation is being treated seriously by the community, there is an opportunity to seek out the ecosystem service value of protected areas in water harvesting. This principle could be applied on both public and private lands and the value of the asset could be set against the quality of water discharged – thus encouraging good land management practices.

The huge demands on the Queensland government for infrastructure investment in transport, health, education, water and energy infrastructure create a situation where it is unlikely to see threshold increases in budgetary allocations for protected area acquisition and management. With the community's revised thinking about the environment brought about by climate change, the time is right to re-examine the economic value of protected areas in delivering water.

The tourism industry role

Queensland's tourism industry is inextricably linked to the state's protected areas – both marine and terrestrial. The tourism industry has long held the view that it is prepared to pay for access to protected areas providing entry fees are hypothecated back to the protected area for management and protection. Some sectors of the industry have periodically called on all users to be charged access fees, claiming that they are unfairly singled out and "easy targets". However, there is a prevailing acceptance that as national park tour operators derive their income from a public asset a commercial operation fee is reasonable.

The reality is that the collection of fees for commercial use of parks is still quite patchy and only comprehensively managed at a small number of sites in Queensland, including the Great Barrier Reef, Fraser Island, Moreton Island, the Glow Worm Caves of Natural Bridge. In 2000 the Queensland government established a joint initiative between the Queensland Parks and Wildlife Service and Tourism Queensland to develop more contemporary responses to commercial operations in its key sites under the Tourism in Protected Areas initiative. This process developed 18 key principles upon which a management scheme would be based. Issues such as collaborative planning, improved tenure linked to performance, support of best practice certification schemes and development of partnership relationships between tourism and protected area managers underpin the TIPA process (Queensland Government 2006c). As mentioned earlier, the GBRMPA has been highly proactive in this area and under its highly successful High Standard Tourism Program commercial tour operators on the reef are provided with a range of incentives (including 15-year permit tenure) in return for committing to best practice certification programs such as Eco-certification. After just three years this program has resulted in some 40 per cent of reef visitors being carried with commercial tour operators that carry Eco-certification.[4]

The tourism industry would be prepared to pay higher commercial operator fees, thus further contributing to protected area management if:

- they received greater certainty over permit tenure;
- money was re-invested in improved visitor infrastructure and environmental management services; and
- all commercial users were treated equally (i.e. all commercial operators were charged fees).

Equally there are opportunities for the private sector to become more directly involved in park management through:

- investment in visitor infrastructure in agreed locations;
- provision of contracted services (e.g. park maintenance, management and visitor services);
- cooperative activities across park boundaries into private lands; and
- participation of boards of management and advisory boards.

Such initiatives could be undertaken wholly by the private sector or in partnership with government through public-private partnerships or other mechanisms.

There is also potential to undertake tourism enterprises on non-government protected areas. Tourism enterprises can provide diversification of income for protected areas.

However, there has traditionally been a significant level of reluctance by protected area managers to attract and take advantage of privately provided infrastructure and services, often based on the perception that commercial interests will exploit the area or demand special access rights which may threaten the conservation values of the area or limit access to other user groups. There are also administrative complications in ensuring that user pays funds are diverted back into protected area management.

Queensland is an international leader in ecotourism, but other nations are seeking out this mantle. Countries the world over are following Australia's lead – South America, Africa and southeast Asia, Canada and New Zealand to name a few. It is essential that Queensland maintains its competitive advantage in this field. Climate change is opening up yet another impediment for Queensland's tourism industry – as a long haul destination with the associated negatives of carbon impacts.

Recreation users role

Free public access to Queensland's national parks has long been held as a basic right. Periodically calls are made for the introduction of user pays fees for park visitors. In reality the economics of such a move is far from proved. With 435 protected areas in Queensland the viability of collecting fees remains elusive. Political memories of the failed Park Pass initiative are too fresh to re-visit this concept. However, collection methods that provide for centralised and universal collection, such as the Great Barrier Reef, Environmental Management Charge (EMC), Fraser Island and Green Island access fees and the Daintree River ferry fee, enable greater efficiencies. There is a role for the development of elite or iconic parks that have elite values (based on a combination of their environmental values, visitor infrastructure or access). These elite parks could become the primary sources of recreation income and could ultimately cross-subsidise the management of lower profile parks. Again this concept does not sit comfortably with many park managers and interest groups, yet it takes a pragmatic approach to the issue and could provide real benefits.

