OUR COUNTRY: OUR COMMUNITY

A COMMUNITY INFORMATION PAPER

FOR THE QUEENSLAND SECTION OF THE LAKE EYRE BASIN

Prepared by

DESERT CHANNELS QUEENSLAND INC.

for

THE COMMUNITY OF THE REGION

October 2004

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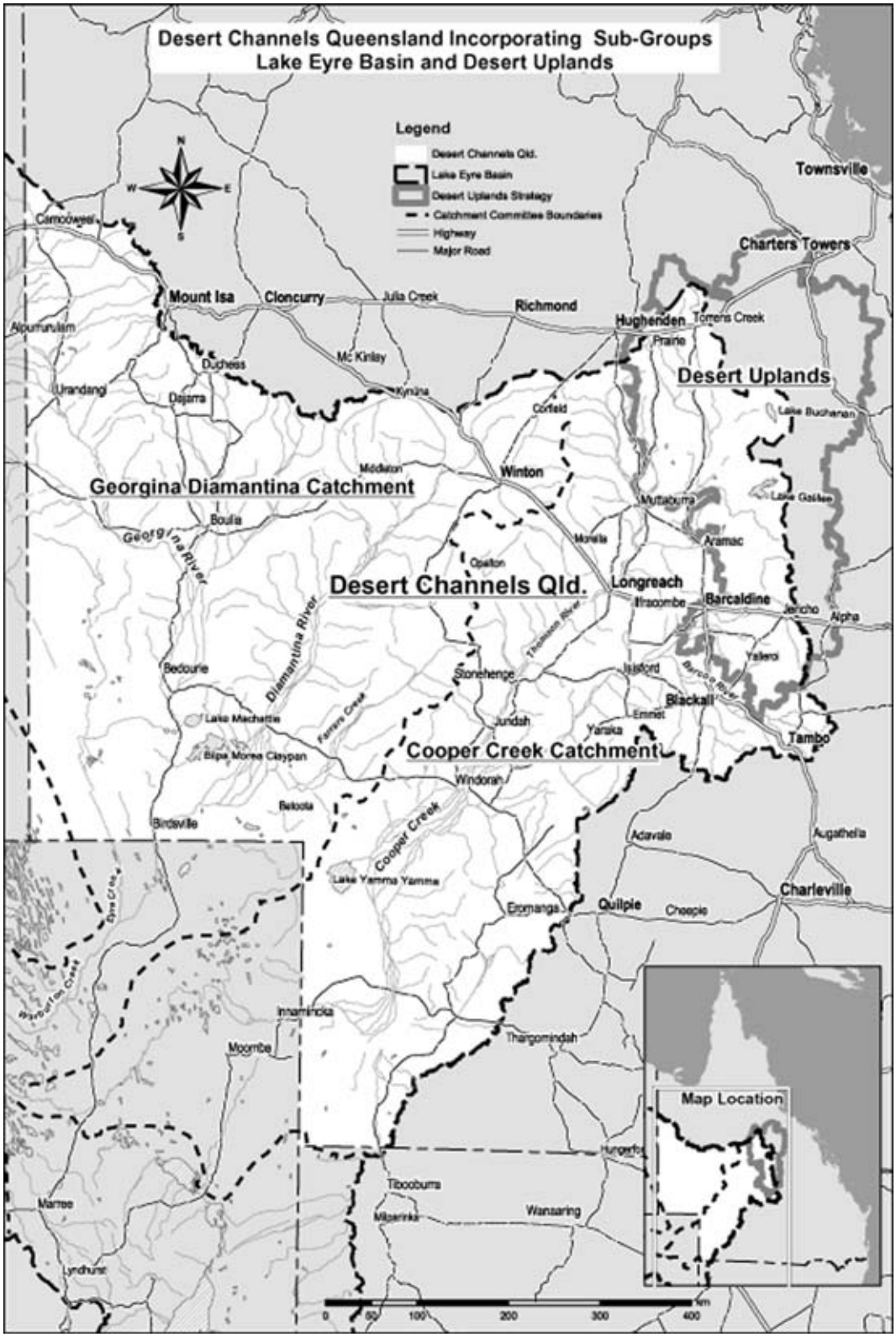
Figure 1: Desert Channels Queensland map



Part one

Background to planning

What is the purpose of this document?

This *Community Information Paper* has been prepared to inform the community about issues relating to the current state and future management of the natural resources of the Queensland section of the Lake Eyre Basin. It provides the community with access to a wide range of useful information to support the natural resource management plan for the region, *Protecting our Assets*.

The process of developing the plan is outlined in the 4 page summary document, *Approach to Planning*.

This paper does not claim to be an exhaustive review of the information available on the region; rather, it seeks to provide balanced information in a timely way. It is a living document that will be revised as additional information becomes available and your comments or contributions are most welcome. It was initially published in September 2003; this version is August 2004.

There are many areas where more information is needed. The planning process has helped identify these information gaps and place priorities on filling them.

This document also encouraged discussion and comment on areas of natural resource management where on-ground actions, innovation, research or policy development were required to address the sustainable future use and protection of this unique part of Australia. This discussion and comment was incorporated into the development of the natural resource management plan for the region, *Protecting our Assets*.

There were a number of ways the community had input into the planning process. These included providing comment via the response form attached to the summary document, *Approach to Planning*, attending public meetings held around the region during October 2003, the action-planning workshop in February 2004, the feedback form on the draft plan which was released in May 2004, or at the numerous public meetings held around the region during June and July 2004.

The sustainable use of natural resources such as land, water, or vegetation involves the whole of the community in the basin. Community includes urban residents with a small allotment, through local government, indigenous groups, and individual landholders, to large corporations with extensive grazing holdings or mining leases.

The development of a regional plan also involved a partnership with interests outside of our region. These include Australian Government and State Governments who provide funding for both planning and actions which are given priority by the plan. The key source of funding from government is through the Natural Heritage Trust (NHT). In order to access this funding the plan must be accredited by the Joint Steering Committee (JSC) which represents both Commonwealth Government and State Governments.

The State Government also has substantial interest in the region in the form of State leasehold land, stock routes, reserves, and national parks. Other interests are the scientific community along with conservation and industry groups.

This paper is in two parts. The first part sets the scene: what is the planning process; how it fits in the big jig-saw; who we are; where we've come from; what we have achieved.

The second part is an overview of the region: what's it like; what makes it and its community unique. The overview presents information on how the landscape evolved and how people have interacted with the natural resources of the catchments. It provides a snapshot of what we are and where we have been. A wide range of contributors generously provided information for this overview (see appendix 1).

A summary document, *Approach to Planning* is attached in the appendix and looks at some of the key natural resource assets of our region - What are they? - What do we need to do about managing them in the future? - Are there targets that we as a community need to aim for in the short or longer term? - What are some of the constraints that will need to be overcome? - Where do the resources come from?

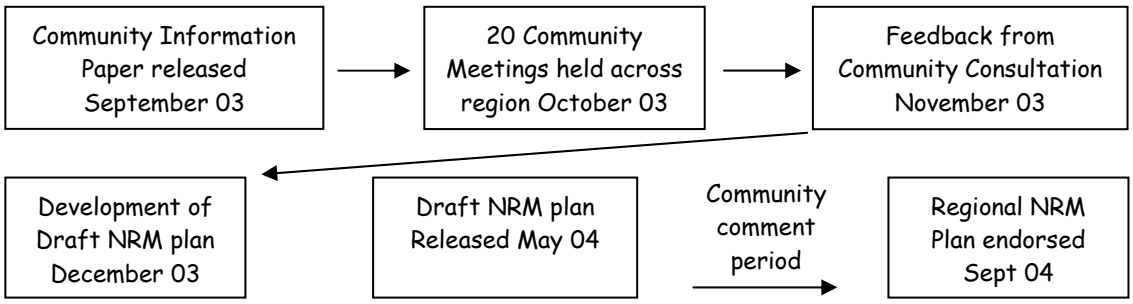
Why do we need a plan?

Regional groups around Australia are going through the process of developing regional natural resource management plans. There are more than 50 regional groups across Australia of which 15, generally based on catchment boundaries, are located within Queensland. The State and Australian governments will assess and endorse these regional plans as part of the arrangements to make funds available for the management of our natural resources through the Natural Heritage Trust.

Regional natural resource management (NRM) planning is not just about the Natural Heritage Trust. Outcomes from the process provide linkages with a range of other planning and provide direction for action taken by a range of stakeholders.

How are we going to do it?

Figure 2: Planning timeline



Who should be involved?

The process of developing a natural resource management plan for our region needs input from across the community (both urban and rural), from State and local government, from Indigenous people, Landcare, conservation, and industry groups.

How does this relate to other planning processes?

There are a number of other planning processes in the region at varying levels and for varying purposes – some of these are statutory i.e. connected to legislation. Examples are *Local Government Land Protection Plans* under the *Land Protection (Stock Routes*

and Pest Animals and Plants) Act 2003, Regional Vegetation Management Plans which are linked to the *Vegetation Management Act 1999* and the *Land Act 1994*, and Water Management Plans under the *Water Act 2000*.

The regional NRM planning process did not override these processes but focused on integrating the different levels of planning into one document that outlines the community's aspirations and actions for investment in the long-term sustainability and protection of the natural resources of its region.

In developing a regional plan there was also other State and Australian Government legislation and policies that had to be taken into account.

The most topical example is The *Lake Eyre Basin Agreement*, which was signed in 2000 by the Commonwealth, South Australian and Queensland Governments and is supported by the following legislation:

Lake Eyre Basin Intergovernmental Agreement Act 2001 (Commonwealth)

Lake Eyre Basin Intergovernmental Agreement Act 2001 (SA)

Lake Eyre Basin Agreement Act 2001 (Qld)

The *Lake Eyre Basin Agreement* provides a process and context for the

Australian and the two State Governments to come together in good faith, to develop and implement agreed policy on water and related natural resource management issues that have potential cross-border impacts (*Lake Eyre Basin Agreement Discussion Paper, 1999*).

Other Commonwealth legislation includes:

Environmental Protection and Biodiversity Conservation Act 1999 – currently identifies six matters of national environment significance (World Heritage Properties, Ramsar Wetlands, Lists threatened species/communities);

Natural Heritage Trust of Australia Act 1997 - establishes the Natural Heritage Trust and related agreements;

Native Title Act 1993 - provides a process for indigenous Australians to establish rights to use or possess lands that they have a prior association with.

Other Queensland legislation includes:

Nature Conservation Act 1992 - provides for protection of biodiversity, and habitat and allows for wildlife licensing and trade. Protects the national park estate and provides requirements to plan for its future management;

Environmental Protection Act 1994 - primary Act providing protection to the environment;

Forestry Act 1959 - provides for forest reservations, the management, silvicultural treatment and protection of State forests;

Soil Conservation Act 1986 - an Act to consolidate and amend the law relating to the conservation of soil reserves and to facilitate the implementation of soil conservation measures by landholders for the mitigation of soil erosion;

Vegetation Management Act 1999 - provides for the regulation of management of remnant vegetation on freehold land;

Land Act 1994 - deals with leasehold and other state land management, which includes lease conditions and the management of vegetation;

Land Protection (Pest and Stock Route Management) Act 2002 - provides for the management of pest animals and plants, stock routes and local government land protection plans;

Water Act 2000 - provides for the management of surface and underground water including planning, allocation and licensing.

National policies:

National Strategy for Ecologically Sustainable Development 1992 - provides broad strategic directions and framework for governments to direct policy and decision-making;

National Principles and Guidelines for Rangeland Management - addresses the sustainable management of Australia's rangelands;

National Strategy for the Conservation of Australia's Biodiversity - seeks to protect biological diversity and maintain ecological processes and systems;

National Framework for the Management and Monitoring of Australia's Native Vegetation - details a range of 'best practice' measures, including regional vegetation management;

The National Water Quality Management Strategy - established to protect and enhance the quality of water resources while maintaining economic and social development;

National Natural Resource Management Monitoring and Evaluation Framework - describes the management of our natural resources, land, soil, native vegetation, biodiversity and water (both fresh and coastal) and marine resources in an integrated fashion.

Natural resource management priorities have been established through several community processes in the region and are outlined in:

Desert Uplands Build-Up & Development Strategy Committee 1999, *Desert Uplands Natural Resource Management Plan*;

Lake Eyre Basin Coordinating Group, 2000, *Strategic Plans for the Lake Eyre Basin*.

A wide range of issues was identified which included pest, water and vegetation management, biodiversity conservation, sustainable enterprises and communities (see page 12 for a full list).

The community group Outback Revival has established a plan for economic and social revival of communities in Western Queensland. Projects addressed by this plan include speciality timbers, aquaculture and geothermal energy (Outback Revival website).

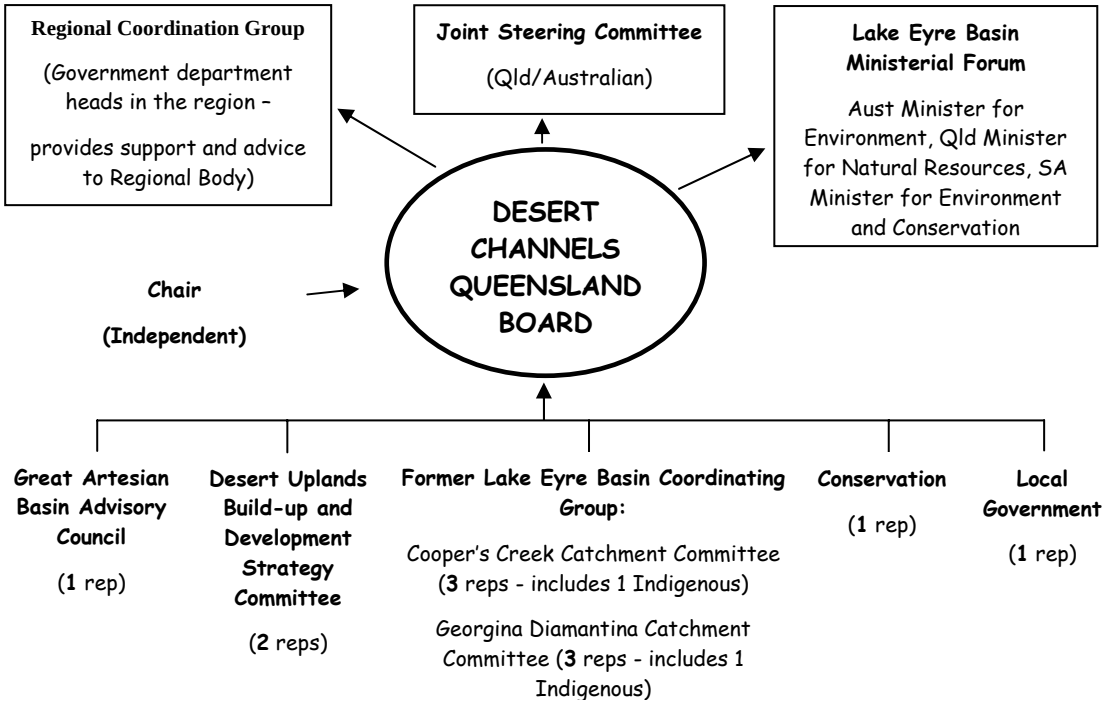
Local government planning in the region has addressed pest management and stock routes issues through the development of pest management and stock routes plans. The current review of all planning schemes in the DCQ area promises to further advance natural resource management outcomes through new Integrated Planning Act 1997 (IPA compliant) planning schemes (Colin Higginson Town Planners pers. Comm.).

Regional development plans in place include the Central Western Queensland Remote Area Planning and Development Board's 1995 *Central Western Region Strategic Plan*.

This plan, due to be reviewed and replaced by a new strategy in 2003/04, addresses some natural resource management issues including the development of alternative policy for the successful management of the Lake Eyre Basin and water management (RAPAD 1995).

Who is Desert Channels Queensland?

Figure 3: DCQ diagram



Desert Channels Queensland Inc. (DCQ) has been formed to develop the plan for the largest region in Queensland - the Queensland section of the Lake Eyre Basin. The Desert Channels Board brings together representatives from the Cooper's Creek and Georgina Diamantina catchment committees (includes two indigenous representatives); the Desert Uplands Build-up and Development Strategy Committee (DUBDSC); local government; conservation; and the Great Artesian Basin Advisory Council (GABAC) (see Fig 3.).

The recognition level of DCQ is increasing but is not as high as that of the region's implementation groups. The Cooper's Creek and Georgina Diamantina catchment committees and the Desert Uplands Build-up and Development Strategy Committee have established profiles, though there are parts of the region where awareness of community natural resource management and its role is limited. The planning process involved targeting areas of the region and communities that have not played a role in the process to date, along with liaising with the more established networks such as producer groups and Landcare. Two particular focus groups targeted for involvement under NHT 2 are local government and the Indigenous community.

As of January 2004 the staff from the former Lake Eyre Basin Coordinating Group transitioned to DCQ. The Lake Eyre Basin Coordinating Group was replaced with a new

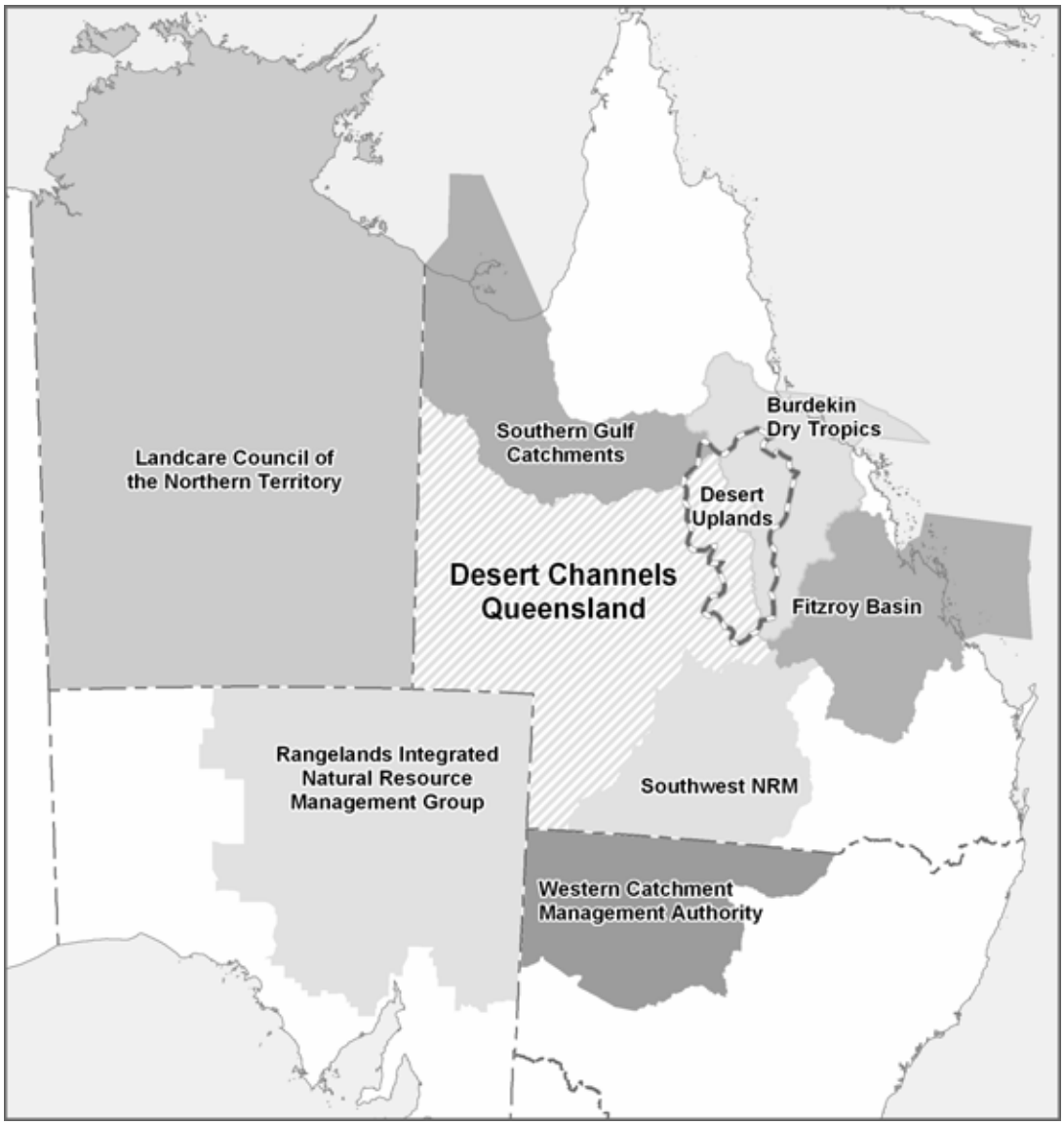
body Lake Eyre Basin Catchments which sees itself having a community advocacy role across the Basin.

Staff funded by DCQ to deliver outcomes for the Desert Uplands bioregion will continue to be employed by DUBDSC.

Relationship to other natural resource management (NRM) bodies

The DCQ region adjoins three regional, NRM groups in Queensland: Southern Gulf Catchments, Burdekin Dry Tropics and South West NRM. All these groups were consulted in the development of the DCQ regional plan. The Desert Uplands implementation group was involved in both DCQ planning and Burdekin Dry Tropics planning because it is based on a bioregion that straddles the common boundary between these regions (see Fig 4).

Figure 4: DCQ region and neighbours



Natural resource management planning upstream in the NT is undertaken by the Landcare Council of the Northern Territory which covers the whole NT. Downstream in SA the Rangelands Integrated Natural Resource Management Group basically covers the

pastoral areas (most of the north) of that state. These regions, due to their small population, have opted for a community of interest rather than a catchment approach.

The DCQ planning process actively dealt with cross-border issues with both of the above bodies. The Lake Eyre Basin Agreement policies and strategies assisted in guiding the process in dealing with the South Australian Rangelands Integrated Natural Resource Management Group (SA Rangelands INRM).

The community approach to natural resource management

The commencement of the Decade of Landcare (1990-2000) brought considerable enthusiasm in the region's community for addressing natural resource management issues. This was the first time people had got together to discuss and address issues which included soils, pasture, water management, nature conservation and weeds. Previous community group action was devoted to single issues such wild dog control syndicates, and in the early part of the 1900s, District Rabbit Boards (see Pest Animals).

As the Decade of Landcare advanced, the concept of Integrated Catchment Management was introduced with the aim of encouraging a 'big picture' approach to NRM issues beyond the Landcare group level.

In the mid 1990s two significant community processes began, prompted by community concerns for the future of their region.

In 1994 there was significant public debate about a proposal to list some of the Lake Eyre Basin for World Heritage. This proposal, although limited to South Australia, triggered considerable debate across the whole Basin. Many in the community held concerns that their ability to make decisions on the management of their land may be impacted. The community first came together with the aim of fighting World Heritage Listing and demanded the opportunity to be allowed to demonstrate that they had the skills to manage the Basin wisely. The Lake Eyre Catchment Protection Group was founded in 1994 with membership principally from the Channel Country in Queensland and the Far North of South Australia.

The following year, 1995, saw proposals put forward to develop a large-scale cotton irrigation project on Cooper Creek at Currareva, near Windorah. This application to pump water from the Cooper triggered a water management planning process for Cooper Creek, a first for the region. Sustained opposition to the project was mounted by the Cooper Creek Protection Group and the Barcoo Shire Council used their planning powers to oppose intensive agriculture in the shire. The eventual *Water Resource (Cooper Creek) Plan 2000* did not allow for significant irrigation development in the catchment.

The Lake Eyre Basin Steering Group came together in 1995 to consider options for community-based management of the natural resources of the Lake Eyre Basin. This group, which had representatives from a wide range of stakeholders, consulted widely around the Lake Eyre Basin about future options for its management. This culminated in a meeting in Birdsville in late 1997 when a range of models were considered for a Lake Eyre Basin Group (LEB Issues and Options Papers 1997). This led to the formation of the Lake Eyre Basin Coordinating Group (LEBCG), which gave rise to the Cooper's Creek and Georgina/Diamantina Catchment Committees. The LEBCG developed a strategic plan and managed a number of projects across the Basin. The Cooper's Creek Catchment Committee and the Georgina Diamantina Catchment Committee also developed individual catchment strategic plans (see community group achievements).

With the move to create regional NRM bodies in 2003, it became clear that the LEBCG would not be in a position to take on the role of a regional body in either South Australia or Queensland. It was also unable to continue to provide the majority of members for the Lake Eyre Basin Ministerial Forum Community Advisory Committee (CAC) and, in mid 2003, nominations were called for a new CAC.

In terms of new regional arrangements, the preferred option by the Federal and state governments for the Lake Eyre Basin was to create new state-based groups or use existing state-based bodies; these didn't necessarily match Basin boundaries. Coverage of the Basin was to be provided by the newly created Rangelands INRM Group in SA (which covered most of the far north of SA including areas outside of the LEB), the Landcare Council of the Northern Territory (covering all the NT), the existing Western Catchment Management Authority (covering the north-west quarter of NSW), and a new body in Queensland (covering the Qld section of the Lake Eyre Basin) with representation from the existing catchment groups and Desert Uplands.

Desert Channels Queensland (named from the Desert Uplands and the Channel Country) was incorporated in early 2003. With the changed arrangements there was no continued funding for LEBGC in its original role. At a meeting in Longreach in November 2003 the catchment community agreed to wind up the LEBCG with the hope of continuing the community advocacy role in a new community body named Lake Eyre Basin Catchments.

In parallel with the Lake Eyre Basin process the community of the Desert Uplands had come together to consider a range of issues that challenged the viability and sustainability of their region which straddles the northeast part of the Lake Eyre Basin and part of the Burdekin catchment. The area had a narrow industry base (cattle) and had become a focus for tree clearing and pasture improvement. The Desert Uplands Build-up and Development Strategy Committee (DUBDSC) was formed in 1995 and consulted widely around the area to ascertain the key issues facing the community. These were published in a position paper in late 1996. This paper highlighted the unique natural resources of the region, threats to these values, low levels of enterprise profitability, degraded natural resources, along with a number of social problems (DUBDSC 1998).

The DUBDSC has developed management plans for the natural resources of the Desert Uplands, as well as plans for integrated regional development and enterprise reconstruction. The DUBDSC has also managed a diverse range of projects in the region (see Achievements).

The DUBDSC and the Cooper's Creek and Georgina Diamantina catchment committees are the key implementation groups in the Desert Channels Queensland Region.

What has been achieved to date?

