Technical Memorandum 44

Geographic information systems and remote sensing in northern Australia: A compendium

Chris Devonport and Peter Waggitt

Supervising Scientist for
the Alligator Rivers Region

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This Technical Memorandum was prepared by

Chris Devonport and Peter Waggitt

Chris Devonport – GIS Laboratory, Northern Territory University, Darwin NT
Peter Waggitt – Office of the Supervising Scientist, Darwin NT

Supervising Scientist for the Alligator Rivers Region
GPO Box 407, Canberra ACT 2601 Australia

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Contents

Abstract

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Remote sensing (RS) and geographic information systems (GIS) techniques have been applied in northern Australia for at least thirteen years. Many individuals and organisations from all parts of Australia have contributed to the present body of knowledge. The diffuse literature and wide spread of organisations involved in this area has, however, made unearthing and accessing such knowledge both difficult and time-consuming, particularly for students and new researchers and practitioners. NARGIS 93 (North Australian Remote Sensing and GIS Forum) offered an opportunity to communicate with RS and GIS groups throughout Australia and attempt to address this problem by producing a compendium of people, projects and literature associated with RS and GIS in northern Australia.

This document includes the information received in response to a request for information which was circulated with the NARGIS 93 brochure together with the results of a conventional literature search. A preliminary review was presented at NARGIS 93 with a view to getting feedback from the RS/GIS community on its completeness and to elicit further information. A substantial amount of further information was received and this document contains everything received up to the time of going to press. This includes information on RS/GIS organisations, individuals, and literature not previously collected together in one place and we trust it will be of value to students, researchers and practitioners working in northern Australia.

Glossary

AARNET	Australian Academic Research Network
ACRES	Australian Centre for Remote Sensing
ACT	Australian Capital Territory
AGSO	Australian Geological Survey Organisation
AMG	Australian map grid
ARRRI	Alligator Rivers Region Research Institute
AURISA	Australian Urban and Regional Information Systems Association
COSSA	CSIRO Office of Space Science and Applications
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CYPLUS	Cape York Peninsula Land Use Study
DME	Department of Mines and Energy (Northern Territory)
ERIN	Environmental Resources Information Network
ESRI	a company specialising in remote sensing data processing
GIS	geographic information system
Internet	a digital information network
NARGIS	North Australian Remote Sensing and Geographic Information Systems Forum
NOAA–AVHRR	National Oceanic and Atmospheric Administration – Advanced Very High Resolution Radiometer
NTU	Northern Territory University
OSS	Office of the Supervising Scientist for the Alligator Rivers Region
RS	remote sensing
SPOT	a French company marketing remote sensing imagery
SSARR	Supervising Scientist for the Alligator Rivers Region
TM	thematic mapping

Geographic information systems and remote sensing in northern Australia: A compendium

Introduction

Northern Australia covers a huge, sparsely populated area and has a different environment (climate, ecology, geology, etc) from many other parts of Australia. Projects involving remote sensing (RS) and geographic information systems (GIS) in this region are subject to particular problems associated with these attributes. It is important that knowledge is shared amongst the relatively small group of people working in these fields to avoid duplication of effort and enhance the benefits of using this technology.

The Office of the Supervising Scientist for the Alligator Rivers Region (OSS) is continually developing new procedures to identify potential environmental impacts and assess the environmental risks and hazards associated with uranium mining in the region. Remote sensing and geographic techniques can provide the necessary tools for monitoring and predicting environmental change at a variety of spatial and temporal scales. A program of research using RS/GIS has been initiated by the Geomorphology section of the Alligator Rivers Region Research Institute, a division of the Office of OSS, which includes a collaborative research agreement with the Northern Territory University.

An important aspect of the agreement was the organisation of workshops and conferences to publicise the work of the program and obtain feedback on progress from other RS/GIS practitioners. The first workshop was held in 1992 (Devonport et al 1992) and was followed in 1993 by the North Australian Remote Sensing and Geographic Information Systems Forum (NARGIS 93).

In the course of preparing for the NARGIS 93 forum, the organising committee faced the problem of establishing who were the organisations and people involved in the use of RS and GIS throughout northern Australia. The diffuse nature of both literature and organisations involved in this area, together with a widespread interest in northern Australia, made targeting interested parties problematic. The 1992 GIS and Rehabilitation workshop held in Darwin was well attended despite a relatively narrow focus. The fact that a number of people had expressed regret at only hearing about the event in retrospect, or by coming across the proceedings, provided the impetus to advertise NARGIS 93 as widely as possible.