Philanthropy and non-government protected areas

As Australia's economy prospers and the wealth of the nation increases it is likely that philanthropy will take a greater role in the funding of protected areas. Unlike the United States where there is a long and proud tradition of philanthropy, it is still in its infancy in Australia. While there are a number of Australian foundations with a tradition of philanthropy, the reality is that the relative levels of giving across the nation are still very small. With the re-emergence of environmental awareness fuelled by climate change there may be an opportunity to sequester more direct cash contributions for land acquisitions and gifted landholdings.

The emergence of non-government protected areas over the past decade is an extremely positive outcome, fuelled in large part through grant funding through the sale of Telstra and channelled through the Commonwealth's Natural Heritage Fund. The development of this non-government estate is welcome for a range of reasons:

- the environmental protection offered through landholdings being managed for conservation purposes;
- opportunities to experiment with alternative approaches to land management; and
- greater flexibility in dealing with strategic alliances (e.g. tourism, mining, indigenous communities, agriculture).

However, it will be important for public and private protected areas to work cooperatively on acquisition strategies so that issues such as representativeness are considered, and to avoid competition over the same lands thus driving up the purchase price of acquisitions.

Conclusion

Impact on natural resources

With regards to the impact of population growth on our natural resources it can be concluded that:

- higher populations and urbanisation in Queensland will increase demand for undeveloped areas of land to support housing, infrastructure, commercial and economic development, as well as recreational activities;
- existing high quality agricultural areas are under threat of being lost to urbanisation pressures;
- increased population implies greater air and water pollution as well as solid waste and the need for better waste management practices and improved efficiency in resource and particularly energy consumption; and
- remaining unprotected natural areas that may fall under development pressure provide critical linkages and habitat for the conservation of Queensland flora and fauna, as well as key tourism and recreation assets. They also provide a range of ecosystem services critical to the ongoing health and wellbeing of all living species, including waste assimilation and the maintenance of air and water quality.

The key messages for the business community are:

- There is a need to support appropriate planning and development design to maintain the natural area and open space network in order to maintain environmental quality, integrity and community quality of life.
- There is a need for support and mobilisation from household to business to government to continue to improve the efficiency of resource use and waste management practices.
- There is a need to conduct risk assessments and develop business responses that will help adapt business activities to climate change effects.
- There is a need to support and engage in immediate action to drastically reduce greenhouse emissions.

Impact on designated natural areas

With regard to the impact of population growth on Queensland's designated natural areas, it can be concluded that:

- higher urban densities will increase pressure on natural areas for recreational pursuits;
- through heightened environmental awareness created by climate change, Queenslanders will have increased expectations about reservation, protection and management of natural areas;
- growth in the urban footprint of Queensland will require the development of more recreation-focused natural areas akin to Brisbane Forest Park;
- multiple use management objectives over protected areas will become more commonplace; and
- highly accessible and iconic protected areas will require significant recreation/tourism infrastructure upgrades to cope with increasing visitor pressures and visitor expectations.

The key messages for the business community are:

- community support for the establishment and protection of natural areas will continue to grow. Businesses that align themselves with conservation initiatives stand to gain consumer support;
- look for business opportunities arising from ecological services and climate change;
- businesses reliant on natural areas for revenue should develop adaptation plans and strategies to respond to climate change;
- advocate for equity in relation to commercial operator fees on state-controlled protected areas; and
- advocate for partnership management models on protected areas in order to maximise the potential of private sector/public sector co-operative management.

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Endnotes

1 The Queensland State of the Environment Report 2003 provides the primary source of information on environmental trends.

2 Current state level adaptation strategies can be found in *Climate Smart Adaptation 2007-2012*, Queensland Government 2005.

3 For an in depth consideration of the relationship between water issues and population growth, please refer to Nicholas Apostolidis' chapter in this volume.

4 GBRMPA, personal communication Lisha Mulqueeny, Director of Recreation and Tourism, September 2007.

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