The Desert Uplands Build-up and Development Strategy Committee and the Lake Eyre Basin Coordinating Group have developed plans and strategies for their areas. As part of extensive community consultation these groups identified a number of areas of concern that impact on the natural resources of the region. These include (in alphabetical order):

Biodiversity Conservation / Endangered Species

Chemical Contamination / Waste Management / Pollution

Climate Risk and Drought

Diversification

Education / Awareness

Grazing Pressure / Pasture Management / Safe Carrying Capacity

Great Artesian Basin

Indigenous Land Management

Lack of data

Land Degradation

Mining and Petroleum

Property Management Practices / Planning

Salinity

Security of Tenure

Streamline Ecology

Surface Water Management

Tourism

Vegetation Management

Viability / Economics

Weeds / Feral Animals

Wildlife use / harvesting

Notable community group achievements

Desert Uplands Build-up and Development Strategy Committee:

- Planning for key components of the Desert Uplands Strategy – this included development of plans for Natural Resource Management, Enterprise Reconstruction and Integrated Regional Development.
- Enterprise Reconstruction Scheme – $4 million dollars has been received from State and Federal governments for interest subsidies (50-75%), for partnership rearrangements, property build-up and development and succession planning or 50 to 75% of the cost of leasing another property. Over 45 properties have been successful in accessing these funds.
- Strategic Land Resource Assessment Project – the DU Region has been mapped at a 1:100 000 scale. This scale can be used effectively for land management at a project level. Results of this $1.2 million dollar project are due late 2003. This Geographic Information System will be a valuable tool, which can be used by landholders for property planning.
- Carrying Capacity Projects – a Carrying Capacity model developed to suit the land types specific to the DU Region was completed in January 2001. It evaluated the South West Safe Carrying Capacity Model on 16 properties. In January 2003, a two-year Safe Carrying Capacity project began which assesses carrying capacity based on climate and soil types.

- Advanced On Ground Conservation Grants – over the past four years a total of 35 projects have been funded (amounting to $345, 000). Projects have included: fencing off riparian areas for vegetation regeneration and areas that contained endangered and/or of-concern flora and fauna; strategic weed control etc.
- Sustainable Forestry – the aims of this project were to evaluate the potential of hardwood species for supplying high value timber to specialised markets, determining guidelines for sustainable harvesting and promoting awareness of the economic and ecological value of woodlands. This project finished in 2002, the DU Committee is continuing to invest in, and promote, a sustainable timber industry in the region.

Lake Eyre Basin Coordinating Group

Cooper's Creek & Georgina Diamantina Catchment Committees

- Strategic Plans – these have been developed for Cooper's Creek Catchment, Georgina Diamantina Catchment and Lake Eyre Basin
- Lake Eyre Basin Agreement – LEBCG played a key role in ensuring it was finalised and had content of substance. A flow-on from this has been the Community Advisory Committee, the Biennial Community Conference (where community members get the opportunity to talk directly to ministers and vice-versa), the Scientific Advisory Panel, and the State of the Rivers Assessment.
- Lake Eyre Basin Integrated Information System (LEBIIS) – has provided Geographic Information System (GIS) support (e.g. weeds mapping), education and awareness maps, and information and data management (e.g. Information and Communication Catalogue). LEBIIS has pulled together data from a range of sources and formats across multiple jurisdictions, and manipulated it into a single, whole-of-basin, usable format (cross-border data sets are often not compatible).
- The Cross-Catchments Weeds Initiative (CCWI) – has attracted $295,000 for parkinsonia survey and devolved grants. This has seen 140 land managers come together in 33 groups to manage the parkinsonia problem in a strategic, cross-border approach. CCWI facilitated the formation of the Shire Rural Lands Officers Group of WQ, has gained funding for rubber vine survey and management, participated in a cross-border feral pig control project, and is working on further feral animal control.
- WISE (Water Information System for the Environment) CD-ROM – this research and educational tool on the Cooper catchment provides a wide range of information from a bibliographic database to maps, interviews and images.
- Inland Rivers – Outback Tracks: – this heritage tourism project presented the first clear, basin-wide picture of the pressing cross-jurisdictional natural resource management issues associated with this burgeoning sector. It developed recommendations and strategies for the sustainable management of the Basin's cultural and natural assets.
- Science – LEBCG placed the Lake Eyre Basin firmly on the scientific agenda and forged a linkage between scientists and community. There is now much more research being conducted e.g. Aridflo, Dryland Refugia (WISE database is a valuable research tool) and the community has input and feels part of it.

- Communication Project –established a local, national and international Basin profile in the scientific, academic, bureaucratic, political, natural resource management, tourism and wider communities. Website had over 30,000 hits in 2002 (PhD students in France are doing a case-study on the Lake Eyre Basin process via the website); quarterly newsletter had a circulation of 800.
- Water Management Plans – input was provided for the Cooper and Georgina Diamantina catchments by the respective catchment committees.
- Land for Wildlife – this pilot project for western Queensland involved 4 local governments, catchment committees and QPWS. There were 12 properties accredited to mid 2003, with a number waiting to be processed.

Note: All the above projects have involved consultation with the community and stakeholders. This has included making the information from the projects readily available.

Our information base

From the earliest explorers' journals of the mid 1800s and accounts by early settlers, to major government funded studies of the mid 20th century (Bureau of Investigation 1949) and more recent efforts by government, academia and the community, there has been considerable interest in finding out more about the region. This interest has been triggered in the last decade by debate on World Heritage Listing and issues to do with water and vegetation management planning, industry viability and sustainable communities.

This interest in information about the region extends not only across the roughly 14,500 people living in the area but far beyond the region. The romance of the Matilda Highway, the story of Burke and Wills and the remoteness of the Simpson Desert all combine to bring tens of thousands of visitors to the region each year, many of whom value the heritage and the largely unchanged landscape.

Although the Desert Channels Queensland Region is vast and the population small (see Our Community) there is a surprising amount of information available on the area. There have been several reviews of the literature about the region one of which was undertaken as part of the DPI 'Safe Grazing in the Channel Country Project'. In the words of the author: 'what initially appeared to be a paucity of references turned out to be a flood'. More than 330 references were cited. It was concluded that though research was far from adequate another problem was the perceived lack of information due to the difficulty of access (White 2001).

A review of management issues in the Desert Uplands (Mitchell 1997) brought together a significant body of information on what is seen as a neglected part of the region but again it was equally as much a matter of access to, as a lack of, information (Mitchell pers. comm.).

In *The Conservation Status of Queensland's Bioregional Ecosystems* (Sattler and Williams (eds) 1999) several authors indicated either a lack of information due to little systematic survey of flora and fauna species in some parts of the region (Mitchell Grass Downs and Desert Uplands) or the information from surveys had not been published as was the case in the Desert Uplands and the Channel Country.

One of the significant achievements of the Lake Eyre Basin process has been the Lake Eyre Basin Integrated Information System (LEBIIS). This NHT funded project has

been developed in partnership with the Department of Natural Resources and Mines for the Lake Eyre Basin Coordinating Group. The project, now in its fourth phase, has developed into one of the most comprehensive collections of data and computer-based mapping available in outback Australia. LEBIIS supports a wide range of projects and publications and has achieved international recognition for its work.

Research for the soon to be published Cooper Creek WISE Rivers database has revealed more than 500 references. This information base will be on CD and can be readily searched by key words.

There is a clear message that, as well as identifying data deficiencies in this planning process, we also need to focus on making key information on our natural resources available in a form that delivers the maximum value to the community.

Part two

The Desert Channels Region

The Queensland section of the Lake Eyre Basin has changed less, since European settlement, than most other parts of Australia. Its rivers are unfettered, its soils untilled, its beauty untamed.

The ecosystems that underpin all life in this semi-arid land are both robust and fragile: robust enough to thrive in the boom and bust cycles of flood and drought yet, fragile and sensitive to change brought by human activity, pests and climate change.

The Desert Channels region is a land of wide horizons, big skies and few people. It saw the birth of Waltzing Matilda, Qantas and the union movement; the demise of Burke and Wills, and the rise of legends like Sir Sidney Kidman and Harry Redford.

Predominant land-use is rangeland grazing of cattle and sheep which sustains a decreasing population in the rural areas. Town communities are increasingly sustained by tourism, government and other service industries.

Natural resource management issues, as identified by the community, centre around enterprise sustainability, vegetation and water management along with weeds and feral animals.

Community[1]

The original inhabitants of the region were as much a part of the landscape as the natural resources on which they depended for survival.

Like nature, the people of the region are tied to the seasons: rain brings optimism and promise to townspeople as well as the rural sector. Because of the economic dominance of the pastoral industry, if the 'cockies' are feeling the pinch, businesses in the towns are as well. It is a dynamic community, much changed from fifty years ago, with some changes being driven by economics; some by technology.

Since the labour intensive early days of the pastoral industry and the boom of the 1950s, the population of the region has generally been in steady decline. Increased mechanisation and tighter margins in the pastoral industry has led to a smaller workforce with fewer employment opportunities for young people.

There is also less willingness to be saddled with the financial burden and uncertainty of land ownership. Consequently, many of the next generation have left the area for greener pastures, and the average age of landholders has increased. This, coupled with the improvement in roads and advances in vehicle design, has seen a major change in the traditional small and localised community-of-interest of rural people.

Once, a rough and dusty one hour (much longer in more isolated parts) trip would get you to a central spot where there might be 40 people from surrounding properties gathered for sport, dances or similar social events. Now, you would be lucky to get 10 people from the same properties, while a smooth, air conditioned drive of the same length of time sees you in a town with modern amenities.

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[1] For a more complete socio-economic profile of the region, see People, services and industry.

The last two decades has seen the advent of satellite television, the replacement of party lines and manual exchanges with automatic phones, the introduction of radio phones to the most remote properties, and the appearance of computers and the internet.

Much of the region is beyond the national electricity grid and the energy costs for these areas are high. The subsidised, hybrid solar/diesel Remote Area Power Scheme (RAPS) units are becoming more common as people seek access to mains-type power and a reliable, cost-effective alternative to diesel generators.

Over the last ten years, the shift from sheep to cattle has been a major factor in population decline. Not only is there less labour required 'on-farm' but the flow-on effect to towns that were once home to hundreds of shearers and related sheep industry workers has been severe. The number of shearing teams that can find permanent work in the region has dropped by about 75%. This brings a related drop in cash-flow in the community.

In recent years, cashed-up, absentee cattlemen have bought enterprises that once supported families. Many of these properties now have only a single caretaker in residence or no one at all. In one case, a cluster of 8 adjoining, family-run properties supported 43 individuals in 8 families, now there are just 14 people and only one family.

For this essentially pastoral community, the silver lining has been the upsurge of interest by coastal fringe Australians in connecting with their cultural roots and exploring the outback and its ethos. Over the last decade, tourism has emerged as a significant industry and in some shires has overtaken grazing as the biggest income generator.

Our landscape

Desert Channels Queensland comprises the Queensland section of the Lake Eyre Basin which is divided into the Georgina/Diamantina Catchment and the Cooper Creek Catchment. These two catchments are almost equal in area in Queensland.

The Georgina and Diamantina Rivers join below Birdsville in Goyder Lagoon in South Australia where they combine to form The Warburton, which flows into the northern end of Lake Eyre. Cooper Creek flows west into SA and enters Lake Eyre on the eastern side. The winding nature, shallow slope and extensive floodplains and lake systems (including the significant RAMSAR listed wetlands of the Coongie Lakes) combined with high evaporation, mean that the Cooper only contributes water to Lake Eyre in the wettest of years. It is estimated that of the stream flows that cross the border into SA 40% is via the Cooper and 60% via the Georgina/Diamantina (DNR 1997).

The Queensland part of the Lake Eyre Basin at 509,933 sq km (LEBIIS 2003) is the State's largest catchment. With the Bulloo River, which borders to the southeast, the catchment is unique in not draining to the sea. Stream flows are extremely variable (see Hydrology). The total area of the Lake Eyre Basin at 1,170,000 km2 is around 15% of Australia's land area.

A significant area of the headwaters of the Georgina catchment lies in the NT (99,841 km2) and a small area of the Cooper Catchment drains from the far North West of NSW (635 km2). The area of the catchment (combined Cooper and Georgina/Diamantina) downstream in SA is 91,480 km2 (as calculated by LEBIIS 2003).

Fig 5. Biogeographic Regions (Bioregions) of the Desert Channels Queensland region (BBS = Brigalow Belt South; CHC = Channel Country; DEU = Desert Uplands; MGD = Mitchell Grass Downs; MII = Mount Isa Inlier; ML = Mulga Lands; SSD = Simpson-Strzelecki Dunefields).

Seven biogeographic regions (see Fig 5) are found in the DCQ area making it the most diverse region in the state. This is in keeping with the wider Lake Eyre Basin, which has 17 bioregions making it the most varied catchment in Australia (Environment Australia 1995). This diversity ranges from the eucalypt woodlands of the Desert Upland along the Great Dividing Range, through the rolling plains of the Mitchell Grass Downs and the vast floodplains of the Channel Country to the Simpson/Strzelecki Dunefields, one of the driest parts of Australia.

Geology

The Lake Eyre Basin is an ancient landscape, weathered over hundreds of millions of years.

The rocks on the northern edge of the basin are the oldest rocks in Queensland. This area of rugged mountain ranges known as the Mt Isa Inlier comprises uplifted Proterozoic rocks around 1800 million years old. These are some of the most mineral rich rocks in the state.

In contrast, the rest of the DCQ region is a series of vast sedimentary basins, which are bounded to the east by the uplifted sediments of the Desert Uplands and the Carnarvon Ranges. To the west of the Mount Isa Inlier is the Georgina basin, an area of limestone and other sediments laid down in shallow seas around 600 million years ago. These sediments include significant deposits of rock phosphate. The remainder of the region comprises the Eromanga, Cooper, Adavale and Galilee geological basins. These sedimentary areas were laid down around 200 million years ago. A large part of this area was flooded between 140 and 100 million years ago. The immense water resource of the Great Artesian Basin is confined in the Jurassic sediments which underlie much of the region (Wadley and King (eds),1993).

These sediments were later overlain by terrestrial deposits which were then deeply weathered in the Tertiary exposing the sediments which weathered to form the heavy clay soils typical of the Mitchell grass downs in the north of the region (Turner et al. 1993). Isolated flat-topped hills in the downs country are remnants of the Tertiary land surface.

Significant marine and land fossils deposits in the region have attracted increasing interest through the excavation of several dinosaur fossils in the Muttaburra and Winton area. The Lark Quarry Dinosaur Trackways are a major attraction where 100 million old dinosaur tracks are preserved.

It is the immense forces of weathering which has converted the geology into a landscape covered by sediments and sand with relatively little exposed geology except around the fringes and scattered ranges within the region.

Landforms

Although the relief of the Queensland section of the Lake Eyre Basin is not great by even Australian standards it is far from a flat, featureless landscape. The general slope of the land is from the north and east to the south and west. The highest points in the catchment are around 550 metres above sea level (asl) at the headwaters of the Wills River in the north west, over 850m asl to the north east in the White Mountains, where Torrens Creek begins, and over 700m asl east of Tambo in the Great Dividing Range.

The gradient of the streams drops quickly on the edge of the basin but soon evens out to a very modest slope, typically around 200mm/km. The lowest points on streams are around 40m asl where the Cooper Creek enters SA and 30m asl where the Diamantina River enters SA. The lowest point in the Desert Channels Region is the bed of salt lakes in the Simpson Desert near Poeppel Corner, where the elevation is around 15m asl.

There are several landforms typical of the region.

To the northeast lies the Desert Uplands which can be divided into two provinces with quite distinct landforms. The Prairie/Torrens Ck Alluvials are the flattest part of the

DCQ region, extending from Torrens Ck in the north to near Muttaburra. The Alice Tableland adjoins and forms the northeast edge of the region. This is an area of sandstone ranges, much of which is covered by tertiary sand sheets (Sattler and Williams 1999).

On the eastern edge of the region lie the unique internal drainage basins of the salt Lakes Galilee and Buchanan. These lakes are considered part of the Lake Eyre Basin drainage division (Division of National Mapping 1983).

The vast rolling Mitchell Grass Downs dominate the north and central parts of the region. The first European settlers named these open undulating clay soil plains after the rolling open downs of southern England.

Dissected residual hills are found throughout the Channel Country but are particularly evident in the Goneaway Tableland Province (which forms the divide between the Cooper and Diamantina catchments) and in the Kynuna Plateau between Winton and Boulia. These hills are low (around 50 to 100 metres) and often mesa-like. Away from these hills run braided streams which increase in width downstream to join the vast floodplains of the channel country.

West of the Eyre Creek in the lower Georgina Catchment lies the Simpson Desert, a vast area of linear dunes running generally north-west to south-east. These dunes, laid down in the Quaternary, can be several hundred kilometres long and lie across a clay plain. Interdune areas can vary from a couple of hundred meters to several kilometres wide. Other dune areas are in the far south near Cameron Corner and scattered through the channel country east as far as Jundah.

Soils

The land resources of a large part of the Desert Channels Queensland Region have been surveyed by DPI (Western Arid Region Land Use Study WARLUS) parts 1, 2, 4, 5 & 6). Areas on the fringes of the region north and east have been surveyed by CSIRO in the Gilbert/ Leichhardt, Fitzroy and Dalrymple surveys. Inadequacies in mapping in the Desert Uplands Region have recently been addressed through the Lake Buchanan/Galilee Catchment Study and the Strategic Land Resource Assessment Project (see group achievements).

Soils are quite varied as can be expected given the vast size of the region and diverse nature of the landscape. They range from the dune sands of the Simpson Desert, through grey and brown clays typical of the Mitchell grass downs, heavy grey clays on the flooded areas of the Channel Country to the duplex soils and red earths and sands of the Mulga lands and the Desert Uplands.

Generally the most fertile soils are those of higher clay content with a tendency to cracking as characterised by the channel country and the open downs. Poorer soils tend to have higher sand content and have been leached over a considerable time span as characterised by the sand dunes in the west of the region and some of the deeper sandier soils in the Desert Uplands. These areas are often recharge zones for groundwater.

Across the region there are also large areas with shallow or stony soils where lack of moisture-holding ability is a bigger constraint than fertility. These soils, characteristic of the dissected residual mesas of the Channel Country and some of the range country in

the Desert Uplands, struggle to maintain pasture and some parts shrubs and trees (Markey pers. comm.).

As there is little cropping undertaken in the region discussion of soils issues has in the main focussed on the suitability of soils to support development of improved pastures in the eastern part of the catchment, particularly where buffel grass has been introduced. Buffel establishes well on freshly cleared loam soils but may be less dominant as fertility declines. Duplex soils with a hard setting surface, which are usually found in poplar box country, are poorly suited to buffel (Cavaye 1991).

Other concerns about soil have generally centred on soil loss due to overgrazing and loss of desirable pasture species or inappropriate road and track construction (see land degradation).

As befits an area, which has spent long periods submerged in seas, salinity is part of the landscape. There is limited information available in the region on salinity but generally it could be said that the present largely natural vegetative cover has evolved to cope with these levels of salinity. Some ecosystems, particularly in the saline depressions, soaks, and lakes of the Channel Country are dependent on high levels of salinity. The alluvial soils of the Georgina/Diamantina catchment have higher salt levels than those of the Cooper Ck system (Phelps pers. comm.). This can most likely be traced to the different periods of inundation by salt and freshwater of the rock strata that are the parent material for the current soils.

Land degradation

Degradation is by nature a sensitive issue that can divide the community. One person's claypan, seen as a natural part of the landscape, may be seen by another person as a degraded site resulting from poor land management.

Degradation can be through soil loss, either through obvious gully erosion or more subtly through gradual sheet erosion by water or wind. Degradation by changing vegetation cover or composition (eg. encroachment with native plants or exotic weeds) can happen slowly and often is not recognised and may be exacerbated by erosion.

Even in the literature opinions vary. For example, the Western Arid Region Land Use Study part 6, which surveyed the lands of the Diamantina and Georgina Rivers, concluded that most land types in the region were in good condition but there was a need to understand the relationship between variable climatic and land conditions to maintain the land in a stable condition (Wilson et al. 1990). Three years later in The Condition of River Catchments in Queensland, the Georgina catchment was reviewed and found that the dunes are extensively eroded where they occur near the better frontage country and frontage areas are usually overgrazed and eroded (DPI 1993).

Compared with many other areas vegetative cover is relatively sparse and rainfall, although low, can be very variable and at times heavy (see climate). On one hand erosion is very much part of the landscape of the region, yet many areas are extremely fragile, where excessive grazing pressure or disturbance can change the land forever.

Land degradation and addressing the soil/pasture/vegetation relationship was identified as one of the key issues raised by the community in the process that gave rise to the Desert Uplands Build-Up and Development Strategy Committee. In the rounds of consultation leading to the formation of the Lake Eyre Basin Coordinating Group, grazing pressure and pasture management were also identified as major issues.

Clearly there are areas within the region that have suffered from the impacts of changed land use. Examples can be found along once heavily used stock routes and around watering points both man-made and natural. Long term overgrazing can gradually degrade large areas, not only resulting in soil loss but also changing vegetation composition to less desirable species and encouraging exotic weeds.

Some soils in the region are highly erodible when disturbed or when drainage patterns are altered. Examples are found in the deep sandy earths of the Desert Uplands and the heavy clay soils of the stony downs in the Channel Country where poor road siting and drainage can impose significant scars in the landscape. Areas of the catchment, such as the scarps of the residual ranges, are naturally highly unstable (e.g. the hills between Winton and Boulia) and significant changes can be seen in one heavy rain event.

There has been no systematic study of land degradation across the whole of the DCQ region. Although it is felt that generally the lands of the region are in good condition, concerns have been raised about degradation issues in some areas.

An overview of the condition of river catchments in Queensland was carried out in the early 1990s as part of the Integrated Catchment Management Strategy. This overview found that scalding and severe gully erosion was characteristic of the upper Georgina catchment. Some soils in the upper Diamantina were naturally unstable leading to gully erosion. The Cooper catchment however was seen to have few large areas that are severely degraded (DPI 1993).

Little experimental work has been conducted on the erodibility of the soils in the region. Generally soils most predisposed to erosion exhibit low surface cover levels, shallow depth, high slope, high inherent salinity and specific textures that make them susceptible to wind erosion. Additionally long periods of drought and increasing tree and shrub densities impact heavily on the level of effective soil surface cover.

Observations by field officers on the texture and structure of the Mitchell Grass Downs soils indicate a similarity to the Brigalow soils of the southern Fitzroy Basin and Western Darling Downs. If this is the case then these soils would be classed as having medium to high erodibility by water. During periods of low surface cover there is an increased risk of erosion. The relatively low land slope however moderates this risk, which is generally lower than 3% (Markey pers. comm.).

Channel country soils are similar to those of the open downs in levels of clay and the degree of soil cracking. Because of the low slope they are generally in a soil build up phase rather than an erosion phase from the water impacts. The greatest risk to the channel country soils is from wind erosion. The extent of this erosion is being studied in a suite of projects at Diamantina National Park led by the Centre for Riverine Landscapes, Griffith University (McTainsh pers. comm.).

The more arid areas of the region are at higher risk from wind erosion. This risk increases with soils of higher clay content and poor surface structure characteristics. Large areas of the west of the region can be included in this higher risk category as can parts of the Desert Uplands.

Anecdotal evidence suggests that increasing tree and shrub cover through encroachment and thickening of species like gidgee in the Mitchell Grass Downs and eucalypts in the open forest communities of the Desert Uplands has reduced the effective ground cover and therefore potential for increased water erosion. The

relationship between these changes in vegetation, land degradation and grazing patterns is an area the community has identified for further research.

Degradation of soils and vegetation cover has been raised as a significant issue in both the Mulga Lands and Desert Uplands bioregions. Some two thirds of Mulga lands properties west of the Warrego River were considered to show signs of significant land degradation (Mills et al.1989). This degradation included soil erosion, pasture decline and woody weed encroachment.

The similar red earth soils of the Desert Uplands have been recognised as having degradation potential through sheet erosion (Turner 1979).

Climate

The DCQ region has a climate ranging from dry monsoonal in the north to temperate arid in the south. The region typically has a hot, dry climate with highly variable rainfall.

Temperatures in the region are amongst the highest recorded in Australia. Most centres in the catchment have recorded maxima in excess of 45°C, with Birdsville recording maxima in excess of 49°C. Although frost is comparatively rare centres have recorded minima as low as –2°C (BOM data).

Annual rainfall in the Cooper catchment varies from around 550 mm at Torrens Creek in the north east of the region to 172 mm at Innamincka just over the border in SA. The Georgina/Diamantina catchment is drier with Camooweal in the north having an average of 394 mm and Birdsville 165 mm (Australian Rainman). The wettest part of the catchment is probably in the White Mountains north of Torrens Creek with an annual rainfall of more than 600 mm and the driest is probably around Poeppel Corner in the Simpson Desert where the annual rainfall may be only 100 mm.

A summer dominated rainfall pattern is experienced over all of the area with either January or February the wettest month. There is a slight trend towards more winter rainfall in the south. The region is characterised by high variability of rainfall. Torrens Creek has a coefficient of variation of around 40%. This variability increases downstream to Innamincka Station where it reaches 90% which is one of the highest rainfall variabilities in Australia (Australian Rainman).

A good example of this variability was exhibited in the recent period when Winton recorded its wettest year with 1,171 mm of rain in 2000. Two years later in 2002 only 55 mm fell in the gauge, the lowest in 119 years of records. In general 2002 was the driest year on record across much of the region.

Although the north of the region may occasionally experience the monsoon from the north, the bulk of the region experiences rain events which are most often connected with an inland trough. This trough generally travels west to east and separates warmer, moist air to the east from drier, cooler air to the west. Slower moving troughs, sometimes moving back to the west and fed by moisture from a belt of low pressure in the summer, produce the most significant and useful rains. Daily falls in excess of 150 mm have been recorded in most centres in the region. Cold front activity in winter tends more to change the temperature but may bring some rain to the far south. Cyclonic activity, most often originating from the Gulf of Carpentaria is capable of delivering significant rain bearing depressions but these are not a reliable source of rain in most years.

Evaporation is very high with most of the catchment experiencing more than 2800 mm per annum. The lower parts of the region have evaporation of over 3200 mm and summer evaporation peaks at over 450 mm/month, amongst the highest in Australia (BOM 2003 Map).

This highly variable climate is reflected in an environment where the flora and fauna are adapted to irregular rainfall and flooding events. The floodplains of the lower parts of the catchments are uniquely adapted to having much of the moisture provided by stream flows from further up the catchment rather than local rain.

Living with a highly variable climate is one of the major challenges for both the pastoral industry and urban communities in the catchment. Even the supposedly more reliable (in terms of rainfall) parts of the region have been significantly impacted by drought. The Blackall Shire, for example, was drought declared for 30% of years in the period 1964 to 1998 (DU NRM Plan 1999). There has been a change in emphasis in recent years for government to provide more resources to landholders to manage for drought rather than deal with the consequences of drought as a natural disaster. A key part of this approach is to improve the capacity of the community to understand climate prediction as an essential tool of land management.

Climate prediction

The use of the Southern Oscillation Index (SOI) for predicting rainfall is relatively less useful in the DCQ region than compared to coastal areas. Grazier surveys throughout the region have identified the need to provide accurate forecasts of summer rainfall with longer lead-times (i.e. more time between when the forecast is issued and the forecast period). The Queensland Centre for Climate Applications is currently working on experimental models such as the SOI phases and the nine-phase sea surface temperature for the Indian and Pacific Oceans along with other forecasting systems to forecast summer rainfall and pasture growth with longer lead times.

The use of the Madden Julian Oscillation (MJO), sometimes known as the '40 day wave', may also give some indication of possible rainfall events in the region. The MJO is simply a band of low atmospheric pressure originating off the east coast of central Africa travelling eastward across the Indian Ocean and northern Australia roughly every 30 to 50 days. While it is a tropical phenomenon, it appears to indicate the timing of rainfall events but, unfortunately, not rainfall amounts.