The authors saw this as an opportunity to answer the question 'How much GIS and RS work has been and is being done in northern Australia and by whom?' The proceedings of the 1992 workshop (Devonport et al 1992) and a selected GIS bibliography prepared by Devonport (1992) provided a starting point, as did discussions with the Environmental Resources Information Network (ERIN) and other interested parties, and even a study of the commercial and advertising pages of the Northern Territory telephone directory (Yellow Pages). A request for information

was mailed to users of RS and GIS throughout Australia with the NARGIS 93 brochure, with a view to collating and publishing the responses along with feedback from the forum participants. This compendium is the outcome of that process: we consider it will prove useful to people working and studying in the field of RS and GIS in northern Australia.

Request for information

The request for information (see example in Appendix 4) was circulated with the NARGIS 93 brochure to over 1,000 people throughout Australia (with the help odf AURISA, ERIN and ESRI). In addition, it was posted to the AARNET news groups *comp.infosystems.gis* and *sci.image.processing* on Internet and was widely reported in the professional literature including, for example, the ACRES, AURISA and COSSA newsletters. A total of 41 replies had been received at the time of the NARGIS 93 forum and a further 14 replies were received subsequently. The respondents are acknowledged in Appendix 3. A perusal of these shows that they stem from individuals or organisations representing a wide range of interests including federal government departments and agencies, state and local government, an aboriginal land council, academic and research institutions (notably CSIRO) as well as commercial enterprises with interests in northern Australia.

The boundaries of northern Australia were not defined in the request for information and it was left to respondents to decide if their information was applicable. The consensus from the responses was that northern Australia includes the broad geographical areas of Central, North, and Far North Queensland, the Northern Territory, and the Kimberley and Pilbara Regions of Western Australia as well as offshore islands and reefs along the northern coastline. The southern boundary is approximately latitude 26° south which runs from Shark Bay in the west along the southern border of the NT to Fraser Island in the east. The region therefore covers approximately half the land area of Australia (see fig 1).

Figure 1 Northern Australia

Organisations and individuals

The responses showed that there are many organisations involved with RS/GIS in northern Australia. Forty-eight organisations were identified and these are detailed in Appendix 1 together with brief descriptions of their activities and personnel. Although this is an extensive list, it should be noted that it is made up entirely of information received in voluntary responses to our request and should not be viewed as a complete list or interpreted as a statistically representative sample. There is, however, enough information to build up a picture of RS and GIS activity in northern Australia.

An analysis of the organisations and individuals reveals that eighteen state government departments and agencies make up almost 40% of the organisations involved. Federal government departments (7) and related agencies such as CSIRO (8) make up the bulk of the remainder. Two other sectors of the community, namely universities (5) and commercial enterprise (5), also play a significant role. Other organisations include an aboriginal land council and a shire council, both of which appear to be leading the way in their respective areas. User groups seem to be under-represented with only two providing information.

From a regional point of view the organisations are fairly evenly spread over the two states and the territory whose boundaries include parts of northern Australia. Queensland is represented by 14 organisations, Western Australia by 12 and the Northern Territory by 10. In addition, eight ACT-based organisations are involved in work in northern Australia and there is marginal interest from the other states. This is understandable as most organisations have a regional focus. The north Australian environment is generally very different from that in the south and consequently there is little incentive for those in a temperate zone to do comparative work or to look north for solutions to problems. The larger number of organisations in Queensland is attributable, in broad terms, to a greater population, the presence of the Great Barrier Reef and a significantly developed and diverse farming sector which is generally absent elsewhere in northern Australia.

A total of 178 individuals were named as being involved in RS/GIS within the organisations listed. They are distributed as follows: Queensland 62, Australian Capital Territory (ACT) 41, Northern Territory 39, West Australia 28, South Australia 4, Victoria 3, and New South Wales 1. Although these figures are only an approximation of the actual number of individuals involved, they are (with the exception of ACT) generally consistent with the levels of population and activity across northern Australia. The number of individuals from the ACT should be viewed in the light of the fact that they are, in most instances, involved with other projects as well as those in northern Australia. Considering that the total represents the minimum number of individuals involved, the RS/GIS 'industry' is a significant one in northern Australia.