Impact of global warming

Generally Australia's continental-average temperature has risen by 0.7°C since 1910 (much of this since 1950) but no trend in rainfall has been evident (CSIRO 2001). Nonetheless predictions for 2030 and 2070 indicate significant climate change is likely for the region.

Predictions for the Lake Eyre Basin are for temperatures to rise by as much as 2°C by 2030 and 6°C by 2070. Rainfall changes predicted are neutral to slightly wetter with perhaps a shift to summer and autumn rain. There may be more extremely wet years and consequently a rise in rainfall variability. The predicted changes in temperature combined with the small change in rainfall may make for increased moisture stress. Global warming may enhance the drying associated with El Nino events (CSIRO 2001).

An attempt has been made to estimate the possible effects of climate change on pasture growth, stocking rates and animal production in the Mitchell grass downs of

western Queensland. Using scenarios of a doubling of CO2 with a 3°C increase and rainfall changes of ±20% annual pasture growth changes varied from –37% to +47%. It was concluded that given the uncertainty of rainfall trends (compared with CO2 and temperature) more work was required on the effect of climate change on rainfall in the region. Predictions of significant moisture deficits, with even small (1 – 2°C) rises in temperature are of concern (Cobon and McKeon 2003).

Our catchment

Catchment hydrology

The Queensland section of the Lake Eyre Basin in notable for shallow gradients, variable stream flows and rather unique flow patterns. The streams reach their maximum mean flows not, like many other rivers at the point they discharge (usually the sea but in this case Lake Eyre) but around the middle of the catchment. It is also part of one of Australia's major drainage basins and has a largely unregulated flow (see water management). Maintaining near natural flows in the catchment has been the focus of the cross-border arrangements put in place by the Lake Eyre Basin Agreement.

The upper parts of the catchments are not unlike the streams in the adjacent catchments of the Southern Gulf and the Burdekin. Streams are comparatively fast flowing and rainfall is in the range of 500-700 mm pa. It is further downstream in the vast eroded landscape of the Mitchell Grass Downs and the Channel Country that stream flows slow as the water splits into braided streams across the floodplains. The heavy soils of the floodplain act to reduce leakage into the streambed sediments and numerous waterholes (some permanent) are found. They can be many kilometres long but the majority would not exceed 10 metres in depth. There is anecdotal evidence of waterholes on the lower end of the Cooper being around 30 metres deep.

Examples of the unique flow pattern of the Queensland part of the Lake Eyre Basin can be found from stream gauge data on the Thomson/Cooper system. Mean annual discharge of the Thomson at Longreach is 1,197,000 megalitres (ML) per annum, below the junction of the Thomson and Barcoo at the Currareva gauge near Windorah the mean flow is 3,320,000 ML pa. This flow then drops to 963,000 ML at Nappa Merrie, just upstream of the SA border (DNR 1998).

Below Windorah that the catchment changes from a pattern of increasing stream flows with distance downstream and relatively confined channels to a broad floodplain where water can spread over more than 60 km. The lower catchment has much lower and more variable rainfall (see Climate), which means that, more often than not, local runoff does not add a lot to the flooding.

This immense variability in stream flows drives the ecological responses of the lower catchment (see Biodiversity). For example the maximum stream flow measured at Currareva was more than 23,000,000ML in 1974. Between 1939 and 1988 there were 11 years in which the flow reached 5,000,000ML or more (DNR 1998).

Unfortunately the Currareva Gauge ceased operation in 1988 so there was no gauging information available at this site from the 1990 flood which was generally thought to be the second or third largest flood recorded. Remote sensing data indicated that some 14,600 km2 of flooding occurred in Queensland downstream of the junction of the Thomson and Barcoo Rivers, with a further 11,300 km2 flooded in SA (DNR 1998).

Information on the Georgina and Diamantina catchments is more limited. Estimated mean annual discharge for the Eyre Creek below Bedourie is 1,200,000 Ml and the Diamantina 900,000 Ml at Birdsville (NR&M 2001).

Pastoral production in the lower Cooper, Georgina and Diamantina is strongly driven by the ability to finish cattle on floodplain grasses and herbage after floodwaters recede. These areas rely less on rainfall to drive pasture growth and can sustain production in many years with low rainfall thanks to reasonable flooding.

Nonetheless there are many years with little or no flow. For example, at Currareva in 1951/52, there was no flow recorded for some 21 months (DNR 1998). Upstream the stream flows are more reliable. At Longreach the longest period of no flow recorded since the gauge was installed in 1969 was 10 months in the period 2002-2003. Longreach recorded the lowest rainfall on record of 107mm in 2002.

In general the information from gauging stations available in the catchment is not great given the immense variability. Most gauging stations have either operated for a relatively short period or have now been removed from service. Some 10 gauging stations have operated in the Georgina/Diamantina catchment. Only one of these, on the Diamantina River at Birdsville, now operated by the SA Government, is still in service. In the Cooper catchment of 14 gauges 8 are still operational (NR&M 2002). The community consultation undertaken as part of the process to develop the Cooper Creek Water management Plan identified the need to restore key gauging stations to operational order, in particular the gauge at Currareva. This gauge was still out of service in 2003 but three new stations have been established upstream: on the Barcoo at Retreat, the Thomson at Stonehenge, and Cornish Creek at Bowen Downs (NR&M 2002).

Several flow models have been developed for parts of the catchment. As part of the Water Management Planning process for the Cooper Creek a daily streamflow model was developed using rainfall events from 1889 to 1995 (DNR 1998). Other streamflow modelling has been undertaken for the Cooper as part of the DRY/WET model which was developed to predict the impact of varying flows on the Ramsar listed Coongie Lakes wetlands in SA. More recently the Environmental Flow Requirements for Australian Arid Zone Rivers (ARIDFLO) project has developed a streamflow model, which covers all the streams in the region.

Rivers in the Queensland section of the Lake Eyre Basin are the major contributors of inflow to Lake Eyre. It is estimated that of the water that enters SA some 40% is contributed by Cooper Creek and 60% by the Georgina and Diamantina (DNR 1997). The winding route the Cooper takes and the area of floodplain, swamps and lakes it fills means it loses a great deal of its water before it gets to Lake Eyre. In the 2000 floods the waters of the western streams and the Georgina Diamantina 'filled' Lake Eyre but the Cooper did not even reach the Birdsville Track, some 140 km from the lake. In much of the Lake Eyre Basin, stream flows, although heading towards the lake, never get there. The sands of the Simpson Desert are an obstacle to much of the water from Central Australia.

Streamline ecology

The health of streams in the Desert Channels Queensland region is in keeping with its relatively undisturbed catchments, unregulated rivers, and near natural flows. Land use is mostly extensive grazing and there is no large scale water extraction (Sattler &

Creighton 2002, Bailey pers. comm. 2003). Stream ecology values in the DCQ region are overall in good condition, though trends in some ecosystems may indicate decline. The most commonly listed threats associated with this decline are:

- increased habitat fragmentation
- total grazing pressure
- feral animals
- weeds
- altered fire regimes
- changed hydrology

Many of these threats combine to impact on riparian zones and wetlands areas (Sattler & Creighton 2002).

The DCQ area has important waterholes and wetlands that are home to a number of fish and turtle species, several with restricted distributions. Several new species have still to be fully described (see Biodiversity).

Across much of the region, total grazing pressure is the main impact on riparian areas and wetlands; this varies greatly with stocking rate, season and water infrastructure. There is a tendency in some areas to establish off-stream watering facilities: these can help maintain water quality through improved riparian vegetation. Other benefits to the landholder are reduced erosion and stock losses from bogging. The greatest impacts occur in drought around waterholes and springs when these refugia[2] are under stress, not only from lack of flow and high rates of evaporation, but also from water extraction (see Water Management). These locations are critical to the survival of specialist aquatic species.

Feral animal activity, particularly pigs, can result in significant degradation of streamline vegetation (see Feral Animals). This activity and the associated impacts have been progressing down the catchments into the lower Cooper and Diamantina in recent years (Magnussen pers. comm.).

Visitor impacts on stream habitats have increased in certain areas. Despite the vast dry landscape of the region visitors tend to congregate around key waterholes. These include the Longreach Waterhole, Currareva waterhole at Windorah, and the waterholes in the Nappa Merrie/Innamincka area on the Cooper. On the Diamantina, the Conn and Old Cork waterholes, Hunter's Gorge at Diamantina National Park and the town waterhole at Birdsville are popular with visitors. On Eyre Creek the Cuttaburra Crossing south of Bedourie is also heavily visited. The recent Lake Eyre Basin heritage tourism report (Future Directions - Schmiechen 2004) identifies significant issues in terms of the sustainability of some tourism impacts (uncontrolled off-road driving, camping, fires, waste disposal) in riparian areas. The draft Management Plan for the Longreach Town Common (Longreach Town Common Group 2003) documents increasing pressure by visitation and camping on the Longreach Waterhole and proposes measures to manage these impacts.

Other human impacts to aquatic habitats are sewage inflows. These are generally unknown but presumed to be minor in most of the catchment with the possible exception

[2] refuges

of Longreach where there are significant sewage inflows of 1-1.5 Ml a day into the catchment below the town. The same section of the river is also impacted by the largest urban water extraction point in the region (see Water Management). Measures to deal with the high nutrient water entering the river systems have been developed, with two local councils in the DCQ region (Blackall and Birdsville), by NR&M through the Artificial Wetlands Scheme. These schemes could be extended to limit excessive nutrient-rich water from entering the river systems at other sites.

In other areas bore water flows from drains into streams and waterholes. One example of this is the waterhole on the Diamantina River at Birdsville which is fed by overflow from the town bore. Bore water could impact on water quality and instream biodiversity (altering vegetation and ecosystem processes relying on the natural drying up of semi-permanent waterholes) and needs further investigation.

There is a need to better document the condition and critical habitats of the riparian and wetland environments in the catchment. In May 2001 the Lake Eyre Basin Ministerial Forum identified a requirement for an assessment of the condition of the rivers in the Lake Eyre Basin Agreement area to be undertaken every 10 years. The methodology for assessment is currently under development, with the proposed monitoring to commence in 2004 (LEB Ministerial Forum 2003). Separate to this, wetland mapping needs to be reviewed.

Stream condition

All of the monitoring undertaken to date has been based on snapshot scenarios. The 'State of the Rivers' survey of the Cooper catchment in 1994 (Moller1999) examined some 273 survey sites from near the headwaters of the Thomson and Barcoo to the SA border in a one-off survey which revealed the following:

Reach environs (lands adjacent to the streams) were found to be very good at 78% of sites and no sites were rated below 'moderate'. Bank stability was found to be 'very stable', with a few exceptions, but streambed conditions were rated lower with some tributaries of the Thomson rated 'very poor' to 'poor'. Grazing activity was recorded as the primary influence on streambed stability.

The survey also assessed riparian vegetation, which was found to be predominately in 'good' to 'very good' condition. Aquatic habitat on the other hand was more often rated 'poor' which reflected a natural lack of diversity in instream habitat rather than quality, perhaps reflecting the sampling methodology which may not have been geared to assessing the types of streams found in the region (Moller pers. comm.)

More recent studies such as the Environmental Flow Requirements for Australian Arid Zone Rivers (ARIDFLO) project have focussed on the responses of different biotic groups (fish, waterbirds, macroinvertebrates etc) to both long and short-term measures of river flows. This project, which undertook fieldwork across the Lake Eyre Basin in SA and Qld between 2000 and 2003, was aimed at identifying the relationships between stream flows and the ecological responses of aquatic and floodplain ecosystems. The period of survey included significant stream flows in 2000 and a major drought in 2002. Results from ARIDFLO will be published in late 2004.

Previously, there has been little sampling of water quality in the DCQ area, and that which has been continuously undertaken has generally been connected with urban water supply. The only longer term study, the Western Streams Water Quality Monitoring Project, noted that attracting resources for research to this region was difficult due to

the belief that the area is relatively undisturbed and that arid areas are less diverse and less impacted than coastal areas (Bailey 2001).

As part of this study, State agency, local government and community sampled some 21 sites in the Lake Eyre Basin in Queensland for periods of between four and six years. The study concluded that the trend in surface water quality was low salinity, visual clarity and dissolved oxygen, and higher pH (alkaline), nutrients and temperatures. These are characteristically variable and any differences or trends could strongly be affected by the timing of sampling in relation to flooding. Further research was recommended incorporating landholder knowledge, and looking at riparian zone interactions and the affects of the natural turbidity on the ecosystem processes.

Salinity levels were measured as conductivity and were found to vary significantly from lows of around 20 micro siemens per centimetre (µS/cm) to 827µS/cm. Generally conductivity in waterholes was seen to increase when flows ceased (Bailey 2001). This is a natural process when water levels decrease through evaporation and concentrate. In some catchments bank seepage from saline subsoil, known as ground water intrusion, may occur as water levels drop.

Mean conductivity levels may increase downstream e.g. at Diamantina National Park the mean was 86µS/cm, whilst downstream at Birdsville the mean was 185µS/cm. Other mean conductivities were the Barcoo River with 205µS/cm and the Thomson River with 119µS/cm. All sites monitored showed salinity levels to be lower than the maximum limit recommended by the Australian and New Zealand Environment and Conservation Council's Water Quality Guidelines for Freshwater Ecosystems of 1,500µS/cm and did not constitute a hazard to aquatic ecosystems (ANZECC 1992), (Bailey pers. comm.). In fact the converse may apply where a high rainfall season means continued freshwater flows that keep the system connected for long periods and salinity levels consistently well below 100µS/cm for several months. This, combined with other factors such as low oxygen levels due to nutrient inflow, could cause fish to suffer skin lesions as their surface mucus membranes are altered due to stress. This theory is still being investigated (Bailey pers. comm.).

Runoff, bringing nutrients into the system and turning over existing bottom sediments in waterholes that are unmixed, can result in algal growth that depletes dissolved oxygen. This can cause fish kills, and stimulate algal growth (Bailey pers. comm.). Further research into the relationship between this phenomenon and the long term affects on the overall continued health of the aquatic systems is needed.

It was concluded that the sampled Lake Eyre Basin streams in Queensland had low visual clarity due to suspended clay sediments, with nutrients varying across the catchment. The Thomson, Barcoo, Cooper, and the mid Diamantina had higher phosphorus levels and lower nitrate levels than the Georgina and lower Diamantina. This trend has been reflected in the water quality sampling done in the lower Cooper (Bailey 2001), (EPA South Australia 1998). In general, instream nutrient levels measured at those sites were not seen to be at levels that would impact on the aquatic health or the use of water for stock and domestic purposes (Bailey pers. comm.).

Information from the above study revealed that monitoring across a vast catchment like the Lake Eyre Basin with highly variable flows and naturally variable water quality is a major task with considerable costs and logistical challenges (Bailey 2001). Given the system has such a wide range of ecosystem types, it may be more appropriate to establish selected sites to build on existing baseline information along with monitoring

of heavily impacted reaches where there are identified threatening processes. Data on condition and trend is needed to define or prioritise areas showing decline, and to determine cooperative management actions.

Water management and use

There are three broad water sources available in the region, surface water, shallow bores and deep bores from the Great Artesian Basin (GAB). The community utilises all three sources for a range of uses including stock and domestic purposes on pastoral enterprises, urban domestic and industrial use, and limited irrigation and aquaculture. Factors that determine which source is used include availability, access, water quality and cost of supply.

Surface water

Surface water was the first and obvious water source both to Aboriginal people and the first European settlers. This determined patterns of settlement, which centred on the larger permanent waterholes. There are very limited numbers of spring-fed surface waters in the region, some examples being the artesian spring pools and streams of the Aramac and Boulia areas.

Away from the major watercourses small dams were sunk using horse and bullock drawn scoops. During the late 1880s, many stone weirs known locally as 'overshots', were built using Chinese and Kanaka labour: some of these can still be seen. The legendary Combo Waterhole of Waltzing Matilda fame on the Diamantina River near Kynuna is a series of overshots. Larger weirs were later constructed for town water supply (e.g. Longreach, Isisford) or irrigation (Lloyd Jones Weir, Barcaldine).

Many of the towns in the region started as small settlements on the banks of a waterhole which provided for their modest needs at the risk of regular flooding. With the discovery of underground water, usually from the GAB, and the need to construct more permanent buildings, townships were relocated out of the flood zone. The main source of water was then from Great Artesian Basin (GAB) bores e.g. Winton. The majority of large townships in the region (with the exception of Longreach) still rely on the GAB for water.

Smaller settlements such as Ilfracombe, Isisford, Jundah, Stonehenge, Yaraka and Windorah rely principally on surface water from dams or waterholes. The largest centre in the region, Longreach draws water from weirs on the Thomson River. Longreach reverted to using river water in the mid 1900s, mainly to provide better quality water for gardens, keeping the bore water reticulated as a hot water supply. Despite having a dual water system most people in Longreach still rely on rainwater for drinking.

With only limited sites to construct on-stream storages in most of the catchment, and annual evaporation rates which exceed 3 metres, the potential use of surface water on a scale beyond stock and domestic supply in the region is limited. The town of Longreach has the largest annual urban extraction of surface water in the catchment at around 2000 ML. Despite this being only a small part of the mean annual flow of the river (less than 2%) there are very limited opportunities to store any more water instream. This combined with the irregular flow patterns of the river mean that careful management is needed when stream flow does not occur for a significant period. The longest recorded no flow period at Longreach since the gauging station was installed (1969) was 10 months in 2002/03. Anecdotal evidence is that in the 1900/02 drought the river did not run for

14 months (Coxon pers. comm.). The Cooper at Windorah did not flow for 21 months in the early 1950s (DNR 1997). The further development of centres like Longreach may depend on improving efficiencies of water use, recycling water and strategic use of GAB water.

The major use of surface water in the region is for stock watering purposes, either directly from a waterhole, pumping from a waterhole to storages, or from dams. Extent of surface water development for stock varies across the region, dependent on land type and availability of other water sources. As part of the water management planning process for Cooper Creek, a survey was undertaken of surface water storages in the catchment using remote sensing with some ground truthing. Some 10,100 dams were recorded with an estimated total capacity of 106,000 ML.

Irrigation enterprises in the region using significant amounts of surface water are few. While there are no major irrigation water users on the Georgina, on the Diamantina system there is a forage irrigation enterprise in the Corfield area, which also uses some GAB water, and on the Thomson where a landholder and the Longreach Pastoral College grow seasonal fodder adjacent to the Longreach Waterhole. The total annual extraction of surface water in the region for irrigation purposes is estimated to be less than 6,000 Ml (Wiggins pers. comm.).

In 1995 some 1,800 ha of crops were licensed to be irrigated from surface water in the region but only 5% was actually in place. In contrast some 900 ha was being irrigated with water from the GAB (DNR 1997). With the development of the Water Resource (Cooper Creek) Plan 2000 most of these surface water licences, which were not developed, were recovered.

In the mid 1990s proposals were put forward to establish a major irrigation farm to grow cotton at Currareva near Windorah. Significant community concerns about the impact of water extraction on environmental flows impacting on both floodplain grazing and the environment led to the commencement of a water management planning process for the Cooper Creek catchment, a first for the Lake Eyre Basin in Queensland.

Surface water extraction from watercourses in the Cooper catchment is subject to the provisions of the Water Act 2000 and the Water Resource (Cooper Creek) Plan 2000. This plan is based on the environmental principles of maintaining variable and seasonal water flow patterns and maintaining water resources for ecologically significant areas. The plan also recognises that beneficial flooding in the plan area contributes significantly to pastoral activities and floodplain ecosystems.

The plan provides for stock, domestic, town and emergency water supply, construction, drilling and road building. Water for any other purpose, including irrigation is not allowed unless the works were in place and operating before May 1998.

The plan also limits in-stream storage (as defined by the Water Act 2000) to 200 Ml for purposes other than town water supply and limits use of underground water where the proposed bore is in an area hydraulically connected to a watercourse or in a defined recharge area of the GAB.

Overland flow (water not in a watercourse as defined by the Water Act 2000) is not covered by the Water Resource (Cooper Creek) Plan 2000. There have been concerns expressed by members of the community (Cooper's Creek Catchment Committee) that overland flow should be considered in the plan. At present it is the Minister's decision under Section 38 (4) of the act to consider whether grounds exist to make regulation of

overland flow necessary. This would require a review and subsequent amendment of the Water Resource Plan, which normally would be reviewed every 10 years.

A Water Resource Plan for the Georgina and Diamantina was approved in August 2004. The Government, in consultation with the community, is currently developing a Resource Operations Plan for these catchments.

Shallow bores

Several areas of the catchment rely on shallow bores to provide the main water supply for stock and some domestic use. There are more than 6,000 shallow bores in the region (DNR 1997). Although such bores are found throughout the region they can be broadly placed in three groups.

The first is the Winton Mackunda formation which is generally tapped into in the area between Winton and the Blackall/Yaraka district. These bores are typically less than 500 metres deep and have highly variable, often salty, water quality. Yields are often low and declining which has led landholders to reconsider drilling GAB bores. These were not previously considered due to the depth required (typically 1,100 metres) and the fact that there was limited prospect of getting an artesian flow. Landholders are now reconsidering their options for water supply: these may include sharing the cost of a GAB bore between properties.

The Desert Uplands area also depends on shallow bores, some of which tap into the recharge beds of the GAB. Except for bores which tap the Doncaster formation, yields are usually good with water quality suitable for most purposes (Wiggins pers. comm.).

A large area in the northwest of the region is not underlain by the GAB and relies on fractured rock beds for underground water. Water quality is usually good but may be high in carbonates from the limestone common in the area. A number of town communities such as Camooweal, Urandangi, and Dajarra depend on this water source as does the Phosphate Hill mine.

Great Artesian Basin

The Great Artesian Basin (GAB) underlies 22% of Australia's land area including most of the DCQ region. It is the largest artesian basin in the world. The groundwater of the GAB is a valuable resource of national significance with much of eastern inland Australia depending on it. It supports primary production valued at $2 billion annually and a population of more than 100,000 people, mostly in small communities and homesteads. There are also substantial environmental and cultural assets dependant on, or affected by, the distribution and use of its groundwater.

More than 800 bores have been drilled into the GAB aquifers in the DCQ region. When first drilled, most of these bores flowed freely at flow rates up to 80 litres per second (l/s), but in general most now flow at rates less than 10 l/s due to the large number tapping the aquifers (DNR 1997).

The GAB provides the most reliable water source in the region, underlying all but the northwest part. There are seven distinct aquifers in the GAB which can be tapped at quite shallow depths in the east of the DCQ region where the first bores were drilled in the 1880s. Deeper bores (1,000 metres or more) are generally found to the south west while the deepest GAB sediments that underlie the region are 2,200 metres deep to the south west of Windorah (DNR 1997).

Water quality varies considerably; depending on formation and depth. Generally the water is cooler and better quality in the east and progressively gets hotter to the southwest. Bores around Birdsville have temperatures up to 100°C.

The sustainable use of groundwater is threatened by aging and inappropriate water extraction and distribution infrastructure. Concerns about the decline in pressure in many areas coupled with a need to reduce water wastage and address other sustainability and environmental issues has led to a whole of GAB approach to management through the establishment of partnerships between the states and Commonwealth. Significant public investments have been required to encourage the necessary private investments in modernising this infrastructure.

The key to improved natural resource management in the Great Artesian Basin is the ability to control the outflows through rehabilitation of bores, and replacement of open bore drains with more water-efficient, piped, reticulation systems and troughs.

Many bores flow into open bore drains, which can be tens of kilometres long and serve more than one property. There are still an estimated 30,000 kms or more of open drains across the GAB with up to 95% of the water in these lost through evaporation and seepage (GAB leaflet). Bore drains are difficult to maintain and provide an ideal habitat for feral animals and weeds.

Although GAB bores drilled since 1954 have been required to be controlled by head works with water distributed in piping, there are still a large number of older bores that flow freely, often without any head works. Many of these have badly corroded casing which require major rehabilitation work to control the flow. In some cases this means plugging the bore and drilling a replacement.

The Great Artesian Basin Rehabilitation Project (GABRP) to rehabilitate uncontrolled flowing bores commenced in 1989. The GABRP rehabilitated more than 340 bores across the Queensland portion of the Basin saving more than 44,100 megalitres per annum (Ml/a). The Bore Drain Replacement Project operated between 1998 and 2001 and was an NHT funded program aimed at complementing the rehabilitation project by replacing bore drains with pipe reticulation systems. Over this period, across the Queensland portion of the GAB, 58 piping schemes were installed with over 29,800 Ml/a in water savings. About 15 of these schemes were within the DCQ region.

The Great Artesian Basin Sustainability Initiative

Currently, the Great Artesian Basin Sustainability Initiative (GABSI) is the program that provides State and Commonwealth funding to rehabilitate and pipe the bores within the Great Artesian Basin. GABSI operates under the Strategic Management Plan, which has a 15-year lifespan with an ultimate goal of capping and piping all free flowing bores by 2015.

The aim of GABSI is to promote and facilitate the establishment of sustainable groundwater management systems for the Great Artesian Basin. This will be carried out through strategic investments in groundwater infrastructure renewal and related activities in natural resource management.

GABSI commenced in 1999 and, up until July 2002, there were 70 bores rehabilitated and piped with 21,800 Ml/a water saved and 1,747 km of drain decommissioned. An additional benefit is the removal of the water source for noxious weeds such as prickly acacia (*Acacia nilotica*) through the elimination of bore drains. Another flow-on is the

reduction of feral animal habitat, which in turn reduces numbers of disease carrying and predatory feral animals. The program has also succeeded in providing clean domestic water supplies to some landholders for the first time.

The vision for groundwater management in the Great Artesian Basin is for the establishment of a natural resource management system which is:

- Self-sustaining – capable of providing sound management without intervention from external parties;
- Self-adjusting – capable of changing management arrangements as the need dictates;
- Responsible – the rights and responsibilities of all stakeholders are clear, agreed, and effective;
- Informed – with adequate monitoring of pressures, flows and bore condition to assist management;

and where:

- Water is withdrawn from the Basin in a controlled and sustainable fashion, with no unacceptable impacts on other users, natural outflows, water-remote ecosystems or heritage values, and with options maintained for future uses and users;
- Water is appropriately valued and used efficiently, supported by market-based mechanisms/signals and regulatory systems as appropriate;
- Entitlements to water, including the protection of stock and domestic supplies, are clearly specified;
- The environment is recognised as a legitimate user of water;
- Water is allocated and used to generate the highest community benefits, such that:
    - The needs of all potential groundwater users are balanced;
    - There is opportunity for, and mechanisms to facilitate, movement of water to higher value uses from lower value uses.
- Groundwater management is integrated with other aspects of natural resource and environmental management, particularly where the use and distribution of groundwater affects other natural resources.

Basin-wide objectives for the Initiative are:

(a) Partial recovery of artesian groundwater pressure consistent with agreed pressure targets;

(b) Widespread positive attitudes, acceptance of responsibility, and adoption of sustainable management practices by water users for the groundwater resources of the Basin to enhance the long-term sustainability of the Basin for all uses;

(c) Improved understanding and awareness in the Basin community of natural resource management issues, including the environment, in the Basin;

(d) Development and implementation of institutional arrangements to encourage the sustainable use of the natural resources of the Basin;

(e) Promotion of partnerships between government, industry and the community in the management and use of the groundwater resources of the Basin including cross-border issues.

Biodiversity

What is biodiversity?

Biological diversity or biodiversity is the variety of life and their interactions in the natural environment, including ecosystems and their processes. "Biodiversity delivers a wide variety of free support services needed by civilization." (Beattie and Ehrlich 2001).

Natural biodiversity provides ecosystems and landscapes with resilience against extreme (local) events, as well as providing useful products and critical services such as pollution breakdown, pest management, and nutrient cycling. It has been traditionally considered on the genetic, species and ecosystem level. In recognition of the complex interactions that occur across a landscape, biodiversity is now being considered at the landscape level (Boulter et al. 2000).

The challenge is incorporating sustainability of biodiversity with sustainable property management, and ensuring economic viability for the landholder. The concept of natural capital needs to be recognised and economically valued. At present we discount the value of ecosystems and the products or services they provide because most sit outside the market economy (Beattie & Ehrlich 2001) (Yencken & Wilkinson 2001), or are not 'seen', known or understood.

Environmental values

The DCQ region is rich in natural assets and these have shaped the human and natural community's way of life and underpin local industries. Functioning of vegetation and animal populations in dryland river systems have a boom and bust cycle. The integrity of most of the area is still in place, reflecting the opportunity for grazing production to positively co-exist with the underlying natural values of the area.

Seven bioregions are found in the DCQ planning area: Mitchell Grass Downs, Channel Country, Desert Uplands[3], and lesser parts of the Simpson/Strzelecki Dunefields, Mount Isa Inlier, Brigalow Belt South, and Mulga Lands (see Fig. 5).

The eastern boundary of the region is an important transition area between the Mitchell Grass Downs Bioregion, Brigalow Belt South, Mulga Lands, and Desert Uplands Bioregions. Areas significant for mound springs occur in a band from Barcaldine up to Torrens Creek and from Julia Creek west in the transition area between the Northwest boundary of the Mitchell Grass Downs Bioregion and the Gulf Plains Bioregion (Fensham pers. comm.).

[3] In October 2003, the Desert Uplands was declared one of Australia's 15 'biodiversity hotspots. Water enters the Great Artesian Basin aquifers here and important artesian spring complexes contain endemic plants, snails and fish including the Edgbaston goby (*Chlamydogobius squamigenus*) and the plant salt pipewort (*Eriocaulon carsonii*). Ecologically and geologically important wetlands include Lake Buchanan and Lake Galilee. The Desert Uplands has 22 rare or threatened animals, including the masked owl (*Tyto novaehollandiae*) and the Julia Creek dunnart (*Sminthopsis douglasi*), and 29 rare or threatened plants.

Within the DCQ area there are 23 (17 Channel Country, 2 Mitchell Grass Downs, 3 Desert Uplands, 1 Mulga Lands) wetlands of national importance[4] that have been listed because of their uniqueness or value to biodiversity conservation (DEH 2003). In terms of area of inundation and condition, the desert wetlands complex of the Channel Country is outstanding in the global context (R. Jaensch, Wetlands International, pers. comm.). Lake Yamma Yamma, a fresh water body supplied by floods of the Cooper Creek system, is Queensland's largest inland ephemeral lake and vast, flood-dependent swamp networks are situated on the Georgina, Diamantina and Cooper floodplains. Other wetland types listed include shallow drainage lines, artesian mound springs, waterholes, overflow swamps and flood-outs. The portions of the Mitchell Grass Downs and Mulga Lands Bioregions within the Desert Channels region support relatively small areas of wetland and their conservation values have not been fully documented.

The intermittently flooded, shallow swamps and lake systems throughout the region provide rich habitat for waterbirds including migratory shorebirds. Several million waterbirds may gather in the Channel Country during extensive floods (Costelloe et al. 2004), rivalling any other wetland system in Australia. Spectacular concentrations of pink-eared ducks *(Malacorhynchus membranaceus)* and other waterbirds later occur in terminal lakes once the floodplains have dried out. The wetlands are nationally and internationally important for breeding waterbirds, supporting large colonies of pelicans, ibises, herons, spoonbills, cormorants and terns, and substantial breeding by ducks (White, 2001; Australian Natural Resources Atlas, 2002, Costelloe et al. 2004). The grasslands also form a major non-breeding ground for some migratory birds, such as the little curlew *(Numenius minutus)* and oriental pratincole *(Glareola maldivarum)* while other migrants such as sharp-tailed sandpiper *(Calidris acuminata)* use drying wetlands during northward migration to Asian breeding grounds (Australian Natural Resources Atlas 2002, Barter & Harris 2002, R. Jaensch pers. comm.).

The cracking clay soils support a very high diversity of large elapid snakes (front-fanged, venomous species), several endemic reptile species, and very high densities of a number of grassland birds and small marsupials. Many distinctive species are found only in the grasslands, including Collett's snake *(Pseudechis colletti)*, the Julia Creek dunnart *(Sminthopsis douglasi)*, long-tailed planigale *(Planigale ingrami)* and the skink *(Ctenotus schevilli)*.

The DCQ region has important waterholes and wetlands that are home to a number of fish and turtle species, several with restricted distributions – Emmott's short-necked turtle *(Emydura macquarii emmotti)*, Cooper Creek catfish *(Neosiluroides cooperensis)*, Lake Eyre yellowbelly *(Macquaria* new species), and the endangered Edgbaston goby *(Chlamydogobius squamigenus)*, Elizabeth Springs goby *(Chlamydogobius micropterus)*, Aramac Springs hardy head *(Craterocephalus* new species), and *mogurndas*. Several new species have still to be fully described including a hybrid carp gudgeon and a hybrid Barcoo/Welch's grunter. Some of these species spread widely during river flow events but become restricted to important wetland refugia during dry times. Others like the gobies are entirely restricted to unique mound spring habitats. These locations are critical to the survival of these aquatic species. Large changes in water flows or water quality, and the translocation of species, can pose a threat to native aquatic populations.

[4] See Appendix 3.

Conservation values in DCQ's bioregions are, overall, in reasonable condition, though trends in some ecosystems indicate decline (Sattler 2002). All bioregions that occur in the DCQ area have a number of 'Of Concern' Regional Ecosystems, under the Vegetation Management Act 1999. Three of these bioregions, Mulga Lands, Brigalow Belt South, and Desert Uplands, have a number of 'Endangered' Regional Ecosystems (REs) as well. (Mulga Lands and Desert Uplands each have 2 endangered REs and the Brigalow Belt South has 29). These endangered regional ecosystems occur on the eastern boundary of the planning area. Tree clearing, more extensive in the eastern part of the region, has caused fragmentation of ecosystems. There has been little clearing in the Channel Country bioregion. In the more fragmented eastern area it is still possible to maintain habitat values through east west and north south linkages at a landscape level. Data on condition and trend is needed to define or prioritise areas showing decline, and to determine cooperative management actions.

From fauna and flora surveys, the total number of species recorded to date for the DCQ area is 2,686 plants and 26 fungi, and 712 animals – comprising 98 mammals, 361 birds, 188 reptiles, 37 amphibians, 26 fish and an unknown number of invertebrates.

Rare & threatened fauna and flora

Some parts of the region are significant as habitat for rare and threatened plant and animal species, and for other species of conservation concern.

Some 55 animals (14 mammals, 24 birds, 13 reptiles, 3 fish, 1 amphibians) and 67 plants in the region are listed as 'of high nature conservation value' under the *Nature Conservation Act 1992* [5]. These are significant for various reasons: - endangered, vulnerable, rare conservation status, range extensions or new species. There has been massive contraction in the distribution of mammals in arid and semi-arid parts of the continent, particularly the small to medium, critical weight range species (Sattler & Creighton 2002).

There are a total of 21 animals and 19 plants in the region listed under *The Environment Protection and Biodiversity Conservation Act 1999* [5] - 10 mammals, 6 birds, 1 reptile, 4 fish, and no amphibians, insects, or fungi.

Some common species are considered to be of conservation concern, such as some international migratory birds listed under international conventions like the *Japan Australia Migratory Birds Agreement* or the *China Australia Migratory Birds Agreement*. Protection of habitat for these migratory species is crucial in considering conservation planning.

For the majority of the significant fauna and flora species of the planning area it is difficult, given current knowledge, to evaluate the protection provided to this component of biodiversity by current plans. Targeted management planning is needed to include those species requiring recovery plans, and additional investment is needed to better understand the spatial aspects of species distribution and their specific ecosystem and habitat needs. As our understanding of the habitat requirements of these species improves it may be necessary to provide protection from threatening processes. In some areas this may simply be a voluntary change in land management practices.

[5] See Apendix 2.

Threatening processes

Major threats to terrestrial biodiversity in the DCQ region include total grazing pressure, feral predators, exotic weed species, vegetation clearing and associated introduction of exotic pasture, mainly in the eastern parts of the region (Sattler 2002; Sattler & Williams 1999). Threats to wetlands and mound springs include total grazing pressure in riparian areas, changes in hydrology, invasion by exotic species and changes to water quality and quantity.

Threats to aquatic biodiversity are covered elsewhere in this paper under Stream Ecology. It should be noted that aquatic biodiversity in the region is dependent on the protection of the values of wetlands and riparian areas. These areas have a range of benefits to water quality as well as terrestrial and aquatic biodiversity. Any threat to these areas is a threat to the survival of aquatic species.

Riparian vegetation and wetlands are regarded as high importance for the maintenance of biodiversity at a local and regional level, in terms of wildlife corridors and habitat (much of it being mapped by the Environmental Protection Agency as 'Of Concern' biodiversity status). They should be actively managed to minimise these threats and ensure that their condition is improving.

Land and water degradation on the common environments is an issue surrounding rural towns. Activities that have an impact are associated with tourism seasonally, and local towns-peoples' recreational use of the common areas, from motorbike riding, grazing, camping, and firewood collection, to littering and toilet wastes in the riverine areas. Another opportunity for conservation issues being balanced with local use has arisen with the Longreach Town Common Draft Management Plan being developed by the community and released in 2003.

Because of the extensive nature of the pastoral industry and the considerable variation of grazing pressure and associated impacts between properties, grazing management practices will continue to be one of the most important influences on conservation. Grazing pressure is also influenced by increased numbers of macropods and feral animals, particularly pigs, rabbits, camels, and donkeys. The maintenance of biodiversity is perceived as an essential component of property management, with on-property conservation carried out as part of normal day-to-day operations (White, 2001; Draft Regional Vegetation Management Plan - Bailey 2003).

Through voluntary nature conservation covenants in the form of nature refuges, landholders can demonstrate their long-term commitment to manage significant, high conservation value areas for their biodiversity values as well as for production. In some cases there may be an added benefit of increased security of tenure.

Individual families or corporations manage extensive areas of land in the DCQ region. The environmental knowledge of these managers is critical to the maintenance of biodiversity in the region. One strategy incorporating this knowledge is the Land for Wildlife voluntary accreditation project, managed jointly by QPWS and the Lake Eyre Basin Coordinating Group. In 2002, its first year of operation, Land for Wildlife has accredited 10 managers and 135,000 hectares of land.

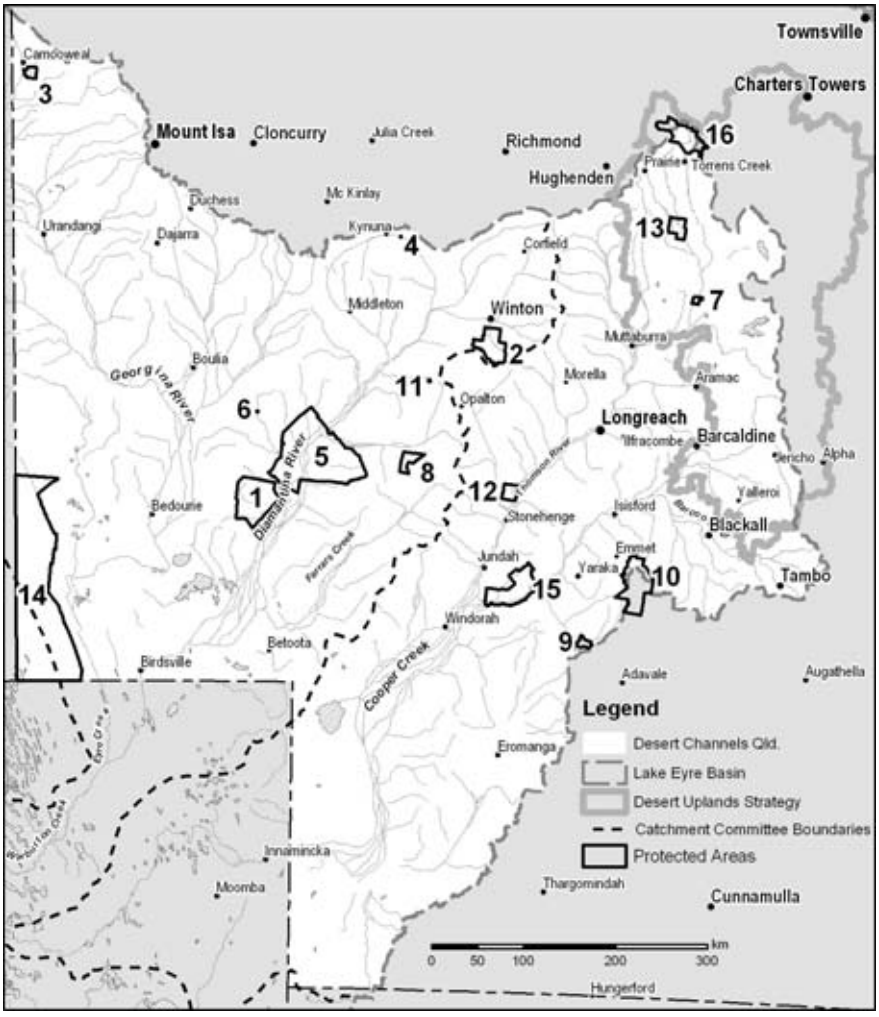
Another project is the Desert Uplands' market-based incentives program which is attempting to develop an economic incentive for landholders who manage their property as part of the wider landscape. Other projects in the Desert Uplands include On-ground Nature Conservation, devolved grants and the East – West Fauna Corridor.

Protected areas

To contribute to the conservation of natural and cultural heritage the state has established and manages a number of state owned areas that are dedicated, to varying degrees, to the protection of biodiversity. Parks dedicated under the Nature Conservation Act 1992 (NCA) are the cornerstones of an integrated strategy to conserve areas of high nature conservation value. Reserves for Environmental Purposes, Camping and Water Reserves and Stock Routes dedicated under the Land Act 1994 also contribute to protecting biodiversity.

The region contains all of Astrebla, Bladensburg, Camooweal Caves, Diamantina, Lochern, Forest Den, Goneaway, Hell Hole Gorge, Moorinya, Simpson Desert and Welford National Parks, and Elizabeth Springs, Lark Quarry and Combo Waterhole Conservation Parks. Other National Parks that straddle the DCQ boundary are Idalia and White Mountains National Parks. Total area of park estate in the region is 21,300 km2 or 4.2% of the region.

Figure 5: Protected areas



Key: Astrebla NP = 1; Bladensburg NP = 2; Camooweal Caves NP = 3; Combo Waterhole CP = 4; Diamantina NP = 5; Elizabeth Springs CP = 6; Forest Den NP = 7; Goneaway NP = 8; Hell Hole Gorge NP = 9; Idalia NP = 10; Lark Quarry CP = 11; Lochern NP =12; Moorinya NP = 13; Simpson Desert NP = 14; Welford NP = 15; White Mountains NP = 16

These reserves, managed by the Queensland Parks and Wildlife Service (QPWS), help protect biodiversity, but nearly all of the 'Of Concern' regional ecosystems fall outside protected areas and are not comprehensively covered (see Vegetation Management).

Knowledge gaps

To maintain and enhance biodiversity and ecological processes, major threats, along with key areas for conservation (including recovery plans), need to be identified and managed across all bioregions and artificial borders. Specific packages focusing on bioregions should include incentives, duty of care and cross compliance measures linked to improved policy and legislative frameworks (Sattler & Creighton 2002).

Incentives and a strategic approach to support management by landholders is an essential first step. Other priorities include completing the Regional Ecosystem mapping for this region (much of it is still draft) and reviewing wetland mapping. Ecological and life history data, and systematic surveys to direct more cost-effective investment in biodiversity conservation activities, are the major information gaps for the Desert Channels Queensland planning region. Consequently, there is limited baseline data available to allow land managers to plan for biodiversity conservation in balance with viable, sustainable property management.

Commercial Kangaroo Harvest

High kangaroo numbers and their management are a major concern across the DCQ region. Total grazing pressure from stock and kangaroos causes great difficulty in being able to effectively spell country.

Table 1: Damage mitigation permits

QPWS (Longreach district) June 2002-June 2003	
red kangaroo *(Macropus rufus)*	4,190
eastern grey *(M. giganteus)*	11,182
wallaroo *(M. robustus)*	17,091

The four species listed under commercial harvest quotas in Queensland are the red kangaroo, eastern grey kangaroo, euro/wallaroo and the whiptail wallaby *(M. parryi)*.

Table 2: Queensland macropod harvest numbers

Year	2004		2003		2002	
Species	Quota	Harvest	Quota	Harvest	Quota	Harvest
red	663,599	N/A	1,011,038	469,038	1,115,226	528,820
eastern grey	1,291,142	N/A	2,140,574	1,141,455	2,197,612	1,106,416
wallaroo	334,440	N/A	313,962	324,285	501,509	217,485
whiptail	0	N/A	0	0	25,000	190
Total	2,289,181	N/A	6,552,194	1,934,778	3,839,347	1,852,911

Kangaroo management is largely the responsibility of State and Territory governments. The Commonwealth becomes involved, through its wildlife trade legislation, when the States want to commercially export kangaroo products.

Under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act), the export of kangaroo products can only be approved under the Act. The kangaroo industry is the largest native animal industry in Australia. The total value of the kangaroo industry to Australia is hard to estimate, but is likely to be in the vicinity of $100 million dollars[6].

Commercial harvest (cull) figures are set at about 16% of the estimated population and for a given year rarely reach the approved quota. The numbers culled are directly linked to market demand and the harvesting capacity of the industry. In the last five years the numbers of kangaroos harvested have been on average 30-50% lower than the annual quotas. The states use a best practice quota setting system, based on the sustainable proportion of population size, and take into account many factors including kangaroo mortality and climatic conditions. Market forces are not taken into account in the setting of kangaroo harvest quotas (Environment Australia Website, 2003).

Vegetation management

The management of native woody vegetation is a significant issue for areas in the east of the region. It is in these areas that clearing of acacia and eucalypt woodlands has occurred to allow pasture development, often using improved grasses such as buffel *(Cenchrus ciliaris)*.

The two major bioregions in the eastern part of the region, the Mitchell grass Downs and the Desert Uplands have been the focus of clearing. In the Desert Uplands around 12% has been cleared (Morgan et al. 2002). It is estimated that approximately 3.2% of the Desert Channels Queensland region has been cleared as of 1999 (Rodgerson pers. comm.). Only minor areas of the Channel Country, North West Highlands and the North West Mitchell Grass Downs have been cleared. Clearing in the Mulga Lands bioregion has been mainly limited to fodder harvesting of mulga. Fodder permits do not allow development of improved pastures and the mulga must be allowed to grow back. The small areas of the Brigalow Belt in the region have been significantly cleared and have limited potential for further development.

Rates of clearing as measured by the Statewide Landcover and Trees Study (SLATS) show that in the period 1999-2001 a significant part of the clearing in the state occurred in the DCQ bioregions. The Desert Uplands bioregion and the Mitchell Grass Downs bioregion had 10.7% and 8.0% respectively of the total area cleared in Queensland and were the third and fourth highest bioregions for clearing during that period (NR&M 2003). This may reflect a focus on eastern parts of the DCQ region for clearing due to its relatively undeveloped state compared with adjacent bioregions such as the Brigalow Belt. This clearing was mostly eucalypt woodland in the Desert Uplands and silver gidgee in the Isisford/Yaraka area of the Mitchell Grass Downs.

The approach to mapping different vegetation types is based on Regional Ecosystems (REs). This method combines land zones (e.g. undulating clay downs, alluvial plains, plateaus, scarps and hills) with vegetation types to produce a unique RE description. In

[6] A signed declaration of the current Queensland approved management plan can be found on the Environment Australia website (Environment Australia Website 2003).

the DCQ region, each RE has been assessed for vegetation management status in terms of percentage retained (remnant) in the region. These are:

- Endangered (less than 10% remnant)
- Of Concern (10-30% remnant)
- Not of Concern (greater than 30% remnant)

Certified RE mapping is only available for that part of the DCQ region from the eastern boundary to just west of Longreach. In the area mapped (10,988,628 ha or 21.4% of the region) the relative amounts of each ecosystem status as of mid 2003 (Rodgerson pers. comm.) is shown in the following table.

Table 3: Clearing and RE status as % of region

Status	% of area of DCQ region
Cleared	13.3%
Endangered (less than 10% remnant)	0.08%
Of Concern (10-30% remnant)	3.13%
Not of Concern (greater than 30% remnant)	83.49%

The estimated amount of clearing over the whole DCQ region, using 1999 imagery, is approximately 3.2% (Rodgerson pers. comm.).

Regional ecosystems have also been assessed for conservation status by EPA, based on a range of other criteria which also include threats from weed invasion, grazing, altered fire regimes, area of the RE in the landscape etc. (see Biodiversity).

The focus of clearing has been in the Barcoo catchment where, in a belt from Yaraka through to Blackall, significant areas of silver gidgee *(Acacia cambagei)* have been cleared. Further upstream, in the Alice and Jordan tributaries, there has been clearing of large areas of eucalypt woodland, brigalow *(Acacia harpophylla)* and gidgee scrubs. At the headwaters of the Barcoo there is a small area of the catchment in the Southern Brigalow Belt bioregion where brigalow has been cleared (QLD Herbarium mapping).

In the Thomson catchment gidgee woodland has been cleared in the areas west of Longreach in the Vergemont, Katherine and Darr tributaries. Areas of gidgee and eucalypt woodlands have been cleared in the Tower Hill and Cornish Creek tributaries. Smaller areas of Black Gidgee *(Acacia argyrodendron)* woodland have been cleared along the Torrens Creek.

Clearing in the Diamantina catchment has been limited to areas of gidgee west and south of Winton. There has been no significant clearing in the Georgina catchment. An emerging vegetation management issue in the Channel Country is the burning of lignum swamp communities to facilitate mustering and increase pasture extent. There is no information available on the impacts of this practice on floodplain biodiversity.

Clearing of vegetation on freehold land is controlled by the *Vegetation Management Act 1999*, and on leasehold land by the *Land Act 1994*. The Regional Vegetation Management Planning (RVMP) process of 2001-02 involved a wide range of stakeholders who were

brought together to prepare Regional Vegetation Management Plans for most of the bioregions of Queensland. Eight plans were developed to cover the DCQ region:

- Desert Uplands North
- Desert Uplands South
- North-western Mitchell Grass Downs
- South-eastern Mitchell Grass Downs
- Channel Country
- Mulga Lands
- Brigalow Belt South
- North West Highlands

These plans took into account the legislation and policy that covers vegetation management on both leasehold and freehold land at that time. Factors such as conservation status, threatening processes, productivity, land degradation and equity were considered in setting regional targets including proportions of the region to be retained as remnant vegetation. The plans also included recommendations for vegetation management in all of the REs in the region, including techniques for clearing (if appropriate), or other vegetation management (such as thinning or use of fire).

With the development of the Vegetation Management Framework and the passing of the *Vegetation Management and Other Legislation Amendment Act 2004* these plans no longer have legal status. Nonetheless much of the information contained in these plans is still relevant and has been used in developing regional codes for the ongoing management of vegetation beyond the cessation of broadscale tree clearing at the end of 2006.

Most of the RVMPs that cover the DCQ region have highlighted issues to do with either vegetation thickening or encroachment. Thickening is where woody regrowth has filled in REs that were typically more open. Examples in the region include acacia woodlands in the Mitchell Grass Downs and Channel Country and eucalypt woodlands in the Desert Uplands. These were once open woodlands and have been significantly altered to thickets of regrowth, which reduces pasture plant cover and in some cases kills the older trees. Causes put forward for these changes include grazing patterns and altered fire regimes. The community has identified a need for access to better information to manage this problem.

Forestry

Although the DCQ region is generally viewed as being west of the traditional forestry areas of Queensland there has been a long history of timber getting, which continues to this day. Early settlers cut timber for dwellings and firewood. The first substantial industrial enterprises in the region were wool scours, which were driven by wood-fired boilers. The large ash pile that can still be seen at the site of the Ilfracombe wool scour is testament to the amount of timber (mostly gidgee) provided by wood cutting teams (Forrest 1988).

More recently timber getting has been restricted to cutting gidgee or boree fence posts with some interest shown in providing high-value craft timbers. Some 39 species of local timber are regarded as having potential for woodturning (Fairbairn 1999). The

Desert Uplands Strategy has supported a number of projects aimed at developing a sustainable industry harvesting high-value timbers, as has Outback Revival.

The only significant sawmilling operation in the region is a cypress pine mill operating at Tambo. This mill, which commenced operation in 2001, has a projected life of at least 10 years with a current annual log allocation of 10,000 cubic metres. Most of this timber will be harvested from leasehold land and Timber Reserves outside of the DCQ region (Verden pers com.).

Commercial sandalwood is found through much of region and has been harvested intermittently since early settlement. The price of sandalwood has fluctuated considerably during this period. Concerns have been raised within the community about the sustainability of this industry which largely harvests timber from riparian areas.

Pastures

Six native vegetation types exist in the region. Mitchell grass, spinifex grass, bluegrass, Channel Country, mulga pasture and gidgee pasture communities. Pasture communities in order of area within western Queensland are shown in the following table (Phelps et al. 2003).

Table 4: Pasture communities

Pasture community	Area ('000,000 hectares)
Mitchell grassland (*Astrebla* spp)	30
Spinifex (*Triodia* spp and *Plectrachne* spp) pastures	21.2
Mulga *(Acacia aneura)* woodland	19.1
Channel Country floodplain pastures	5.4
Gidyea *(A. cambagei)* and Georgina gidyea *(A. georginae)* woodland	4.8

Mitchell grass (*Astrebla* spp.) is the most extensive and valuable of Queensland's inland pastures and occurs as tussock grasslands. These grasses grow on heavy textured clay soils, 90% being cracking clay with the remainder fertile duplex soils (sandy surface, clay at depth). They have high livestock carrying capacity compared to other native species, are long-lived and drought-resistant. Carrying capacity rates vary with seasonal conditions and range from 1 to 2 hectares per sheep, or 10 to 15 hectares per beast[7]. Short-term Channel Country grazing after good rainfall can produce carrying rates of 1.5 to 2 hectares per beast (Markey pers. comm.).

Improved pastures of introduced buffel grass (*Cenchrus* spp.) have been established in the east of the region, usually where gidgee scrubs or eucalypt woodlands have been cleared. Not all areas cleared are suitable for the establishment of buffel, which does not tolerate flooding and does not establish on some clay soils. Landholders clearing stony gidgee woodlands in the region rely more on native pastures and herbage.

[7] The conversion of stocking rates from sheep to cattle varies according to pasture type

Spinifex plants are dense, slow-growing tussock-forming perennial grasses. These plants are usually green for much of the year and seed in response to rain. In low-fertility soils they often make up the major pasture species available to grazing animals. Gummy spinifex *(Triodia pungens)* forms an important pasture in the Desert Uplands. Cattle predominate in this region and stocking rates vary from 20-30 ha/beast depending on the season (Markey pers comm.).

Significant areas of the region, mostly in the Channel Country, are subject to flooding. Estimates of the area of floodplain vary depending on definition. The Bureau of Investigation 1947 study estimated that some 40,000 square kilometres could be flooded in the Georgina, Diamantina, Cooper and Bulloo systems. The 1990 flood alone was estimated to have covered some 18,600 square kilometres between Windorah and Nappa Merrie (DNR 1997).

The floodplain areas produce abundant pasture growth when floodwaters recede and are dominated by shallow-rooted annual herbage, notably Cooper clover *(Trigonix suavissima)* and grass species, and support deep-rooted perennial shrub species such as Queensland bluebush *(Chenopodium auricomum)* and Lignum *(Muehlenbeckia florulenta)*. Both localised rainfall and floods influence pasture production on the floodplains. Floods can result from rainfall in the immediate area or, typically, from rainfall many hundreds of kilometres away. Timing of floods with respect to seasonal temperature has a major bearing on the nature and composition of resulting pasture. Local rainfall can also increase the growing period of pastures on the floodplains as the floodwaters recede. Pasture response to these natural irrigation areas can be substantial both in area and amount, and has been utilised by a variety of grazing enterprises for over 130 years. These areas are the backbone on which breeding and growing-out operations of the large pastoral companies are based and are also important for smaller, locally based graziers (Phelps et al. 2003).

Away from the channels there are areas of Mitchell grass and seasonal herbage pastures. The latter is often found in stony country where runoff from small rains can result in reasonable pasture growth in depressions. Dunes scattered through the Channel Country, and on the fringes of the Simpson Desert to the west, can provide reasonable light grass and herbage in season but carrying capacity is low.

Concerns about the long-term sustainability of both native and introduced pastures in the region have been raised in recent years, particularly when pastures do not recover as well as expected after drought. A recent DPI research proposal (yet to be funded) seeks to look at the impact of drought on the pastures of the Mitchell Grass Downs and the spinifex in the Desert Uplands. Some Mitchell grass and spinifex pastures have failed to respond to reasonable rains after the drought of 2002 with only low yielding annual forbs and grasses resulting (Phelps pers. comm.). This problem has also affected buffel pastures throughout the region. In what was well-established Mitchell and buffel pastures, less than half the plants (and quite often much less) recovered when what should have been drought-breaking rains fell in parts of the region in early 2003.

Spinifex pastures which rely on regrowth from runners rather than seed (most seed is infertile) are particularly vulnerable to attack by a native grasshopper in many parts of the Desert Uplands. There is some evidence that fire regime may have some bearing on the incidence of attack from this insect (House pers. comm.).

Buffel pastures in the region were significantly impacted by the 2002 drought with many areas showing less than 50% recovery in well-established pastures. There are

concerns that recovery from seed may be slow due to nutrient run down in such pastures. Decline in quality of buffel pastures, which may be caused by nutrient run-down has been recognised in several areas of the region.

The relationship between pasture type, condition and seasonal outlook is probably one of the most significant natural resource management issues for the grazing industry in the region. Understanding the long-term capacity of the land to be productive (safe carrying capacity over decades) combined with an appreciation of the short-term outlook (feed budgeting within a season) are the keys to sustainable grazing enterprises. These issues are covered by the Grazing Land Management series of workshops developed by DPI and Meat and Livestock Australia (MLA). A manual and workshops for the Mitchell Grass Downs have been developed and recently tested. It is hoped that other parts of the region will, in time, benefit from similar workshops which cover a wide range of natural resource management issues in addition to pasture management, use of fire, control of weeds and protection of biodiversity.

Safe carrying capacity work has been undertaken in the Desert Uplands and Mitchell Grass Downs. This has involved testing the South-West Safe Carrying Capacity Model developed by DPI for the Mulga Lands. In the Desert Uplands' Carrying Capacity project (funded by NHT) the model was refined to take into account differing pasture to tree relationships, response to rainfall and influence of developed pastures. The refined model was seen as reasonably predicting safe carrying capacity in a significant part of the Desert Uplands but further testing and refinement of the model was required (Kiernan 2001). Further work in the Desert Uplands commenced in 2003 in an MLA funded project using the GRASP (Grass Production) model for pasture growth. This model is seen as being better adapted to the pasture/climate relationship of the region.

Pest management

Pest animals and plants are one of the major natural resource management issues for the DCQ region. Pest plant infestations and threats are centred on the north and east whilst feral animal impacts are felt more widely.

Control of feral animals and weeds as defined by the *Land Protection (Pest and Stock Route Management) Act 2002* is primarily the responsibility of the landholder. Failure to do so can result in penalties under the Act as well as contravention of lease conditions under the *Land Act 1994*. The State Government department responsible for land protection is the Department of Natural Resources and Mines. Local government works in cooperation with NR&M to liaise with and assist landholders in meeting their obligations. Shires are required by the Act to develop Local Government Area Pest Management Plans which determine resources and priorities for action in their area. Increasingly these plans are taking a strategic approach to pest problems in order to make the most of their limited resources, which may include subsidies for weed or feral animal control under certain conditions. Such strategic approaches are also encouraged by partnerships between community-based NRM groups such as the catchment committees, Desert Uplands Build-up and Development Strategy Committee (DUBDSC) or the regional body, Desert Channels Queensland.

During the consultation undertaken by the LEBCG and the DUBDSC, the community recognised feral animals and weeds as major natural resource management issues. The Cross Catchment Weeds and Feral Animals Initiative was instituted by the Cooper's

Creek Catchment Committee to undertake a range of weed awareness, mapping and strategic control across the Cooper and Georgina Diamantina catchments. One of its major outcomes has been the establishment of the Shire Rural Lands Officers Group, which brings together Rural Lands Officers from all the shires in the region in regular forums to coordinate their efforts to control feral animals and weeds, and to manage stock routes.

Pest animals

The Desert Channels Queensland region has a variety of pest animals. These range from fish and amphibians through to birds and large herbivores. It is important that the community and visitors to the region are aware of the potential impact on this part of the world by behaviour that either encourages or introduces species to our environment that do not belong (the exception to this is the dingo). The following table shows the most common plus some lesser known intruders.

Table 5: Pest animals of the DCQ region

dingo	wild dog	fox	cat
rabbit	pig	goat	deer
cane toad	mosquito fish	horse	donkey
camel	starling	red-claw	Murray cod

Established

Dingo and wild dog

The dingo *(Canis lupus dingo)*, and domestic dogs *(Canis familiaris)* that have gone feral have recently been lumped together under the term 'wild dogs' and are present throughout the area. Control of dingoes by trapping and poisoning was one of the major tasks for the early settlers of the region. As the land became fenced these techniques were augmented by the construction of dingo or 'barrier' fences, either around individual properties or whole regions. A number of such fences were constructed in the region. In recent times, with the availability of a more effective poison – Sodium Fluoroacetate or 1080 – and the reduction in area of country used for sheep, some of these fences have fallen into disrepair. The Queensland Government (with resources contributed by local government) now maintains only one dingo fence. This 2,500 km long fence skirts the DCQ Region to the southeast, passing through the Barcoo, Blackall and Tambo shires. Almost all the DCQ Region is outside the area protected by the fence.

Wild dogs are a significant issue and go beyond the immediate impacts on individual grazing enterprises. The inability to control wild dogs is seen by many as helping to drive a major land-use change in the region, particularly on the fringes of the established sheep areas in the north and east of the region. As cattle grazing requires less people than sheep there is potential for a significant population change in parts of the region. This may in turn influence the resources available on the land to manage a range of NRM issues such as feral animals and weeds.

As a consequence, control of wild dogs is a high priority for both landholders and local government in the central and eastern parts of the region. Significant

resources are devoted to wild dog control by shires in this area. Blackall and Barcaldine each spend $100 000 annually $60 000 of this on baiting and the remaining $40 000 on bounties. Aramac shire spends $80,000 and Tambo about $60 000. Bounty in all four shires is $50 per scalp.

Shire rural lands officers and NR&M staff, trained in the use of 1080, coordinate baiting. The major baiting campaign is termed the 'chemical barrier' and involves baiting a band of country from Tambo Shire, through Blackall and Barcaldine north to Aramac Shire. This baiting aims to have as many landholders as possible involved; present participation rate is around 70%. Baiting is undertaken each month between April and November. Other large-scale baiting campaigns are undertaken across the region as far west as the Boulia and Diamantina Shires. The majority of the area is baited using meat baits dropped from the air but some landholders still prefer to hand-lay baits which may be tied at marked locations to reduce the chance of losing working dogs.

Key issues for 1080 baiting, which has come under increasing scrutiny in recent years, are:

- Making sure that aerial baits are dropped as accurately as possible through use of in-plane GPS units that can download maps of the area flown.
- Ensuring baits have the right concentration of 1080 to avoid non-target kills but still guarantee the death of any wild dog that takes it. Samples of baits are regularly taken for analysis.
- Making baits as attractive as possible; there is some evidence that some dogs do avoid baits. There are varying opinions as to which meat is best but kangaroo meat is commonly used, as it is commercially available boned and cut to size. Horse or cow meat is also used, particularly where landholders are asked to contribute meat.
- There can be problems with baiting effectiveness when not all landholders cooperate. This may be the case where cattle producers do not recognise the value of baiting and refuse to bait. There has been a gradual shift to more cattle producers recognising how dogs can injure calves but the general trend away from sheep to cattle has made things more difficult for sheep producers and local government who have to work hard to convince landholders who have never baited before to become involved.
- There will always be some landholders who refuse to bait and prefer to trap dogs. This can be effective but is labour intensive.

In order to provide more accurate information on baiting, a project to monitor the effectiveness of the chemical barrier commenced in mid 2003. This project looks at bait placement and attractiveness as well as bait strength. The project, funded by local government with support from NR&M, has a field officer located in Blackall and is anticipated to run for two years.

Fox

Foxes *(Vulpes vulpes)* can be a major problem during lambing and also have been identified as a major issue in National Parks in the area where there is a focus on managing endangered species. The introduction of the bridled nail-tail wallaby to

Idalia National Park, south-west of Blackall, has only been made possible by a coordinated fox-baiting program in selected areas of the park and surrounding properties. Foxes are a remarkably adaptable predator and are found throughout the region including the waterless areas of the Simpson Desert (Rowlands pers. comm.).

Foxes, like dogs, can be controlled by meat baiting, but can also be controlled using the commercially available FOXOFF® baits.

Feral cat

Feral cats *(Felis catus)* are found throughout the region and have a major impact on native animals. There are no widespread control activities but local trapping of cats is common around towns and homesteads. There are very large numbers of cats in the environment. One cat trap set at a location on the Thomson River at Longreach caught 22 cats over a six-month period.

Barcaldine Shire Council from 1997 to 2001 paid a cat bounty of $10 for cats destroyed in the rural parts of the shire. The bounty is still in place but has been reduced to $4. The Queensland government has recently moved to make cats one of the feral animals dealt with by NR&M.

Experimentation with cat baiting techniques was undertaken in the mid 1990s by NR&M at Diamantina National Park. A number of scents, visual and sound devices were tested to attract cats to bait stations. No method was sufficiently reliable to make cat baiting a practical proposition on a scale that would impact significantly on cat populations (Cremasco pers. comm.).

Rabbit

Rabbits *(Oryctolagus cuniculus)* are a major pest in the southern parts of the region but have not become established further north. They first entered the state in the southwest in the 1880s. Construction of the first rabbit-proof fence started in 1886 and extended west to the edge of the Simpson Desert where remains of the fence can still be seen. Unfortunately the rabbit had invaded some districts before the fences were erected. From 1886 to 1929 more than 1,000 km of government and Rabbit Board fences were constructed in Queensland, along with 36,000 km of private rabbit fences, before a Royal Commission recommended abolition of all but the most eastern rabbit boards (NR&M 2002.).

Ultimately it was the landscape that held back rabbits from moving north. The heavier clay soils of the Mitchell Grass Downs preclude rabbits from establishing burrows in all but areas of loamy or sandy soils. In this area rabbits tend to live in fallen timber and heavy grass. Nonetheless the rabbits took a heavy toll on the southwest, particularly in the Simpson Desert where they reduced ground cover and the regeneration of trees and shrubs significantly.

The release of the disease Myxomatosis in 1950 reduced rabbit numbers significantly for several decades and gave many pasture plants, trees and shrubs in the region a chance to recover. Unfortunately, the early level of control was not maintained and as the main vector of spread of the disease was mosquitoes, the disease had less impact in the drier areas of the region such as the Simpson Desert.

The arrival of the Rabbit Calicivirus Disease (RCD) to the region in late 1995 had immediate and dramatic results in the far southwest where rabbit numbers crashed. By mid 1996 the disease had spread into the Simpson Desert with similar results. This level of control has been maintained (Berman pers. comm.). Regeneration of tree and shrub species in the desert has been significant (Rowlands pers. comm.).

Elsewhere in the region, where rabbit numbers are more scattered, RCD has less effect and repeated releases of the disease in the area around Longreach has not resulted in effective control. In these areas spot control has been more effective using oats treated with a chemical called Pindone (Magnussen pers. comm.).

The effect of rabbits on the environment in areas like the Simpson Desert and on primary production in areas elsewhere in the southwest of the region cannot be underestimated. Where RCD has not established effective control in the Bulloo catchment it is estimated that on one property alone (Bulloo Downs) annual loss of production due to rabbits has been in the vicinity of $600,000 (based on each rabbit costing $1 per year in lost production) (Berman pers. comm.). In these areas reduction in rabbit numbers has been undertaken using broad hectare rabbit warren ripping, something that has not been undertaken in the DCQ region to date.

Feral pig

Feral pigs *(Sus scrofa)* have been present in the region since the earliest settlement. The river channel and floodplain areas favour pigs which breed up readily in better seasons. Pigs cause considerable environmental damage by rooting up plants and making areas susceptible to erosion and can be significant predators of young livestock.

The DCQ region is shown as having one of the highest densities of feral pigs in Queensland, with seven shires in the central parts of the region from Barcoo up to Aramac mapped as having abundant and widespread populations (Queensland Feral Pig Management Strategy).

There is evidence that pig numbers have been increasing in some parts of the region. In particular, pigs have been observed moving further down the Cooper and Diamantina River during the 1990s. Small numbers of pigs have made it as far down as the Innamincka Regional Reserve. Control of these scattered populations has recently been undertaken using NHT funds devolved under the Cross Catchment Weeds and Feral Animals Initiative.

Pig control has usually been undertaken using 1080 injected meat baits often laid in conjunction with dog baiting campaigns. There is also a significant wild game meat industry in the region with freezer boxes, located at a number of centres including Ilfracombe, Winton and Boulia, taking an average of 7,500 pigs per year (Latimer pers comm.). Some landholders shoot pigs or allow hunting parties to undertake control.

Experimentation with grain baiting at Lochern National Park southwest of Longreach has revealed considerable potential for this technique. Pigs are free fed fermented grain for a few days to encourage them to become familiar with the bait station. The final day the grain is treated with 1080 late in the day. The station is checked first thing the next day to make sure no grain is left to be

taken by non-target species. This technique has proven to be highly effective. As the pigs are taking bait from a central point and do not usually get far the number of pigs taken can easily be monitored (Magnussen pers. comm.).

Recent concerns about the threat of exotic disease have highlighted the role that feral pigs may play in spreading disease. Although eradication of feral pigs from the entire DCQ region may not be realistic, targeted control and eradication would go a long way to reducing the disease risk.

Goat

Goats *(Capra hircus)* are found through much of the region. They prefer the hill and scrub country but can also be found moving across open downs.

The increasing value of goats and the establishment of improved herds, often using Boer goat genetics, have meant that the large numbers of feral goats seen in the region in the early 1990s may be gone forever. Goats are now an important part of many grazing enterprises and can play a significant role in reducing the impacts of native and exotic woody weeds.

Deer

Two species of deer – Red *(Cervus elaphus)* and Chital *(Axis axis)* - have established small feral populations in the Barcaldine and Jericho Shires, having escaped from failed deer farming enterprises. These populations have the potential to be serious pests and need to be eradicated.

Cane toad

Cane toads *(Bufo marina)* have been in the upper part of the catchment for many years but movement south-west has been slow. Toads have spread 700 km from Cardwell where they were released in the 1930s to be near Longreach in 2003. In the same period they have moved nearly 2000 km around the gulf to be in the Darwin area. This may indicate that they are close to reaching the limits suitable habitat in the DCQ region.

Cane toads are poisonous at all stages and can result in rapid death if ingested by most animals. Cane toads are also voracious predators and can displace native animals and may transmit disease such as salmonella in areas of low hygiene (NRM Facts 2003).

Mosquito fish

Since their introduction in the 1920s to combat mosquito larvae around Brisbane and Sydney, the mosquito fish *(Gambusia holbrooki)* has spread to inland waterways. It is found in waterholes, dams, ornamental ponds, and bore-drains across much of the DCQ region. This prolific breeder displaces native fish through their aggressive behaviour and out-competing them for food. If they find their way into sensitive artesian spring habitat, mosquito fish are a real threat to the survival of locally endemic species.

Horse and donkey

Feral horses *(Equus caballus)* and donkeys *(Equus asinus)* are scattered through the more isolated parts of the region but are not regarded as a significant problem like they are in the adjacent regions of the far north of SA and Central Australia.

Sparrow

The predominantly urban-dwelling house sparrow *(Passer domesticus)* has colonised all of eastern Australia and is slowly spreading towards the Top End. It is a pest in and around town and farm buildings where it nests in eaves, vents, ceiling cavities and sheds.

Camel

Feral Camels *(Camelus dromedarius)* are common west of the Georgina River in the Simpson Desert and adjacent areas. It is estimated that the camel population in the Simpson Desert may be as high as 70,000 (NT Parks survey). Smaller populations are found in the central Diamantina around Mt Windsor and Curran.

With their soft pads, camels are regarded as less damaging to the soil than other large herbivores that have hard hooves. They also range over great distances, not needing to return as regularly to water, and as browsers, do not impact much on pasture plant cover. Nonetheless they damage trees and shrubs and may selectively reduce some species such as the sandalwoods (*Santalum* spp.).

Camels have been controlled in areas where they have impacted on fences. They have also been mustered for sale but this has been limited. A camel industry based on live export and meat has been established in Central Australia where camels are co-grazed with cattle in areas with a significant shrub cover.

Camels are no longer a declared pest in Queensland and there is no proposal to undertake eradication of them in the region at this time.

Present but isolated

Starling

The common starling *(Sturnus vulgaris)* has colonised south-eastern Australia and is spreading into the centre of the continent. Equally at home in urban or rangeland environments, it competes with native birds for nesting sites.

Goldfish

Goldfish *(Carassius auratus)* found in the upper reaches of the Cooper Creek system are the result of careless aquarium cleaning or thoughtless disposal of unwanted fish. The effect they will have on native aquatic life is unknown.

The following two species have been introduced, or translocated, to the Lake Eyre Basin drainage from elsewhere in Australia.

Red claw

Native (endemic) to the northern Cape York, Gulf and Top End rivers, red claw *(Cherax quadricarinatus)* is widely farmed and has been introduced to many other catchments in Australia. While there is no evidence of adverse impacts from the introduction of red-claw into the Lake Eyre Basin, there is concern that its superior reproductive rate may eventually displace endemic species.

Murray cod

Nationally, the Murray cod *(Maccullochella peelii peelii)* is listed as threatened and a Species of National Significance. Its numbers have dwindled to less than 10% of pre European numbers across its natural range of the Murray Darling Basin.

Introduced into the Cooper Creek system in the late 1980s, it is not known if it will establish a self-sustaining population. Being a 'top predator' and eating almost anything that fits into its sizeable mouth, the impact of a permanent population could have an adverse affect on endemic species.

Potential threats

Cattle tick

The Desert Channels region enjoys a cattle tick *(Boophilus microplus)* –free status. There have been outbreaks in the past but these have been eradicated, however, it is an event present threat.

European carp

What is known as European carp *(Cyprinus carpio)* actually originated in central Asia. They are best known in this country as the 'rabbits' of the Murray River and are held responsible for habitat degradation and out-competing native species. They can breed twice a year, with mature females producing up to three million eggs per kg of body weight. If carp were to become established in the Lake Eyre Basin, the result could be catastrophic for aquatic life.

Pest plants

There are a number of serious weed infestations and weed threats to the Desert Channels Queensland region. There is a large part of the region, mostly in the Channel Country, where there are few weed species but, given the established species in the upper catchments, there are major concerns about the ability to control potential spread. Given the relatively sparse population and resources of the region it is imperative that there is a high awareness of the threat of weed spread and that control efforts are timely and strategic.

The following list of pest plants of the DCQ region has been compiled with the assistance of NM&E Land Protection staff and the Shire Rural Lands Officers Group.

(* Declared plants in Qld)

Established (but with potential for further spread)

Prickly acacia* *(Acacia nilotica)*

The worst weed in the region, with large areas infested in the upper Diamantina, and upper Thomson. Worst infestations are around Winton, Muttaburra, Aramac and Barcaldine. Easily spread by stock, in particular cattle movement. Trend to more cattle in the region (see Industry) is a significant risk. Best practice control is by a mixture of mechanical and chemical techniques. Biocontrol agents trialled to date have not impacted significantly on the species (DNR 2000). Strategic control has reduced the spread of the species in some parts of the region but in many areas the impact of this weed has not been curtailed (see Weed Management Groups).

Parkinsonia* *(Parkinsonia aculeata)*

One of the most widely distributed woody weeds in the upper catchments. Mainly present along streamlines, seed is readily spread by water. Impact of this weed has been underestimated due to it often being hidden by other riparian vegetation. Seed beetle biocontrol agent (*Penthobruchus sp.*) has been

successfully established with up to 95% seed destroyed at some sites and may contribute to the integrated management of this weed (NR&M Pest Fact 2001). Best practice control is by a mixture of mechanical and chemical techniques. Funding has recently been made available for strategic control of this species (see Weed Management Groups).

Mesquite* *(Prosopis pallida)*

Is a significant weed in the upper Diamantina with scattered infestations in the Thomson catchment. Best practice control is by a mixture of mechanical and chemical techniques. No biocontrol has been undertaken as the extent of infestation makes eradication achievable. Some shires (e.g. Ilfracombe) are close to eradicating this species.

Rubber vine* *(Cryptostegia grandiflora)*

This significant weed of riparian areas has become established in the upper Thomson along sections of the Tower Hill and Reedy Creeks. Isolated infestations further downstream have been controlled.

Mexican poppy *(Argemone ochroleuca)*

Noogoora burr* *(Xanthium strumarium)*

Bathurst burr* *(Xanthium spinosum)*

These three annual weeds are scattered through the upper catchments. There are limited infestations in the Channel Country. Control, usually limited to wool production areas, is difficult to achieve where there are upstream seed sources.

Present but isolated/localised (potential for further spread)

Parthenium weed* *(Parthenium hysteropherus)*

Infestations present in Blackall, Isisford, Jericho, Longreach, Flinders, Barcaldine & Aramac Shires, with small, mostly roadside infestations appearing elsewhere following rain or as a result of introduced contaminated horse or fowl feed. All infestations are being controlled or are eradicated.

Coral cactus* *(Opuntia cylindrica)*

Infestations present in Ilfracombe, Longreach, Flinders, Quilpie & Blackall Shires.

Devil's rope pear* *(Cylindropuntia imbricata)*

A serious infestation is present on the Longreach Town Common. It is being controlled. Many other smaller infestations are present across the region as a result of dumped/escaped ornamental plantings.

Snake pear* *(Opuntia spp.)*

A serious infestation is located to the north of Longreach. It is confined to one property.

Balloon vine *(Cardiospermum grandiflorum)*

The only known infestation is located on Cooper Creek, near Windorah, in the Barcoo Shire.

Florestina *(Florestina tripteris)*

An established infestation is situated between Barcaldine and Blackall on the Landsborough Highway and two neighbouring properties. The species is not known to grow anywhere else in the LEB. As an annual weed there have been concerns that it may be another parthenium.

Lippia weed *(Phyla canescens)*

Is common in household gardens in towns; reported to have escaped on to the Longreach Town Common.

Bellyache bush *(Jatropha gossypifolia)*

Infestations in Aramac, Barcaldine, Jericho, Flinders & Dalrymple Shires; has been reported in household gardens in Barcaldine and stables in Longreach.

Mother of millions* *(Bryophyllum spp.)*

Infestations are present in Ilfracombe, Aramac, Jericho, Blackall & Barcaldine Shires.

Chinee apple* *(Ziziphus mauritiana)*

A small infestation is present near Corfield in the northern part of the Winton Shire.

Leucaena *(Leucaena leucocephala)*

Common in townships. Has spread from town gardens to creeks of the Thomson River in Longreach (under control).

Athel pine *(Tamarix aphylla)*

Found in most Shires. Planted in town gardens and in and around sheep and cattle yards, sheds and homesteads; has not displayed the weed characteristics in the DCQ region as it has in the Finke River system in NT.

African love grass *(Eragrostis curvula)*

Infestations south of the region in Murweh Shire along roadsides. Possibly infestations along roadsides in Tambo, Blackall & Barcaldine Shires are awaiting positive identification.

Thornapples* *(Datura spp.)*

Very small, isolated infestations have been reported on roadsides and in paddock situations, usually following rain. Not common.

Lion's tail *(Leonotis nepetifolia)*

Recent discovery. Only known infestation in Jericho Shire (contained).

Potential threats (not present, but have potential to become established)

Giant rat's tail grass* *(Sporobolus pyramidalis/Sporobolus natalensis)*

Water lettuce* *(Pistia stratiotes)*

Giant sensitive plant* *(Mimosa pigra)*

Neem *(Azadirachta indica)*

Calotrope *(Calotropis procera)*

Water hyacinth* *(Eichhornia crassipes)*

Quilpie mesquite* *(Prosopis spp.)*

Salvinia *(Salvinia molesta)*

Giant rat's tail grass has the potential to invade the eastern parts of the region. By displacing desirable grasses this species can lower carrying capacity substantially and is difficult to identify and control.

Water lettuce has been brought into the region from coastal nurseries and has been introduced to ornamental ponds. From the experience of the substantial infestation on the Warrego River at Cunnamulla this species has the potential to be a very serious aquatic pest requiring considerable resources to control.

Weed management groups

There are a number of weed management groups active in the region. These include the National Prickle Bush Management Group (NPBMG) which deals with prickly acacia, parkinsonia and mesquite. This group has developed a containment line for prickly acacia that broadly separates the more heavily infested areas in the upper Diamantina and Thomson catchments from the scattered infestations to the south. Within the containment line the emphasis is on adaptive management, which means the goal is to reduce and manage the impact of the weed. Eradication is not a realistic option at this time. Outside the line the aim is eradication through strategic control efforts. The NPBMG has funded strategic control of prickly acacia in several parts of the catchment through the Weeds of National Significance (WONS) program.

The NPBMG has also funded parkinsonia mapping and strategic eradication in the region, which has been managed by the LEBCG. The use of aerial survey has revealed significant parkinsonia infestations in the Thomson catchment that were not previously identified.

The National Rubber Vine Weed Management Group has funded a number of activities in the region These include devolved grants for control work, and extension of best practice control techniques including use of fire.

The Parthenium Weed Management Group has devoted significant resources to extension in the region, which includes making a display trailer available for shows and field days. The group has also funded the construction of wash-down facilities at Barcaldine and Isisford.

Local government and Landcare groups are also active in supporting landholders in controlling weeds. This can be in several forms which range from subsidising chemical and assisting with labour and Weedbuster days, to sponsoring devolved grants. The trend has been for shires to pay a defined subsidy to landholders who have signed a weed control agreement and have completed the agreed works. This process is often combined with weeds inspections and mapping.

Land

Indigenous land management

Aboriginal people came to the Australian continent at least 60,000 years ago and throughout the DCQ region there are many sites with evidence of Aboriginal life. Around 22,000 years ago climatic conditions became much drier and would have impacted on Aboriginal life. There is evidence that Aboriginal people were using the country about 17,000 years ago, and sites along the southern parts of Cooper Creek have

been dated at about 12,000 years old (Ryan (ed.) 2003). Clearly, Aboriginal people developed the skills to adjust to changing environments and live within the capacity of the land.

Although the region is rich in Aboriginal sites, from the many stone scatters and limestone wells of the Simpson Desert to the shell middens and grinding stones of the lower Cooper and the rock art sites of the Desert Uplands, there has been limited systematic cultural heritage survey of the region. In fact it is estimated that less than 5% of Queensland has been examined for Indigenous heritage places and artefacts. Despite similarities in language and social organisation, Aboriginal groups throughout our region displayed considerable cultural variation. Around thirty language groups were thought to have covered the DCQ region (see Fig 5). Tragically, today, most of these languages have been lost.

Three broad groups can be identified. In southwest Queensland, Aboriginal people were culturally aligned with people from the Darling River system. The second group are those who inhabited the major inland rivers draining into Lake Eyre. These people were culturally aligned with the Desert people of Central Australia. The third group belonged to the uplands of the Mt Isa-Cloncurry region. These groups were explicitly linked and an extensive trade network developed. The purpose of trade was not just to exchange items, but also to cement religious and social connections. The complex network of social and religious links was shattered with the advent of European settlement. (Ryan (ed.) 2003). This era brought harassment, violence and introduction of diseases to which Aboriginal people had no defence. Many survivors were moved to missions or Government settlements well away from their traditional lands. In many cases station work was the only way Aboriginal people had of staying with their country.

Today the Aboriginal population of the region is modest compared with many other parts of outback Australia. It is estimated at around 6%, with most of these people living in the west of the region. The Indigenous population of the Georgina/Diamantina catchments, with significant communities at Dajarra and Urandangi, is around 12.5%. In the Cooper catchment there are around 3% Indigenous people and no major communities (ABS 2001).

Aboriginal people, through their affinity with their land, are today seeking to be involved with land management in the region. Several of the larger National Parks have involvement with Aboriginal people. The Simpson Desert National Park, one of the largest in Queensland, has been declared a National Park (Aboriginal Land) jointly managed by QPWS and the traditional owners.

Figure 6: Indigenous language groups

Today, recognition of Native Title has provided many families, not only the rights to their country, but also the capacity to negotiate over the future of that country (Ryan (ed.) 2003). To date, 205 Native Title claims have been made in Queensland – some 24 claims covering around 50% of the DCQ region, mostly in the west and north.

Four representative bodies cover the DCQ region for Native Title. These are the Carpentaria Land Council in the far west, Queensland Southern Representative Body in the south, the Gurang Land Council in the central part and the Central Queensland Land Council in the northeast. A number of local Aboriginal organisations also exist throughout the region.

Encouraging the contribution of Indigenous people in managing the natural resources of the region will be a key part of the regional planning process.

European settlement

In 1845, Edmund Kennedy was second-in-command to Thomas Mitchell, when Mitchell discovered the rich grasslands of central Queensland and named the Victoria River. Kennedy returned following year to rename the river 'Barcoo' and follow it, naming the Thomson River as he went, to south of present-day Windorah. Here, he realised it was the same stream that Charles Sturt had named Cooper's Creek a few years previous.

The ill-fated Burke and Wills expedition set of from Melbourne in 1860 to cross Australia from south to north. It traversed the DCQ region to the gulf and back before coming to grief on the lower Cooper.

Alfred Howitt, William Landsborough, John McKinlay, and Frederick Walker all mounted separate rescue expeditions for Burke and Wills. Howitt subsequently found John King, the only survivor, and the bodies of Burke and Wills.

Unlike the Burke and Wills expedition, which found little of value, the rescuers discovered a good deal of new pastoral country, particularly Landsborough who crossed the Barkly Tableland (Wadley and King (eds.) 1993). McKinlay chartered Lake Eyre's northern shores and, after receiving word of the deaths of Burke and Wills, decided to press on and explore the country in the northeast. Favoured by exceptionally good conditions, he was the first explorer to survey Queensland's central western region in detail and report on its abundant Mitchell grass plains.

William Landsborough, Augustus Charles Gregory and Frederick Walker all visited different parts of the region in different seasonal conditions. They had a poor understanding of the boom bust cycles in the outback and gave different descriptions of the country they saw. Some saw a pastoralist's dream of lush grasslands and plentiful water, others saw a barren wasteland of little or no use (2002 Year of the Outback Website).

Rural settlement in the region began with vast holdings granted by provisions of the Unoccupied Crown Lands Occupation Act 1860. In the case of Bowen Downs the run extended from Aramac (one of the first towns in the region) to near present day Longreach). These holdings were held by companies and they built up substantial stock numbers. The Mt Cornish run (part of Bowen Downs) had a herd of 70,000 cattle by the 1880s (Moffat 1987).

In 1870, Harry Readford carried out one of the boldest cattle thefts in Australia's history. In the company of others, he stole nearly 1000 head of cattle from Bowen Downs. Blessed by reasonable seasons he trekked them down the Strzelecki Track into South Australia (Moffat 1987).

The 1880s saw the resumption of areas from the original vast sheep and cattle runs with aim of promoting closer settlement. Even so, in the 1890s properties such as Wellshot, south of Ilfracombe still shore more than 400,000 sheep (Forrest 1988). The development of the region for wool production extended far out into the Channel Country. This brought a need for a substantial labour force and towns and settlements sprang up as the railway line extended west to Barcaldine in 1886 and Longreach in 1892.

Barcaldine was the scene of one of the most significant events in the political life of Australia when, during the Shearer's Strike of 1891, the Australian Labor Party and Union movement was born. This history is celebrated in that town at the Worker's Heritage Centre and the 'Tree of Knowledge'.

The expansion of the wool industry brought a boom in employment with thousands of shearers, shedhands and jackaroos employed. Shearers swelled the population of towns such as Barcaldine and Blackall whilst woolscours in centres like Ilfracombe and Blackall operated into the second half of the 1900s. This shearing heritage is celebrated in Blackall where the woolscour is preserved along with the story of Jackie Howe, the legendary blade shearer who gave his name to the blue singlet worn by shearers to this day.

Qantas, the world's second oldest airline was registered on 16th November 1920 as the Queensland and Northern Territory Aerial Service Ltd in Winton. Not long after the company headquarters were moved to Longreach. Today the Qantas Outback Founder's Museum in Longreach preserves the history of these early aviation pioneers.

Another icon of the outback, 'Waltzing Matilda', was penned by Banjo Patterson at Dagworth Station near Kynuna in 1895. It was first performed at the North Gregory Hotel in Winton later that same year.

Local government was achieved about this time across most of the region by way of Divisional Boards. These transitioned to shires and shire councils in the early part of the 20th century.

The period between the wars saw closer settlement, with many parts of the downs country broken into 20,000 acre or even 10,000 acre blocks, which, at that time, could sustain a family. Further west in the Channel Country holdings did not change much in size. The few attempts at closer settlement had ended in failure – the Carcoory ruins north of Birdsville still stand as testament to these efforts.

Gradually, a new policy of regionalisation occurred in which larger towns, such as Mt Isa and Longreach, became centres for business, government administration, education services, health and welfare.

Today the region attracts tourists to the home of many well-known icons of Australian outback life. The Waltzing Matilda Centre in Winton, Australian Stockman's Hall of Fame in Longreach, Australian Workers Heritage Centre in Barcaldine and Blackall Woolscour are popular stops along the Matilda Highway. Further west tourists now travel throughout the Channel Country each winter and flock in thousands to events such as the Boulia Camel Races and the Birdsville Cup.

Land tenure

Approximately sixty-five percent of Queensland is covered by state rural leasehold land i.e. land for which leases may be issued for the purposes of grazing or agriculture. The Queensland Government has initiated a review of the future management and use of leasehold land through the Draft State Rural Leasehold Land Strategy 2003. The purpose of the draft strategy is to look at the emerging issues and available options and define mechanisms to reconcile any conflict between lessees and other stakeholders. The strategy seeks to update the conditions of leases in line with current natural resource management practices. Since the release of the draft strategy, ongoing consultation and feedback has been occurring across the state, with the aim of delivering a workable process that is user friendly and effective for all parties.

There are three main land tenure types in the region: Pastoral Holding (Term Lease (Pastoral Purposes)); Grazing Homestead Perpetual Lease (GHPL); and Freehold. By area, the Term Lease (Pastoral Purposes) dominates the DCQ region. These leases are held by

private individuals, private companies and pastoral companies, some of which are publicly listed and others privately owned. They are found throughout the Channel Country and, to a lesser extent, in the Desert Uplands. Terms vary up to 50 years and there is no limit on the total area held. Half of the current Term Leases in Queensland will expire during the next 15 to 20 years, and their renewal is being considered as part of the Draft State Rural Leasehold Land Strategy (NR&M 2002).

The second largest category is Grazing Homestead Perpetual Leases (GHPLs). These dominate the more closely settled areas of the region, typically in the eastern Mitchell Grass Downs and some of the Desert Uplands. This tenure was created to allow for closer settlement by family-based enterprises. Corporations cannot hold GHPLs (Arthur pers. comm.).

The third category is Freehold. Perpetual leases can be freeholded, a process that generally commenced in the mid 1960s and reached a peak in the region in the 1970s and 1980s. At that time significant areas of perpetual lease moved to freehold in the east of the region. Terms at that time were favourable and advantages included the purchase of rights to quarry materials and timber along with the opportunity to subdivide. In recent years the rate of freeholding has slowed as the cost of freeholding, which is linked to land prices, has risen. There is currently no appreciable premium in the market for freehold land (Arthur pers. comm.).

The region was pioneered by a number of prominent pastoral families, including the Duracks, Costelloes, Kidmans, Duncan-Kemps and Tullys. Descendants of these families are still present in the region, either with continued family property ownership (3rd or 4th generation), or as managers for the larger pastoral companies.

Stock routes

Approximately 12,000 kilometres of Primary, Secondary and inactive stock routes traverse the region. The stock route network is still an important part of the grazing industry in the region and is seen as a cost effective way of moving cattle while getting some feed along the way. The larger stock movements in recent years have generally been mobs of company-owned cattle moving from the north of the region down into the Channel Country or to markets in Longreach or Roma. Once the routes were used by flocks of sheep as well as cattle; today sheep are rarely seen.

Local movements of cattle have also been common in the droughts of the mid 1990s and 2002/03 where local producers sought to keep their core breeding herd alive by traversing the routes. The advent of the water tanker and use of supplements has given drovers greater options to seek out feed in areas of the routes that previously would not have been accessible. In just three months from July to September 2003 Longreach Shire recorded stock movements of more than 10,000 head, with Aramac and Winton Shires not far behind.

As managers of the stock routes network, local government is facing challenges in balancing the demands of local graziers, who see the route as a resource for survival in drought, with those of travelling stock. Local government is also struggling with funding the management of the routes whilst only getting a modest return which fails to cover the management and maintenance. Currently there is a working group, representing local government and industry, looking at management issues, particularly in the light of the new legislation covering the management of stock routes, which came into place in mid 2003. Under the Land Protection (Pest and Stock Route Management) Act 2002 local

government is required to develop a draft stock route management plan to go to the Minister for Natural Resources by March 2005.

Stock routes are increasingly seen by the community as a resource for conservation, heritage and recreation. The Year of the Outback 2002 saw the re-enactment of several droving exploits in the region, including the Harry Readford Cattle Drive which passed down the Thomson and Cooper on the way from Aramac to Roma. The romance of droving, combined with tourists seeking access to camp on the routes and reserves, is presenting new challenges to the management of stock routes.

People

The following sections on people, services and industries provide a social and economic profile of our region.

Population

The population of the Desert Channels region is sparse. Two thirds of the region's 14,500 inhabitants live in 25 towns which vary in size from 15 to 3,800 people. The rest are widely scattered across half a million square kilometres of extensive pastoral country, most of these in the northeast. Residents of Indigenous descent (1 in 16) are spread throughout, most live in the west and northwest, the latter being home to the Indigenous communities of Dajarra and Urandangi.

Australian born residents make up about 88% of the population while a little over 6% (about 900) are of Indigenous origin. This compares to the State average of 76% and 3.1% respectively. From 1991 to 1996 there was a more than 28% increase in those identifying themselves as Indigenous in the Central West. Almost half of this increase is due to the desire to identify as Indigenous.

In common with other parts of Australia's rangelands, our population has been in decline; this trend is predicted to continue. Figures from the 2001 census show that the region's population has declined by 0.1% in the 5 years from 1996. The Government Statistician projects that the population of the region will contract by an average of 0.6% over the next 20 years.

In the 10 years to 2001, the average age of the wider population has risen in line with the national trend. Two age brackets, 1-9 years and 19-30 years have shown a marked decline in representation within the community while the 34-59 year bracket has generally shown a 10% increase with the 50-54 bracket showing double that. This may be a reflection of people in the rural industry delaying retirement, coupled with less young people willing to take on the life. The number of residents in the 59 to 69 age group has fallen slightly in the same 10 year period while there are now more people above age 69.

Table 6: Population trend by age group

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0-4	1,487	1,448	1,404	1,363	1,302	1,253	1,260	1,259	1,236	1,210	1,215	1,127	1,107
5-9	1,391	1,357	1,322	1,286	1,262	1,252	1,183	1,183	1,203	1,223	1,229	1,213	1,162
10-14	999	1,007	1,017	1,019	1,019	1,023	1,052	1,019	984	965	970	996	992
15-19	1,165	1,100	1,034	976	920	887	890	887	940	978	999	973	924
20-24	1,437	1,402	1,356	1,297	1,197	1,098	1,066	1,059	1,032	989	948	958	1,000
25-29	1,496	1,426	1,364	1,317	1,266	1,258	1,230	1,176	1,149	1,125	1,128	1,120	1,052
30-34	1,281	1,290	1,296	1,294	1,265	1,245	1,230	1,231	1,191	1,175	1,169	1,128	1,089
35-39	1,045	1,068	1,093	1,120	1,143	1,180	1,183	1,183	1,208	1,190	1,147	1,138	1,071
40-44	986	972	971	970	965	962	982	1,010	1,045	1,089	1,111	1,126	1,124
45-49	817	848	876	886	886	901	902	911	916	930	946	963	979
50-54	698	700	701	707	729	743	774	801	826	830	861	872	871
55-59	653	643	634	621	616	620	616	653	658	691	702	752	764
60-64	672	646	616	582	558	539	508	495	498	516	543	570	599
65-69	448	462	486	503	517	534	550	528	500	470	446	454	444
70-74	357	362	370	378	378	377	399	424	421	427	415	446	423
75-79	221	229	242	249	259	280	263	271	278	276	293	340	352
80-84	145	149	150	150	151	151	172	184	190	202	199	188	194
85+	120	127	137	143	152	160	153	142	141	128	123	152	161
Total	15,417	15,237	15,068	14,860	14,585	14,464	14,413	14,418	14,416	14,413	14,443	14,517	14,309

Pressure to get greater returns from the land with fewer inputs, often combined with threats from wild dogs, is seen as driving a shift from sheep to cattle in the region. There has been significant social change caused by the major decline in employment that has resulted. Jobs have been lost from centres like Blackall which has seen about 200 people leave in the three years to mid 2004 including 70 students from the school in eighteen months.

Employment

The town communities, around two-thirds of the people in the region, are firmly connected both socially and economically to the natural resources of the region. Providing services to rural industry is a significant employer in all the towns of the region.

Of the approximately 8,000 strong workforce of the region, 31.8% is employed in agriculture compared to the State average of 5%. The presence of a major Defence Department radar installation, along with the fact that Longreach is a regional centre for Government services, sees 6.7% of the workforce employed in government administration and defence industry where the average for the State is 4.8%. Also worth noting are the participation rate and the unemployment rate: 70.1% and 3.9% for the DCQ region compared to 63.1% and 8.2% for the State.

Table 7: Employment numbers

Year	Employed				Unemployed			Labour Force			Total
	Full-Time	Part-Time	Not Stated	Total Employed	Looking for Full-Time work	Looking for Part-Time work	Total	Total	Not in	Not Stated	
1991	5,980	1,390	432	7,801	360	91	451	8,252	3,524	306	12,082
1996	5,407	1,642	143	7,191	348	122	470	7,661	3,813	360	11,834
2001	5,882	1,924	235	8,040	231	66	297	8,338	3,438	634	12,409

The decline in employment in the pastoral industry has more than halved the population living outside of the towns in many parts of the region. For example, in the 1950s in the Stonehenge area, two large properties could each muster a cricket team out of their employees, now they would be lucky to be able to stage a doubles tennis match between them.

Services

Education

The education needs of the region are met by 26 State-run schools (4 are schools of distance education servicing the remote areas; 3 of these are situated outside the region) and 4 Catholic schools. Most remote area students complete their secondary studies at boarding schools on or near the coast with many having to travel 1,500 kilometres or more to do so.

The 23 State-run schools in the region had total student numbers at February 2003 of about 1800 (years 1-12). Longreach has a District Office for Education Queensland and also has a Special Education Unit based at the Longreach Primary School.

Four non-State schools service the region for Preschool to Year 7. They are Our Lady's School (Longreach), St Joseph's School (Barcaldine), St Joseph's School (Blackall) and St Patrick's School (Winton) (Education Queensland Schools Directory Website).

Enrolments in the Longreach School of Distance Education (opened 1987) peaked at 330 (1992) before the drought of the 1990s saw 'families leave in droves' and numbers fall to 187 (2000). In this case, things have turned around, simply on the back of legislation that now allows anyone to do home schooling even if they live next door to a school. Enrolments have rebounded to 240 in 2004 with a corresponding staffing level of 36.

Other Distance Education schools that provide services to the DCQ region are at Mt Isa, (220 students), Charters Towers (460 students) and Charleville (240 students) (Education Queensland Schools Directory Website).

Longreach Pastoral College enrolled its first students in February 1967, and was the first rural training school in Queensland. Presently LPC is the only Qld institution providing extensive training in cattle, horse, sheep and goat grazing in semi-arid conditions. The college campus property is 10,867 hectares of Mitchell grass grazing, with studs carrying 600 head cattle, 1100 sheep and 600 goats. The College also owns the 13,200 hectare 'Manningham', 75 km west of Longreach, which carries 8000 sheep

and 200 cattle. There are 137 students on campus, 8 students off campus (Longreach Pastoral College Website). Longreach Pastoral College is a branch of TAFE and provides a range of training opportunities including apprenticeship support.

The nearest universities to the region are James Cook (Townsville), Central Queensland (Rockhampton) and Southern Queensland (Toowoomba).

The percentage of people in the region with tertiary qualifications is around three quarters of that for the whole of the State (12.2% as opposed to 16.3%).

Table 8: Non-school qualifications

Level	2001	% change from 1996	% change from 1991	1996	1991
Post Graduate Degree	53	47.22%	23.25%	36	43
Grad' Diploma & Grad' Certificate	92	22.66%	41.53%	75	65
Bachelor Degree	762	32.25%	108.76%	575	365
Advanced Diploma & Diploma	576	-1.36%	-1.36%	584	584
Certificate	1774	34.08%	39.24%	1323	1,274
Not stated	1423	10.13%	3.56%	1292	1,374
Not applicable	7746	-2.84%	-8.25%	7973	8,443
Total	12425	4.56%	2.24%	11859	12,147

Health

The DCQ region despite its scattered population has an extensive health network. Most of DCQ comes under the Central West Health Service District, which has its main office in Longreach, plus offices in Winton and Barcaldine. Queensland Health has six hospitals servicing the region; these are Alpha, Aramac, Barcaldine, Blackall, Longreach and Winton. Primary Health Care Centres include Boulia, Isisford, Jundah, Muttaburra, Tambo, and Camooweal. Community Health Service clinics operate at Dajarra and Birdsville while Outpatient Clinics operate at Windorah and Yaraka. Community Health Services are provided at Urandangi, Bedourie, Birdsville, Barcaldine and Longreach. Dental Services operate at Blackall, Barcaldine, Longreach and Winton.

Private Health facilities in the region include the Uniting Church Frontier Services Clinic at Birdsville, and the Bush Nursing Clinics at Jericho and Bedourie. Aged Care Services provided in our region include Domiciliary, Aged Care Assessment Team (ACAT), and Home and Community Care (HACC). Nursing Homes, which are Queensland Government, certified facilities include the Pioneers Hostel and Nursing Home in Longreach (Queensland Health Service District Profile/Website).

Apart from the conventional health services mentioned above, the region comes under the 'mantle of safety' of the Royal Flying Doctor Service. Doctors and aircraft at bases in Mt Isa, Charleville, Broken Hill, and Port Augusta provide regular medical clinics and emergency evacuations to the more isolated parts of the region.

Communications

Despite the fact that the population of the remote parts of the region has declined, communications is now better than ever.

Satellite television came to the outback in the 1980s and, in the past decade, telecommunications for rural residents has progressed from party lines and manual exchanges to automatic telephones and, in many cases, broadband satellite internet services and mobile phone coverage.

The DCQ region was the last part of Australia to have manual telephone exchanges. These were linked to far flung properties by single fragile lines, often fencing wire, which were maintained by the landholders and offered a notoriously poor quality. This all changed in 1991 when the last manual exchange and the terrestrial system was closed, and replaced with the Digital Radio Concentrator System (DRCS) radio telephone network. Not only did this provide automatic telephones, it provided them to remote areas where previously the only contact was through HF radio and the Royal Flying Doctor Service.

The DRCS provided reliable phone services but was unable to deliver acceptable internet access. Concerns about the disadvantage that remote residents were facing in getting internet access resulted in satellite based, high speed internet access being made available in most remote locations. For many landholders the once-off availability of this service at no cost brought them into the computer age with most properties now having at least one person moderately proficient in computer use. This service has made it much easier for people to access information on natural resource management. The access to information and internet communication is often in the hands of the women in the family and, in many cases, they perform the accounting role on family properties.

All of DCQ, indeed all of Australia, has 100 per cent coverage with satellite hand-held mobile systems. At the same time, the rollout of CDMA mobile phone services is effective and ongoing. Most towns on the major tourist corridors through the region are now covered by this system and there is a spread outwards to Aramac, Isisford and Stonehenge.

There is also a large UHF (Ultra High Frequency) radio network across the region. Most properties use this system for internal and inter-property communication and syndicates of landholders have been formed to install repeaters to extend coverage. The Barcoo Shire, in partnership with the community, has gone to the extent of installing a network of repeaters that, when linked, will allow communication from one end of this 60,000 square kilometre shire to the other.

ABC Radio Western Queensland is the mainstay of rural broadcasting in the DCQ region. Based in Longreach, ABC 4QL covers nearly two-thirds of Qld and is one of the largest broadcast zones in the southern hemisphere. ABC Radio Carpentaria based in Mt Isa complements this coverage. Longreach is also home to 4LG, which prides itself as being one of the smallest commercial broadcasters in Australia. In contrast with much of commercial radio 4LG is still independently owned.

The community/rural radio sector is fulfilling a broad but largely unacknowledged role in the Queensland media landscape, particularly as a source of local content. Sixty per cent of community radio is broadcast to regional areas, in light of increasing withdrawal of commercial radio from regions. Indigenous community radio is growing, guided by the National Indigenous News Service (Ford, Meadows & Foxwell 2002).

The daily North-West Star out of Mount Isa and the weekly Longreach Leader enjoy wide circulation in the region and are supported by a number of small local papers and newsletters. The Brisbane-based Queensland Country Life is the rural issues paper of choice for most of the region.

This communication, information and entertainment revolution has permanently altered the amount and type of social interaction. Nowadays, people in the bush are only out of contact through choice and without leaving your home you can be informed, entertained or transported to a world far away from the everyday.

Transport

The quality of the road network across the region has improved despite a declining rural population. Much of this improvement has been driven by increased tourist traffic.

The road from Longreach to Windorah is almost completely sealed and will provide an all-weather loop from Charleville, through Windorah to Longreach. Currently there is a push on for a sealed road into Birdsville which currently receives 50,000 plus visitors per year.

Over the last 10 to 15 years, most shires have made a concerted effort to upgrade major shire roads. Many have been gravelled, which has not only helped cope with increased traffic in dry times, but ensured a degree of passibility during moderate rain.

Improved roads have facilitated the transportation of stock to and from properties, to market, and away to agistment when drought conditions set in. This gives a greater flexibility to property managers in maintaining healthy pastures and livestock.

In addition to improved roads, advances in vehicle design have meant a greatly increased ease of covering the vast distances of the region. In 2004, people are less likely to be confined to their immediate community as access to larger regional centres with a wide range of entertainment, sporting and social activities is now quicker and more comfortable.

Waste management

The region is characterised by a lack of heavy industry so there are few major waste disposal issues other than urban. Local government is slowly improving its waste management, moving away from burning rubbish towards separating waste. For example Longreach council has set up specific bays for materials such as green waste, recyclable building materials, steel and white goods and has put in place a waste oil recovery facility. Recycling of materials such as cardboard (estimated to comprise more than 30% of the waste stream) and plastics, is still difficult due to the high cost of freight to recycling plants in comparison with the value of the material.

Waste management is governed by two acts, *Environment Protection Act 1994* and the *Integrated Planning Act 1997*, administered by the Environment Protection Agency (EPA). Some aspects of these Acts have been devolved to local governments. EPA maintains two registers that contain land-use planning information – Environment Management Register and the Contaminated Land Register. Industry, shires and landowners have obligations under the Acts relating to the identification, notification and management of contaminated land. Council quarries (extraction and screening) also have to be licensed by the EPA.

Statutory legislation relevant to water quality in the DCQ region comes under three main bodies. The EPA administers environmental protection legislation under the *Environment Protection Act*, Environment Protection Policy (Water), Licensing/approvals of environmentally relevant activities, Codes of Practice, and urban stormwater management plans.

Contaminated soil on pastoral properties is an ongoing issue. The long term use, both historic and present day, of residual chemicals such as DDT, Dieldrin and Arsenic in sheep dips, stock yards etc. is monitored by the DPI. When properties change hands risk assessments are made, and if warranted, field investigations are carried out by the DPI, soil samples are taken, and if residues are present, a residue minimisation plan is developed to manage and control the spread of contamination. These residue minimisation plans should be registered with the EPA (Pidgeon pers.comm.).

Industry

Our community has seen the wool boom of the 1950s followed by a cattle boom and bust in the 1970s, the peak of wool and growth of tourism in the 1980s followed by the collapse of the sheep industry and resurgence of beef at the turn of the new century.

This has brought considerable change in both the rural and urban parts of the region. Graziers have gone from 'riding on the sheep's back', with its high labour requirements, to running cattle, with lower input costs and potentially higher returns. Drought has always been part of life and landscape; it has always been felt (economically) in the towns although not as severely as in the bush. These days, the economic contribution from tourism has taken the edge off rural downturns for town businesses.

Pastoral

In the early years of settlement, the lush Channel Country pastures were a critical link in the vast cattle empire of Sir Sidney Kidman, 'The Cattle King', who built a chain of cattle properties from northern Australia to the Murray River.

The cattle enterprises of the Channel Country are still an important part of the beef industry, but methods of management and cattle genetics have changed how the industry operates since the days of "droving cattle down the Cooper, where the seasons come and go" (Banjo Patterson). The industry was once dependent on European breeds such as the Shorthorn, but many enterprises now have Brahman bloodlines, and some are developing their own 'composite' breeds. Steadily improving road transport enables cattle to be moved from breeding properties, often north and west of the region, to properties in the Channel Country where they are 'grown out' to feedlot weight or fattened.

An estimated 0.5 to 1 million head of cattle are run in the Channel Country of Queensland, with a record gross turn-off value of $64.6 million in 1998-99. Beef turn-off value following major flood events such as in 2000 is reputedly worth $150 million.

It is worth noting, of the top 10 beef producers in Australia, seven have Channel Country holdings with substantial areas of floodplains (Phelps et al. 2003). For example, in 2001, Stanbroke Pastoral Company ran the floodplain holdings of Davenport Downs, Tanbar, Nappa Merrie and Bulloo Downs, and was Australia's leading beef producer (by turn-off), producing 36, 207 tonnes of beef. They were Australia's largest landowner (13.4 million ha across 27 properties), the largest cattle producer (551, 351 head) and employed 440

staff throughout Australia (Stanbroke changed hands in May 2004 and has been substantially broken up).

S. Kidman & Co have the largest number of Channel Country holdings with Sandringham, Glengyle, Durrie, Morney Plains, Mooraberee, Durham Downs, Nariyilco and Innamincka Station. Australian Agricultural Company has Brighton Downs and South Galway; North Australian Pastoral Company has Marion Downs, Coorabulka and Monkira; Consolidated Pastoral Company has Nockatunga; Colonial Agricultural Company has Keeroongooloo. Santos, with primary interests in the extraction of oil and gas, also owns the properties Nappa Merrie and Gidgealpa, but has sub-leased these to pastoralists. (Phelps et al. 2003).

In the northeast of the region, the Desert Uplands, once regarded as a less productive area more suited to drought refuge and cattle breeding, is now home to a cattle industry worth around $70 million a year. Improvements in cattle genetics, land development and water improvements, along with better control of grazing, nutritional supplementation and controlled mating, have changed the face of the region.

In the heyday of the wool industry the sea of grass in the Mitchell Grass Downs gave rise to hundreds of smaller sheep holdings and many famous merino studs such as Isis Downs, Terrick Terrick and Portland Downs.

The decline in the sheep industry since the wool crash at the end of the floor price scheme, combined with the drought of the 1990s, made sheep in many parts of the region almost worthless. The Queensland sheep flock declined from 19 million to fewer than 6 million in the space of a dozen years. In the DCQ region this has been marked by an initial retreat in sheep from the north of followed by a recent shift from sheep to cattle in the Barcaldine – Blackall area, once the heart of the Queensland merino flock. Isis Downs and Terrick Terrick are but a memory.

From 1990 to 2004 Muttaburra went from 6 shearing teams to 1, Aramac from 2 to 0, and Blackall from 11 to 2. One Longreach contractor used to keep 2 teams in full-time work but now only have work for 1 team for about 10 months. For them, the slide started in about 2000 with the influx of cattle interests.

This shift in land use has been most pronounced in the north and west of the region. The Boulia area now has few sheep and the number of sheep north of Muttaburra has drastically declined. The move away from sheep and the continuing drought in the south east of the region in 2003 has impacted severely on larger centres like Blackall, which have been heavily reliant on servicing the wool industry.

Despite the pick-up in prices and the improved outlook for the industry at the end of the 1990s, flock numbers have continued to decline due to competition for land from beef producers, good live export prices, good mutton prices, wild dogs and low reproductive rates exacerbated by frequent drought conditions.

The strong market for sheep meat has been one glimmer of hope in the industry during more than a decade of crisis. Mutton has returned to favour and has been marketed as a restaurant product from the region. Several sheep producers in the region have moved into lamb production and send animals to Blackall (the only remaining killing works in the region) for slaughter. Complementing this move to meat has been the development of a modest industry based on purely meat-sheep breeds such as the Damara and Dorper which are well adapted to difficult conditions.

The emphasis on diversification was once based on water; it has now shifted with a realisation that large-scale irrigated agriculture will never happen in the region. Despite the lack of reliable water supplies, there are still people in the region looking at aquaculture and small-scale irrigated agriculture. However, for most landholders the future lies in opportunities to market produce innovatively. A prime example is the OBE Beef Group, based in the Channel Country, which now has around 30 producers providing organic beef to the world.

Goat production has also risen in the area in the past decade with a move away from harvesting feral goats to managed herds. These use improved genetics, often based on Boer goat bucks over feral nannies. The goat industry has been assisted by a reliable market and the construction of a goat meat abattoir at Charleville.

Another opportunity with goats involves the control of woody plant encroachment and invasive weeds. They are also being run in tandem with camels on areas infested with exotic weeds such as parkinsonia and prickly acacia. Camels eat from the top down while the goats go from the bottom up, often killing the plant without the need for any additional action. The added advantage, in this situation, is that these browsing animals can be co-grazed with sheep or cattle without placing additional grazing pressure on pastures.

The game meat industry, which harvests kangaroos and pigs across much of the region, is a significant employer. Any moves to develop strategies to manage total grazing pressure must closely involve the kangaroo industry. Region wide projects to manage feral pig numbers also must involve the people who gain a livelihood from harvesting pigs. The major centre for the kangaroo industry is Blackall whilst several smaller centres along the lower Thomson are dependent on pig harvesting.

Gross value of DCQ's agricultural production 2000-01 was $500 million (QRBIS). Livestock disposals and products comprise almost all of the total value of agricultural production in the region: the balance is a small amount of fodder harvesting ($5.3 million in the year to March 2000).

Table 9: Agricultural production

Total agricultural production and the value of stock and wool sales shown in millions of dollars							
Year to	Mar 99			Mar 00			June 01
Contributing factors	destocking continues due to drought, low wool prices, low sheep prices			good wet (cattle return from agistment, turn-off drops, lift in prices), cattle producers buying up sheep country, low wool and sheep prices, little restocking with sheep			booming cattle prices, great season in Channel Country, lift in sheep prices
Shire	Stock	Wool	Total	Stock	Wool	Total	Total
Winton	$32.3	$13.4	$45.7	16.1	$8.8*	24.9	$53.6
Blackall	$23.1	$8.7	$31.9	26.5	$8.8*	35.3	$40.9
Aramac	$12.2*	$12.9	$25.1	15.2	$14.7*	29.9	$26.8
Boulia	n/a	n/a	n/a	21.7	$3.5*	25.2	$42.8
Barcoo	$15.9	n/a	n/a	29.2	$1.1*	30.3	$49.2
Longreach	n/a	n/a	n/a	19.6	$15.2*	34.8	$51.0

Note: some numbers may not add up due to rounding
Source: ABS, Agriculture, Queensland (unpublished data).

* assumed value
n/a figures not available

The above table has limited data but does show the influence of commodity prices, drought (1999), the shift from sheep to cattle (2000), good seasons and booming cattle prices (2001). Note: there is no breakdown for the 2001 figures.

The DCQ region has relatively few animal husbandry issues. While Foot and Mouth disease (FMD) risk is ever present, nationwide contingencies (e.g. The Australian Veterinary Emergency Plan (AUSVETPLAN)) have been put in place to monitor and control a potential outbreak. Three-day sickness in cattle is an ongoing concern, particularly in the Channel Country after flooding when there is a the build-up of biting insects which can spread the disease (Jackson pers. comm.). Threats to Queensland livestock and human health, spread via feral pigs, include exotic diseases: FMD; Classical Swine Fever; Aujseky's Disease; Japanese Encephalitis; Swine Vesicular Disease; African Swine Fever; Trichonosis; Rabies; Screw-worm fly infestations; along with endemic diseases: Brucellosis; Tuberculosis; Porcine Parvovirus; Leptospirosis; Melioidosis; Sparganosis; Murray Valley Encephalitis (Choquenot et al. 1996).

Botulism, a common disease in parts of the region, can be related to phosphorus deficiency, and consequent bone chewing (Ahern, et al. 1994). It is ever present in the environment and is caused by *Clostridium botulinum*, a group of bacteria commonly found in soil. Equine Infectious Anaemia (EIA) is an ongoing risk to horses in the DCQ region.

Tourism

The DCQ region has a highly recognised and well-established tourism sector. Tourism has provided opportunities particularly along the themed route, the Matilda Highway, where several major attractions have been developed. The first, the Australian Stockman's Hall of Fame (opened 1988) has now been joined by the Blackall Woolscour, Barcaldine's Worker's Heritage Centre and the Waltzing Matilda Centre in Winton and Lark Quarry dinosaur tracks.

The area centred on this corridor attracted 290,000 of the 714,000 people who visited outback Queensland in 2001. This is a considerable rise from the 1996-97 when 323,000 visitors came to outback Queensland and spent $86.3 million (Outback Queensland Tourism Authority).

This growth in outback travel, fuelled by burgeoning recreational vehicle ownership, better roads and a love affair with the outback, has also benefited smaller communities. A number of byways have been established taking tourists through the Channel Country to Birdsville and across the Simpson Desert. This area is the heartland of Lake Eyre Basin tourism with major flow routes from Boulia to Birdsville and the Birdsville Track, across to Innamincka and Windorah. Visitation to this remote part of Australia has grown significantly in recent times, fuelled by promotion of the Outback through the Year of the Outback 2002 and the widespread availability of four-wheel drive recreational vehicles.

This remote area tourism has significant negative impact on some of our most fragile sites, and needs to be managed if the industry is to be sustainable.

In 2001, approximately 293,000 people visited the region, 65% were self-drive; Birdsville saw 50,000 of these and Innamincka (SA) 45,000. Most of those visiting Innamincka would have either come from, or be going on to, the DCQ part of Queensland.

Tourism is still a seasonal industry largely driven by the 'grey nomads' (retired, 50 plus age group) who journey through the area in the cooler months. These visitors are very cost conscious and are becoming selective as to which attractions they visit. Increases in fuel costs have impacted on this market in the past and are a potential threat to future growth in the industry. The proportion of international or younger visitors to the region is small.

Local government now sees tourism as a viable and important part of economic development. This is reflected by the employment of tourism officers, and the development of tourism plans. The Outback Queensland Tourism Authority, with support from Tourism Queensland, is the main regional tourism body actively marketing the region.

In the Central West region to March 2001 there were 1,406 hotel, motel, resort, guesthouse and serviced apartment rooms in accommodation establishments with 15 or more rooms. This represented 2.7% of the Queensland industry. Longreach Shire accounted for 13.4% (189 rooms) of the total number of Outback rooms. Longreach Shire contributed 13.8% or $2.4 million of the Outback Tourism region's takings. (ABS, Tourist Accommodation, Queensland).

Tourism has been consistently identified as an area of interest, opportunity and concern by many community consultations, plans and strategies in recent years. In 2001 the Lake Eyre Basin Coordinating Group initiated a two-year project to evaluate and report on Heritage Tourism in the Lake Eyre Basin. The Heritage Division of the Department of Environment and Heritage was a major partner in this project which was funded by the Department of Transport and Regional Services, Regional Solutions Program. The final report, *Lake Eyre Basin Heritage Tourism – Future Directions*, provides the first comprehensive overview of tourism dynamics in the Basin.

Findings from this significant project show that tourism is rapidly emerging as a major form of land use alongside more traditional practices such as pastoralism and mining. Natural and cultural heritage assets are seen by some as commodities with commercial value (Schmiechen, 2003.). This has a significant bearing on issues of access both on pastoral leasehold lands and protected areas, as well as becoming a major consideration in any integrated land management approach.

Lake Eyre Basin Heritage Tourism – Future Directions indicates significant challenges ahead in planning for the sustainable use of many of the natural heritage attractions of the Channel Country. Examples of environmental issues include the damage that uncontrolled vehicle access and camping can do to the fragile banks of the waterholes in the lower Cooper. This report also raises a range of issues that need to be addressed if tourism is not going to have unsustainable impacts on the natural resources of the region (Schmiechen, 2003.).

Lake Eyre Basin Heritage Tourism – Future Directions provides a benchmark and guide to sound planning and actions to ensure tourism can operate and develop within clear parameters and become an integral part of the land management process.

Mining & petroleum

The mining and petroleum industry, while driving considerable economic activity in the south and the north, exports most of its products and income outside the region. Many of the large-scale operations employ fly-in-fly-out crews which limits the local flow-on employment and economic benefits. In addition, nearly all the production from these

enterprises leaves the region. However some of the considerable gas production is used in the Barcaldine gas fired power station to supplement coal fired power from the national grid. Ironically, most of the liquid fuels produced in the Eromanga refinery leave the region only to be replaced with fuel from refineries in the east.

The BHP Billiton Cannington Mine is just inside to boundary of the DCQ region. During the 2000-2001 financial year it earned almost A$450 million in exports, contributing about A$16 million to the Queensland economy in royalties, and some A$94 million directly to regional economies through wages and purchases (this is mainly to Cloncurry and Townsville and would be negligible in the case of the DCQ economy). With approximately 570 staff (both BHP employees and contractors), Cannington Mine produced almost 960 tonnes of silver contained in 317,000 tonnes of lead and 165,000 tonnes of zinc concentrates in the 2001-2002 financial year. The ore body is a finite resource and is expected to end in 2016. Cannington Mine has an exemplary environmental management program, often exceeding legislative requirements. For example the Company performance in recycling, with 80% recycling of material considered recyclable (BHP Billiton Website).

About 50 kilometres west-south-west of Cannington is the Osborne Copper/Gold Mine. Wholly owned by Placer Dome Inc, it employs 265 staff and is run as a fly-in fly-out operation. Production in 2001 was 49,213 tonnes of copper and 41,706 ounces of gold, from both underground and open-pit operations (Mining Industry Website).

Western Mining Corporation (WMC) Fertilisers' Phosphate Hill project 150 km south of Mt Isa is a combined open-cut mine and phosphoric acid, ammonia and fertiliser manufacturing plant. Completed in 1999, this $700 million dollar development is a major employer and contributor to regional, State and National economies. The Phosphate Hill deposit has a 15-year strategy to develop to a large-scale, low-cost producer. Australia has imported much of its phosphate fertiliser for many years; this operation will have a significant impact on Australia's balance of trade (Western Mining Corporation Website).

Santos, a major Australian energy company, is the nation's largest producer of natural gas. The core of Santo's business is a majority working interest in the Cooper/Eromanga Basin oil and gas fields. Two main facilities exist in the DCQ area. The Ballera gas plant is located in the central part of the Cooper/Eromanga Basin. Natural gas from surrounding fields is transported to the plant for processing. Gas liquids (condensate and liquid petroleum gases) are transported by pipeline to Moomba in SA. A gas pipeline also runs from Ballera to Mt Isa. The Jackson oil production facility, 70 km southeast of Ballera processes oil from surrounding fields and pipes it to Brisbane.

Santos produces sales gas, ethane, crude oil, condensate and LPG. In 2002 production reached a record level of 57.3 million barrels of oil equivalent. Santos annual sales revenue as at 31 December 2002 was $1,478.4 million and they employed 616 staff and 500 contractors in the Cooper Basin. Santos presently produces nearly all the gas consumed in South Australia, NSW and ACT, and is a major supplier to southeast Queensland (Santos website).

While there are no figures for the DCQ region, in that part of the region that conforms to the ABS statistical division of Central West, there were 47,700 tonnes, or 10% of Queensland's production, of crude oil produced in 2000-01, valued at $14.6 million.

Outside of this statistical division, but still inside DCQ is the Jackson oil facility. It accepts production from approximately 40 oil fields (including Watson, Tickalara, Cooroo

and Naccowlah) containing about 182 oil wells and pipes it on to the Lytton refinery in Brisbane. Theses fields originally contained over 360 million barrels of oil of which about 110 million barrels will ultimately be recovered. To date about 95 million barrels has been produced (Santos website).

In addition, there are many small, private mining enterprises across the region. In contrast with the large mining corporations, the income generated from these small-scale operators tends to remain in the region.

Opal mining occurs in the central part of the DCQ region from the Winton district south to the Quilpie area. Key areas include Middleton, Opalton, Kynuna, Opalville, Yaraka, Thomas Mountains, Mayneside and the Kyabra-Eromanga region. In the ABS statistical division of Central West there was over $1 million worth mined in 2000-01.

Gypsum (2,500 tonnes in 2000-01, worth over $11,000) is mined near Winton and transported by road and rail, mostly for use on Burdekin cane fields.

Energy

Despite this abundance of energy, the cost of, and access to, usable energy (large parts of the region are beyond the electricity grid) is a significant economic cost in remote areas.

Hot dry rocks, or radiogenic granite, underlie large parts of the region. The proving of this potential geothermal energy source has been underway throughout 2004 in the south of the region. This energy source has the potential to power the nation for several centuries and its harnessing could be one of the region's major resource and economic developments over the next 10 to 20 years.

Summary of principle issues

Water

Access to water, regardless of where it comes from (surface or underground), is an issue for all communities. Centres dependent on surface water such as Longreach, Isisford, Yaraka, Jundah and Windorah all faced significant restrictions in water use in the 2002/03 drought. This has driven some communities to secure better supplies, augment with underground water, as well as focus on the wiser use of water. Local government is moving to review how it supplies and charges for water to bring the use of this resource more into line with the water reform agenda across Australia.

Drought

The drought of the mid 1990s was made worse by low commodity prices, which in turn put a hold on investment in infrastructure and natural resource management. In contrast the 2002/03 drought has seen an expanded cattle industry in the region benefit from strong demand for red meat which also benefited sheep producers hampered by stagnant wool prices. Excess sheep, which a decade earlier were either shot or given away, sold during the recent drought for close to $20 per head.

The two major changes in the management of stock in the last drought were the ready ability to destock at good prices, and the financial capacity to augment fodder supplies with feed brought in from outside the region. The use of licks has also risen but there are concerns that such supplements could encourage graziers to leave stock on depleting pastures for too long. Nonetheless there are more options which have the potential to

allow landholders to more sustainably manage their pastures. Investment in improved water distribution has also made additional areas of pasture available, which could make for more sustainable grazing but alternatively could place greater pressure on biodiversity.

Pressures on personal life often come to a head during drought. The extra financial burden can result in low self esteem which can lead to depression and in extreme cases, with the husband, suicide. When there is no money for boarding school, some mothers have moved into a town with the kids for education. In addition, some wives have had to take up paid, off-farm employment to relieve the budget bottom line. Both of these circumstances have not only split the family unit but removed the mutual support and task sharing.

Economic pressures

Attitudes to natural resources and the industries they support have been changing. The concept that the traditional grazing industries would always have a future came into question in the mid 1990s when land values stagnated, wool prices tumbled and drought impacted on cattle numbers. People looked to diversification and many subscribed to the old adage that 'given water, you can grow anything'. A proposal to grow cotton on the Cooper and the robust public debate that followed polarised the community into for and against irrigation. The issue was finally brought to an end by the political decision to ban, through the Cooper Creek Water Management Plan released in 2000, any new irrigation in the catchment.

Tourism and services have lessened the impact of seasonal conditions and commodity process on the non-rural sector of the community even though the grazing industry still dominates the economy. The recent boom in cattle prices to record levels has driven soaring land values throughout the region to levels that, in the eyes of many, are not sustainable. The more sought-after country has increased by as much as 200% with the attendant but lesser flow on to other types. A decline in the beef industry and a collapse of land values, if coincident with poor seasonal conditions, is the biggest single foreseeable risk to the economy of the region.

Weeds

Weeds clearly have a massive impact on the productivity of the region and the well-being of the community. Is estimated that prickly acacia costs landholders $5 million per year in control and lost production, mainly in the DCQ and Southern Gulf regions. If left unchecked, the impact of this weed could rise significantly. Large amounts of landcare group time and local government resources in the region are devoted to weed control. Weeds are a focus for landcare groups and restrict the ability of these groups to participate in other aspects of natural resource management.

Wild dogs

Local government in the east of the region has been under considerable financial strain coping with the cost of wild dog control. Several shires in the region spend more than $100,000 (Blackall Shire spends $200,000 or around 20% of its rate base) on this aspect of natural resource management alone. This commitment to wild dog control makes it very difficult for some shires to assist landholders with strategic weed control.

Tree clearing

Shifts in government policy, with respect to tree clearing, cut short community engagement in developing regional tree clearing guidelines or vegetation management plans, and have caused disillusionment in parts of the landholder community. The tree clearing issue, coupled with angst over the water planning process, has only enhanced the community's significant distrust of government. This has caused suspicion of the regional natural resource management process which is seen by many as 'government'.

Population decline

The decline in rural population means there are fewer people to be engaged in land management; the capacity to manage our land sustainably is being reduced.

Some National Parks, once profitable properties employing people and contributing to the local economy, QPWS policy now sees many parks in the region with no permanent residents. Not only is the National Parks workforce smaller, capital expenditure over the given area of land is also much smaller than it would be for a comparable, commercial area. Conversely, they supply ecosystem services which benefit everyone, and may be attracting more visitors to the region.

Waste

Management of waste is also an area where communities in the region are facing pressures to do better. Environmental regulation is driving local government to ban the burning of refuse tips which will incur significant costs to dispose of refuse in landfill. Distance makes recycling of materials, other than scrap metal, uneconomic. This is a major challenge for remote areas and cooperation of local governments in developing a waste management strategy could provide opportunities for more cost efficient recycling.

Note: The figures presented in this profile are derived from several sources. Anecdotal and gut feel (the 2 principle compilers of this report have, between them, spent more than 50 years in the region) play an important role in presenting the broad overview. The Australian Bureau of Statistics (ABS) 2001 Census is heavily drawn on, mainly through the QRBIS (Queensland Regional Bodies Information System) database maintained by the Office of Economic and Statistical Research (OESR).

The Desert Channels region is made up of 10 whole shires (Aramac, Barcaldine, Barcoo, Blackall, Boulia, Diamantina, Ilfracombe, Isisford, Longreach, Winton) and 9 part shires (Bulloo, Cloncurry, Dalrymple, Flinders, Jericho, McKinlay, Mount Isa, Quilpie, Tambo). The QRBIS database provides the best match for our region even though it excludes the relevant parts of McKinlay and Dalrymple shires from its statistics. While the ABS Statistical Division of the Central West is a much looser match to DCQ, it still provides useful information which is not yet available from QRBIS. Consequently, there may be small discrepancies in some of the figures presented in this profile.

Appendices

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Appendix 2 – Rare and Threatened Species

(under Queensland's Nature Conservation Act [1992] and the Commonwealth's Environment Protection and Biodiversity Conservation Act [1999])

(source: WILDNET data capture 2003)

NCA codes: E = Endangered V = Vulnerable R = Rare

EPBC codes: E = Endangered V = Vulnerable R = Rare CE = Critically Endangered CD = Critically Dependent

Scientific Name	Common Name	NCA	EPBC	Group
Acacia ammophila		V	V	Plant
Acacia crombiei	pink gidgee	V	V	Plant
Acacia deuteroneura		V	V	Plant
Acacia meiosperma		R		Plant
Acacia peuce	waddy	V	V	Plant
Acacia ramiflora		E	V	Plant
Acacia spania		R		Plant
Acacia strongylophylla		R		Plant
Acacia tenuinervis		R		Plant
Accipiter novaehollandiae	grey goshawk	R		Bird
Amytornis barbatus	grey grasswren	R		Bird
Amytornis dorotheae	Carpentarian grasswren	R		Bird
Amytornis striatus	striated grasswren	R		Bird
Antechinomys laniger	kultarr	R		Mammal
Aristida burraensis,		R		Plant
Aspidites ramsayi	woma	R		Reptile
Atriplex fissivalvis		R		Plant
Atriplex lobativalvis		R		Plant
Atriplex morrisii		R		Plant
Babingtonia squarrulosa		V		Plant
Bertya pedicellata		R		Plant
Boronia eriantha		R		Plant
Brachychiton collinus		R		Plant
Brachyscome eriogona		R		Plant
Brachyscome tesquorum		R		Plant
Cacatua leadbeateri	Major Mitchell's cockatoo	V		Bird
Cadellia pentastylis	ooline	V	V	Plant
Cajanus lanuginosus		R		Plant

Callistemon chisholmii		R		Plant
Calotis suffruticosa		R		Plant
Cerbera dumicola		R		Plant
Chalinolobus picatus	little pied bat	R		Mammal
Chlamydogobius micropterus	Elizabeth Springs goby	E	E	Fish
Chlamydogobius squamigenus	Edgbaston goby	E	V	Fish
Corymbia gilbertensis	Gilbert River ghost gum	R		Plant
Ctenotus aphrodite		R		Reptile
Ctenotus ariadnae		R		Reptile
Ctenotus capricorni		R		Reptile
Ctenotus schevilli		R		Reptile
Ctenotus serotinus		R		Reptile
Cyclorana verrucosa	rough collared frog	R		Amphibian
Dasycercus cristicauda	mulgara	V	V	Mammal
Dasycercus hillerii	ampurta	C	E	Mammal
Dasyuroides byrnei	kowari	V	V	Mammal
Desmodium macrocarpum		R		Plant
Dichanthium setosum,		R	V	Plant
Egernia rugosa	yakka skink	V	V	Reptile
Ephippiorhynchus asiaticus	black-necked stork	R		Bird
Epthianura crocea	yellow chat	V		Bird
Eremophila alatisepala,		R		Plant
Eremophila tetraptera		V	V	Plant
Eriocaulon carsonii		E	E	Plant
Eryngium fontanum,		E	E	Plant
Erythrotriorchis radiatus	red goshawk	E	V	Bird
Erythrura gouldiae	Gouldian finch	E	E	Bird
Eucalyptus quadricostata		R		Plant
Euphorbia sarcostemmoides	climbing caustic	R		Plant
Falco hypoleucos	grey falcon	R		Plant
Fimbristylis vagans		R		Plant
Furina barnardi	yellow-naped snake	R		Reptile
Goodenia angustifolia		R		Plant
Gossypium sturtianum		R		Plant
Gossypium sturtianum var. sturtianum		R		Plant

Grantiella picta	painted honeyeater	R		Bird
Grevillea venusta	grevillea	V	V	Plant
Hakea maconochieana		V	V	Plant
Heteromunia pectoralis	pictorella mannikin	R		Bird
Indigofera oxyrachis		V		Plant
Lasiorhinus krefftii	northern hairy-nosed wombat[8]	E	E	Mammal
Lawrencia buchananensis		V	V	Plant
Leptosema chapmanii		R		Plant
Leptosema sp. (Burra Range F.D.Hockings 30)		R		Plant
Lerista wilkinsi		R		Reptile
Lophoictinia isura	square-tailed kite	R		Bird
Macarthuria ephedroides		R		Plant
Maccullochella peeli peeli	Murray cod[9]		V	Fish
Macroderma gigas	ghost bat	V		Mammal
Macrotis lagotis	greater bilby	E	V	Mammal
Maireana cheelii	a bluebush	C	V	Plant
Melithreptus gularis	black-chinned honeyeater	R		Bird
Micromyrtus rotundifolia		V		Plant
Miniopterus schreibersii oceanensis	eastern bent-wing bat	C	CD	Mammal
Mukia sp. (Longreach D.Davidson AQ279935)		E	E	Plant
Myriophyllum implicatumt,		R		Plant
Myriophyllum sp. (Aramac B.A.Wilson 110)		E		Plant
Neochmia phaeton	crimson finch	V		Bird
Nesaea robertsii		E		Plant
Nettapus coromandelianus	cotton pygmy-goose	R		Bird
Ninox strenua	powerful owl	V		Bird
Notomys fuscus	dusky hopping-mouse	E	V	Mammal
Onychogalea fraenata	bridled nailtail wallaby	E	E	Mammal
Oxyuranus microlepidotus	western taipan	R		Reptile
Pedionomus torquatus	plains-wanderer	V	V	Bird
Peripleura sericea		R		Plant
Petrogale purpureicollis	purple-necked rock-wallaby	V		Mammal

[8] Presumed extinct in the Desert Channels Queensland region

[9] Native species introduced to the Lake Eyre Basin

Pezoporus occidentalis	night parrot	E	E	Bird
Polytelis alexandrae	princess parrot	C	V	Bird
Pseudechis colletti	Collett's snake	R		Reptile
Pseudomys australis	plains rat	E	V	Mammal
Pterodroma arminjoniana heraldica	Herald petrel	E	CE	Bird
Ptilotus blakeanus		R		Plant
Ptilotus brachyanthus		R		Plant
Ptilotus maconochiei		R		Plant
Ptilotus pseudohelipteroides		R		Plant
Ptilotus remotiflorus		R		Plant
Pyrrholaemus brunneus	redthroat	R		Bird
Rhaphidospora bonneyana		V	V	Plant
Rhinonicteris aurantius	orange leaf-nosed bat	V		Mammal
Rhodanthe rufescens		R		Plant
Rostratula benghalensis	painted snipe	R		Bird
Rulingia salviifolia	sage-leaved rulingia	R		Plant
Scaturiginichthys vermeilipinnis	red-finned blue-eye	E	E	Fish
Sclerolaena blackiana	Black's copperburr	R		Plant
Sclerolaena blakei		V	V	Plant
Sclerolaena everistiana		R		Plant
Sclerolaena walkeri		V	V	Plant
Simoselaps warro	robust burrowing snake	R		Reptile
Sminthopsis douglasi	Julia Creek dunnart	E	E	Mammal
Sporobolus pamelae		E		Plant
Sporobolus partimpatens		R		Plant
Steganthera australiana		R		Plant
Stictonetta naevosa	freckled duck	R		Bird
Tadorna radjah	radjah shelduck	R		Bird
Taphozous troughtoni	Troughton's sheathtail bat	E		Mammal
Thryptomene hexandra		R		Plant
Xerothamnella parvifolia		V	V	Plant

Appendix 3 – Birds of the Desert Channels Region

('M' after common name indicates it is listed under the EPBC Act as a migratory species)

Family	Common Name		*Scientific Name*
Accipitridae	black kite		*Milvus migrans*
Accipitridae	black-breasted buzzard		*Hamirostra melanosternon*
Accipitridae	black-shouldered kite		*Elanus axillaris*
Accipitridae	brown goshawk		*Accipiter fasciatus*
Accipitridae	collared sparrowhawk		*Accipiter cirrhocephalus*
Accipitridae	grey goshawk		*Accipiter novaehollandiae*
Accipitridae	letter-winged kite		*Elanus scriptus*
Accipitridae	little eagle		*Hieraaetus morphnoides*
Accipitridae	Pacific baza		*Aviceda subcristata*
Accipitridae	red goshawk		*Erythrotriorchis radiatus*
Accipitridae	spotted harrier		*Circus assimilis*
Accipitridae	square-tailed kite		*Lophoictinia isura*
Accipitridae	swamp harrier		*Circus approximans*
Accipitridae	wedge-tailed eagle		*Aquila audax*
Accipitridae	whistling kite		*Haliastur sphenurus*
Accipitridae	white-bellied sea-eagle		*Haliaeetus leucogaster*
Anatidae	Australasian shoveler	M	*Anas rhynchotis*
Anatidae	Australian shelduck	M	*Tadorna tadornoides*
Anatidae	Australian wood duck	M	*Chenonetta jubata*
Anatidae	Black swan	M	*Cygnus atratus*
Anatidae	Blue-billed duck	M	*Oxyura australis*
Anatidae	Cape barren goose	M	*Cereopsis novaehollandiae*
Anatidae	Chestnut teal	M	*Anas castanea*
Anatidae	Cotton pygmy-goose	M	*Nettapus coromandelianus*
Anatidae	Freckled duck	M	*Stictonetta naevosa*
Anatidae	Green pygmy-goose	M	*Nettapus pulchellus*
Anatidae	Grey teal	M	*Anas gracilis*
Anatidae	Hardhead	M	*Aythya australis*
Anatidae	Magpie Goose	M	*Anseranas semipalmata*
Anatidae	Maned duck		*Chenonetta jubata*
Anatidae	Musk duck	M	*Biziura lobata*
Anatidae	Pacific black duck	M	*Anas superciliosa*

Anatidae	Pink-eared duck	M	*Malacorhynchus membranaceus*
Anatidae	Plumed whistling-duck	M	*Dendrocygna eytonii*
Anatidae	Radjah Shelduck	M	*Tadorna radjah*
Anatidae	Wandering whistling-duck	M	*Dendrocygna arcuata*
Anatidae	Australian wood duck		*Chenonetta jubata*
Anhingidae	Darter		*Anhinga melanogaster*
Apodidae	fork-tailed swift		*Apus pacificus*
Apodidae	white-throated needletail		*Apodidae Hirundapus caudacutus*
Ardeidae	Australasian bittern		*Botaurus poiciloptilus*
Ardeidae	Black bittern		*Ixobrychus flavicollis*
Ardeidae	Cattle egret		*Ardea ibis*
Ardeidae	Great egret		*Ardea alba*
Ardeidae	Great-billed heron		*Ardea sumatrana*
Ardeidae	Intermediate egret		*Ardea intermedia*
Ardeidae	Little bittern		*Ixobrychus minutus*
Ardeidae	Little egret		*Ardea garzetta*
Ardeidae	Pacific heron		*Ardea pacifica*
Ardeidae	Pied heron		*Ardea picata*
Ardeidae	Rufous night heron		*Nycticorax caledonicus*
Ardeidae	Striated heron		*Ardea striata*
Ardeidae	White-faced heron		*Ardea novaehollandiae*
Charadriidae	Banded lapwing		*Vanellus tricolor*
Charadriidae	black-fronted dotterel		*Elseyornis melanops*
Charadriidae	inland dotterel		*Charadrius australis*
Charadriidae	Inland dotterel		*Peltohyas australis*
Charadriidae	Masked lapwing		*Vanellus miles*
Charadriidae	Masked lapwing (northern subspecies)		*Vanellus miles miles*
Charadriidae	oriental plover		*Charadrius veredus*
Charadriidae	Red-capped plover		*Charadrius ruficapillus*
Charadriidae	Red-kneed dotterel		*Erythrogonys cinctus*
Ciconiidae	Black-necked stork		*Ephippiorhynchus asiaticus*
Cuculidae	oriental cuckoo		*Cuculus saturatus*
Falconidae	Australian hobby		*Falco longipennis*
Falconidae	black falcon		*Falco subniger*
Falconidae	brown falcon		*Falco berigora*

Falconidae	grey falcon		*Falco hypoleucos*
Falconidae	nankeen kestrel		*Falco cenchroides*
Falconidae	peregrine falcon		*Falco peregrinus*
Glareolidae	oriental pratincole		*Glareola maldivarum*
Gruidae	Brolga	M	*Grus rubicundus*
Gruidae	Sarus crane	M	*Grus antigone*
Jacanidae	Comb-crested jacana		*Irediparra gallinacea*
Meropidae	rainbow bee-eater		*Merops ornatus*
Pelecanidae	Australian pelican		*Pelecanus conspicillatus*
Phalacrocoracidae	Great cormorant		*Phalacrocorax carbo*
Phalacrocoracidae	Little black cormorant		*Phalacrocorax sulcirostrus*
Phalacrocoracidae	Little pied cormorant		*Phalacrocorax melanoluecos*
Phalacrocoracidae	Pied cormorant		*Phalacrocorax varius*
Podicipedidae	Australasian little grebe		*Tachybaptus novaehollandiae*
Podicipedidae	Great crested grebe		*Podiceps cristatus*
Podicipedidae	Hoary-headed grebe		*Podiceps poliocephalus*
Rallidae	Australian crake		*Porzana fluminea*
Rallidae	Baillon's crake		*Porzana pusilla*
Rallidae	Black-tailed native-hen		*Gallinula ventralis*
Rallidae	Buff-banded rail		*Rallus philippensis*
Rallidae	Bush-hen		*Gallinula olivacea*
Rallidae	Chestnut rail		*Eulabeornis castaneoventris*
Rallidae	Dusky moorhen		*Gallinula tenebrosa*
Rallidae	Eurasian coot		*Fulica atra*
Rallidae	Lewin's rail	M	*Rallus pectoralis*
Rallidae	Purple swamphen		*Porphyrio porphyrio*
Rallidae	Red-necked crake		*Rallina tricolor*
Rallidae	Spotless crake		*Porzana tabuensis*
Rallidae	Tasmanian native-hen		*Gallinula mortierii*
Rallidae	White-browed crake		*Poliolimnas cinereus*
Recurvirostridae	Banded stilt	M	*Cladorhynchus leucocephalus*
Recurvirostridae	Black-winged stilt	M	*Himantopus himantopus*
Recurvirostridae	Red-necked avocet	M	*Recurvirostra novaehollandiae*
Rostratulidae	Painted snipe	M	*Rostratula benghalensis*
Scolopacidae	Bar-tailed godwit		*Limosa lapponica*
Scolopacidae	Black-tailed godwit	M	*Limosa limosa*

Scolopacidae	common greenshank		*Tringa nebularia*
Scolopacidae	Common sandpiper		*Tringa hypoleucos*
Scolopacidae	Curlew sandpiper		*Calidris ferruginea*
Scolopacidae	Greenshank		*Tringa nebularia*
Scolopacidae	Latham's snipe	M	*Gallinago hardwickii*
Scolopacidae	Long-toed stint		*Calidris subminuta*
Scolopacidae	Marsh sandpiper		*Tringa stagnatilis*
Scolopacidae	pectoral sandpiper		*Calidris melanotos*
Scolopacidae	Red-necked stint		*Calidris ruficollis*
Scolopacidae	Sharp-tailed sandpiper		*Calidris acuminata*
Scolopacidae	Wood sandpiper		*Tringa glareola*
Sternidae	Caspian tern		*Hydroprogne caspia*
Threskiornithidae	Australian white ibis		*Theskiornis molucca*
Threskiornithidae	Glossy ibis	M	*Plegadis falcinellus*
Threskiornithidae	Straw-necked ibis		*Theskiornis spinicollis*
Threskiornithidae	Royal spoonbill		*Platalea regia*
Threskiornithidae	Yellow-billed spoonbill		*Platalea flavipes*

Appendix 4 – List of nationally important wetlands in Queensland

Wetland name	Bioregion	Area (ha)
Aramac Springs	Desert Uplands	400
Austral Limestone Aggregation	Mitchell Grass Downs	69,395
Birdsville—Durrie Waterholes Aggregation	Channel Country	32,656
Bulloo Lake	Channel Country	83,227
Cooper Creek Overflow Swamps—Windorah	Channel Country	124,853
Cooper Creek Swamps—Nappa Merrie	Channel Country	106,311
Cooper Creek—Wilson River Junction	Channel Country	63,925
Diamantina Lakes Area	Channel Country	393
Diamantina Overflow Swamp —Durrie Station	Channel Country	29,196
Elizabeth Springs	Mitchell Grass Downs	400
Georgina River—King Creek Floodout	Channel Country	138,347
Lake Buchanan	Desert Uplands	23,201
Lake Constance	Channel Country	1,841
Lake Cuddapan	Channel Country	1,704
Lake Galilee	Desert Uplands	25,778
Lake Mipia Area	Channel Country	69,691
Lake Phillipi	Channel Country	16,086
Lake Torquinie Area	Channel Country	15,242
Lake Yamma Yamma	Channel Country	86,548
Mitchell Swamp	Mulga Lands	5,000
Moonda Lake—Shallow Lake Aggregation	Channel Country	14,738
Mulligan River—Wheeler Creek Junction	Channel Country	17,014
Muncoonie Lakes Area	Channel Country	88,767
Toko Gorge and Waterhole	Channel Country	243

Appendix 5 – Acronyms and Abbreviations

ABS	Australian Bureau of Statistics
AQIS	Australian Quarantine and Inspection Service
ARIDFLO	Australian Arid Zone Rivers Project
BOM	Bureau of Meteorology
BSE	Bovine spongiform encephalopathy ('mad cow disease')
CCCC	Cooper Creek Catchment Committee
CSIRO	Commonwealth Scientific Industrial Research Organisation
DCQ	Desert Channels Queensland
DPI	Department of Primary Industries
DU	Desert Uplands
DUBUDSC	Desert Uplands Build-Up & Development Strategy Committee
EPA	Environment Protection Authority
FMD	Foot and Mouth Disease
GAB	Great Artesian Basin
GABSI	Great Artesian Basin Strategic Initiative
GDCC	Georgina Diamantina Catchment Committee
ILUA	Indigenous Land Use Agreement
INRM	Integrated Natural Resource Management
LEB	Lake Eyre Basin
LEBCG	Lake Eyre Basin Coordinating Group
LEBIIS	Lake Eyre Basin Integrated Information System
LPG	Liquid Petroleum Gas
NAPSWQ	National Action Plan for Salinity and Water Quality
NHT	Natural Heritage Trust
NHT2	National Heritage Trust 2
NR&M	Natural Resources & Mines
NTA	Native Title Act
QPWS	Queensland Parks Wildlife Service
RAMSAR	Convention for Wetlands of International Importance
SOI	Southern Oscillation Index
WARLUS	Western Area Land Use Study
WQ	Western Queensland

Appendix 6 – Bibliography

Australian Communications Authority (1999-2000), Telecommunications Performance Report, Chapter 5, Mobile Services, pp.83-105

Ahern, C.R., Shields, P.G., Enderlin, N.G. and Baker, D.E. (1994), The Soil Fertility Of Central and North-East Queensland Grazing Lands, Report prepared for The Meat Research Corporation and Queensland Department of Primary Industries, Brisbane.

ARIDFLO, (2002), Biological and Hydrological Information Booklets, Thomson River Reach, Lower Cooper Creek Reach and Upper Diamantina Reach. Department of land Water and Biodiversity Conservation, Environmental Protection Agency, Queensland and South Australian Government.

Australian Bureau of Statistics, 2001 Census Basic Community Profile and Snapshot 3 Queensland, Aramac, Barcaldine, Barcoo, Blackall, Boulia, Diamantina, Ilfracombe, Isisford, Longreach, Tambo and Winton Shires, Australia Now 2 Australian Social Trends Population – Population Distribution: Population characteristics and remoteness, www.abs.gov.au

Australian Natural Resources Atlas 2002.

Australian Rainman, Interactive climate database, Centre for Climate Applications, Queensland Department of Primary Industries

Bailey, V. (2001), Western Streams Water Quality Monitoring Project, NRM Brisbane QNRM01076

Bailey, V & Long, P. (2001), Wetland, Fish and Habitat Survey in the Lake Eyre Basin, Queensland: Final Report, NRM Brisbane QNRM01074

Barter, MA and Harris, K 2002. Occasional Count No 6. Shorebird counts in the NE South Australia-SW Queensland region in September-October 2000. The Stilt 41, 44-47.

Beattie, A. and Ehrlich, P. (2001), Wild Solutions - How Biodiversity is Money in the Bank, Melbourne University Press, Australia.

Boulter, S.L., Wilson, B.A., Westrup, J., Anderson, E.R., Turner, E.J. and Scanlan, J.C. (2000), Native Vegetation Management in Queensland, DNR Brisbane.

Burrows, W.H., Scanlan, J.C. and Rutherford, M.T. (1998), Native Pastures in Queensland, resources and management, DPI Information Services QI87023.

Cavaye, J.M. (1991), The buffel book: a guide to buffel grass pasture development in Queensland, Queensland Department of Primary Industries

Central Western Queensland Remote Area Planning and Development Board, (1995), Central Western Queensland Regional Strategic Plan

Cobon, D.H., and McKeon G.M. (2003), Climate Change in Western Queensland – Case studies examining impacts on pasture growth, stocking rates and animal production, (in prep).

Choquenot, D., McIlroy, J., and Korn, J. (1996), Managing Vertebrate Pests: Feral Pigs, Australian Government Printing Service, Canberra, 163pp.

Commonwealth Bureau of Meteorology, Australian Rainman CD ROM

Commonwealth Bureau of Meteorology Website: http://www.bom.gov.au/

Commonwealth of Australia, (1999) (with the State of Queensland and Government of South Australia), Lake Eyre Basin Agreement – A Discussion Paper for Community Consultation.

Costelloe J.F., Hudson P.J., Pritchard J.C., Puckridge J.T., Reid J.R.W. (2004). ARIDFLO Scientific Report: Environmental Flow Requirements of Arid Zone Rivers with Particular Reference to the Lake Eyre Drainage Basin. Final Report to South Australian Department of Water, Land and Biodiversity Conservation and Commonwealth Department of Environment and Heritage. School of Earth and Environmental Sciences, University of Adelaide, Adelaide.

CSIRO, (2001), Climate Change Projections for Australia www.dar.csiro.au/publications/projections2001.pdf

Division of National Mapping, (1983), Dams and Storages, Natmap Australia 1:5,000,000 Map Series (Includes Drainage Divisions as adopted by the Australian Water Resources Council, Commonwealth of Australia)

DCITA (2002), Australian Telecommunications, 'An Overview of Australian Telecommunications Strategies, Services and Initiatives', DCITA Website.

Department of the Environment and Heritage 2003. A Directory of Important Wetlands in Australia. Australian Wetland Database. [Online], http://www.deh.gov.au/cgi-bin/wetlands/search.pl?smode=DOIW , 17 December 2003.

Desert Uplands Build-Up & Development Strategy Committee (1998), Desert Uplands Community Scheme 1998 – 2004, An Integrated Regional Adjustment and Community Development Strategy

Desert Uplands Build-Up & Development Strategy Committee 1999, 'Desert Uplands Natural Resource Management Plan', 42pp.

EA (2001), 'Directory of Important Wetlands in Australia', Third Edition, Chapter 8, Canberra, pp. 55-69.

Environment Australia, Biodiversity Group, (1995), Interim Biogeographic Regions of Australia, Commonwealth of Australia

Edmondston, V. (2001), 'Managing the Channel Country Sustainably, Producer's Experiences', Department of Primary Industries Information Series QI01022, Brisbane, 48pp.

EPA, (2002), 'The State of Waste and Recycling in Queensland', EPA Website, 35pp.

EPA South Australia, Water Monitoring Report - Ambient Water Quality Monitoring of SA's Rivers & Streams (Chemical & Physical Quality) Report No 1 June 1995 - December 1997.

EPA/QPWS, (2000), 'Environment Management Guidelines and Enforcement Guidelines', EPA Website, 8pp.

Ford, G., and Moye, R. (1996), 'A Précis of the Status of Biodiversity Conservation Resource Information Lake Eyre Basin, Queensland ', Department of Environment, South-western Region, Toowoomba, Queensland, 25pp.

Ford, S., Meadows, M., and Foxwell, K. (2002), 'The Australian Community Radio Sector, Culture Commitment Community', Griffith University, Brisbane, 124pp.

Gronold, M. (2000), 'Western Queensland Industry Profile', Queensland Department of Primary Industries

Hart, Q. (2002), 'Managing Pest Animals in Australia' Bureau of Rural Sciences, Canberra, 12pp.

Kiernan, C.V. (2001), Desert Uplands Carrying Capacity Model – Evaluation and adaptation of the South West Strategy Carrying Capacity Model in the Desert Uplands, Desert Uplands Build-up and Development Strategy Committee, 2001.

Lake Eyre Basin Ministerial Forum Secretariat (2003), Lake Eyre Basin Rivers Assessment Brochure

Lake Eyre Basin Coordinating Group, (2000), 'a future for all - Strategic Plans for the Lake Eyre Basin', PO Box 601, Longreach Qld. 4730.

Lake Eyre Basin Coordinating Group, (2004), 'Lake Eyre Basin Heritage Tourism – Future Directions', PO Box 601, Longreach Qld. 4730.

Lake Eyre Basin Integrated Information System (LEBISS), GIS and data management project, Desert Channels Queensland

Mills, J.R., Turner, E.J. and Caltabiano, T. (1989), Land Degradation in South West Queensland. Project Report Q089008, Queensland Department of Primary Industries, Brisbane.

Mitchell C. (1997), Review of Desert Upland Region Management Issues, Desert Uplands Build-Up and Development Strategy Committee.

Moller, G.I. (1999), State of the Rivers – Cooper Creek and Major Tributaries, Queensland Department of Natural Resources.

Moffatt, A.G.I. (1987), The Longreach Story, A History of Longreach and Shire, Longreach Shire Council, Jacaranda Press.

Morgan, G., Lorimer, M., Morrison, A., and Kutt, A. (2002), The Conservation of Biodiversity in the Desert Uplands, Queensland Environment Protection Agency.

National Parks and Wildlife Service NSW, (2002), WISE (Water Information System for the Environment) CD-ROM, Cooper Creek Catchment

NRM (2003) DRAFT RVMP - NWMGD, SEMGD, CC & DU Plans 2003 (sections V. Bailey, & J McCosker).

Outback Revival website: http://revival.outbackqld.info/index.htm

Phelps, D.G. (2000), 'Pasture Response to Flooding and Rainfall In Australia's Arid Channel Country', Queensland Beef Institute, Agency for Food and Fibre, Department of Primary Industries, Longreach.

Phelps, D.G., Day, K.A., Jeffery, M.R., Connelly, P.T., Fraser, G.W., McCallum, B.S., Sullivan, M.T., White, I.A., Robertson, S.A. and Cobon, D.H., 'Sustainable Grazing in the Channel Country Floodplains', A Technical Report on findings between June 1999 and August 2002, 134pp.

Queensland Government, (2003), 'Western Queensland Regional Budget Statement', 2003-2004.

Queensland Department of Environment & Heritage, (1996), 'Waste Management Strategy for Queensland', 35pp, EPA Website.

Queensland Department of Primary Industries, (1978), Western Arid Region Landuse Study Part IV, Technical Bulletin No. 23

Queensland Department of Primary Industries, (1980), Western Arid Region Landuse Study Part II, Technical Bulletin No. 22

Queensland Department of Primary Industries, (1993), The Condition of River Catchments in Queensland

Queensland Department of Natural Resources, (1997), Lake Eyre Basin Queensland Water Resource Assessment Report

Queensland Department of Natural Resources, (1998), Draft water management Plan for Cooper Creek – Information Paper

Queensland Department of Natural Resources, (2000), Prickly Acacia Best Practice Manual

Queensland Department of Natural Resources and Mines (2002), Stream Gauging Station Index 2002.

Queensland Department of Natural Resources and Mines (2002), NRM facts: History of Rabbit Fences in Queensland

Queensland Department of Natural Resources and Mines (2003), Land Cover Change in Queensland 1999-2001, Statewide Landcover and Trees Study Report (SLATS).

Queensland Department of Natural Resources and Mines (2003), Draft regional Vegetation Management Plans: North West Highlands, Channel Country, North West Mitchell Grass Downs, South East Mitchell Grass Downs, Northern Desert Uplands, Southern Desert Uplands, Southern Brigalow Belt, Mulga Lands

Queensland Department of Natural Resources and Mines, (2003), 'Draft State Rural Leasehold Land Strategy', 44pp.

RAPAD (Central Western Queensland Remote Area Planning and Development Board), Central Western Queensland Regional Strategic Plan (1995).

Reid, J. and Jaensch, R. in prep. Aerial waterbird survey results. In, Report of the ARIDFLO project in the Lake Eyre Basin 2000-3. [Julian to provide full citation]

Ryan, M. (ed.) (2003), 'Outback Queensland Discovery Guide', Queensland Museum, 350pp.

Sattler, P.S. and Williams R.D. (eds) (1999), The Conservation Status of Queensland's Bioregional Ecosystems, Environmental Protection Agency, Brisbane.

Sattler, P and Creighton, C. eds (2002), Australian Terrestrial Biodiversity Assessment 2002, National Land and Water Resources Audit, Environment Australia and Land & Water Australia, Canberra.

Schmiechen, J. (2003), Lake Eyre Basin Heritage Tourism – Future Directions, Lake Eyre Basin Coordinating Group.

Tourism Queensland, (2001), 'International and Domestic Visitor Experience in Queensland Regions', 1985-1999, Report 3, Office of Economic and Statistical Research, Queensland Treasury, pp. 82-86.

Turner, E.G. (1979), Reports on the Management of Eucalypt-spinifex Woodlands of Central Western Queensland, Division of Land Utilisation Report 79/2, Queensland Department of Primary Industries, Brisbane.

Turner, E.G., McDonald, W.J.F., Ahern, C.R., Thomas, M.B. (1993), Western Arid Region Landuse Study Part V, Technical Bulletin No 30, Queensland Department of Primary Industries, Brisbane.

Wadley, D., King, W.(eds) (1993), Reef Range and Red Dust – The Adventure Atlas of Queensland, Queensland Department of Lands

White, I.A. (2001), With Reference to the Channel Country, Review of available information.

Queensland Department of Primary Industries

Wilson P.R., Purdie R.W., Ahern C.R. (1990), Western Arid Region Landuse Study Part VI, Technical Bulletin No 28, Queensland Department of Primary Industries, Brisbane.

WILDNET database (2003) EPA / QPWS.

Yencken, D. and Wilkinson, D. (2001) Resetting the Compass, Australia's Journey Towards Sustainability, CSIRO Publishing, Australia.