The efforts of these organisations and individuals are directed principally at conservation (eg management of parks and their flora and fauna), resource management (eg land degradation issues related to the pastoral industry), rehabilitation (eg mine sites), land use programs (eg CYPLUS), defence applications, survey and mapping of natural resources, and education and training (eg universities). They are using a variety of remote sensing techniques including radar, videography, satellite imagery, and aerial photography. This information is being integrated into GIS together with other data and used for mapping, analysis and in some cases predictive modelling purposes. Almost all the organisations are oriented to the practical application of RS/GIS technology although some are at the forefront of research and development. The emphasis on environmental issues is a consequence of the relatively low levels of population and economic development throughout the region. Organisations using land information systems and facilities management did not respond to the request for information as they presumably do not perceive themselves as part of the RS/GIS community. Also absent from responses were geological exploration organisations, including mining companies.

Bibliography

A literature search was undertaken using the library facilities of the OSS, the NTU and the Northern Territory Department of Mines and Energy. References revealed by the search together with details in responses provided 164 references to published and unpublished books, articles and reports relating to RS/GIS in northern Australia. These are documented in Appendix 2. The date of publication of these papers ranges from 1980 to the present with a flurry of activity in 1988 (20 citations). Recent workshops and conferences swelled the 1992 contribution to 32 (helped by the publication of proceedings of the 1992 GIS and Environmental Rehabilitation Workshop in Darwin) and the 1993 contribution to 28 (with a substantial input from the proceedings of NARGIS 93 (Riley et al 1993)).

The subject matter of the studies was predominantly resource management, mapping, and environmental modelling. Resource management (29 citations), monitoring (26) and assessment (16) together accounted for 71 citations. Mapping, mostly for resource development and agricultural purposes, accounted for 60 citations and environmental modelling and prediction a further 20 studies. Environmental aspects of interest are indicated in the number of papers relating to vegetation (38), erosion and rangelands (26), geology and geomorphology (26), water resources (17), fire (15) and wildlife (7). There is considerable crossover in both objectives and topics and many papers address several issues. Sources of remotely sensed information used in these citations were dominated by Landsat imagery (54) and aerial photography (13). Radar (5) and SPOT imagery (4) were used least which probably reflects the experimental nature of the first and the unsuitability of SPOT's higher resolution for large areas.

Although publications are not the only, nor necessarily the best, measure of output from individuals, they do have value as a source of information for the RS/GIS community at large. Some individuals or groups have made a particularly significant contribution in this way. For example, Geoff Pickup and Vanessa Chewings in Alice Springs whose 18 papers relating to the mapping and modelling of the Central Australian environment account for 11% of the bibliography. Garth Morgan and Tony Orr together account for 14 citations with their work on the operational use of remote sensing for military applications in northern Australia. Other notable contributions include Bernard Fitzpatrick's work on *Mimosa pigra* and more recently rangeland monitoring (11 citations), and Pauline Catt's work on coral reefs and other aspects of remote sensing (9 citations).

Discussion

The geographer JA Mabbutt noted in the foreword to a book on northern Australia (Parkes 1984) nearly ten years ago that there had long been a need for a geographical study of the interplay of environmental challenge and human endeavour in the vast arena of northern Australia. His statement remains valid today and the need for a better understanding of the natural environment in relation to issues such as land rights and cultural heritage, mining impacts and rehabilitation, conservation and national parks, as well as the management of pastoral and maritime industries, is becoming increasingly more important in a world with ever-increasing demands being placed on ever-dwindling resources.

A major contributor to increased understanding is better information about the past (which might indicate trends and/or correlations), the present (monitoring and analysis), and the future ('what if' modelling/predicting). Geographic information systems and remote sensing are modern, enabling technologies which offer the potential of providing such information to managers in a useable form. This fact has not gone unnoticed and huge amounts of money, time and effort are being expended world-wide in these areas. The trend in northern Australia, although constrained

by limited resources, is no different. This was well demonstrated at the recent NARGIS 93 forum held in Darwin at which many projects in north Queensland, the Northern Territory and north Western Australia were discussed. This trend is also evident from the response to our request for information which revealed the large number of organisations and individuals associated with RS/GIS in northern Australia.

Early aspirations for the application of remote sensing techniques in northern Australia (eg Honey 1984; Graetz & Pech 1984) have, as elsewhere, been slow in realisation. The reason is primarily the lack of resources which still characterises this area and which means that much baseline research has not yet been undertaken and even less has been published. This situation is compounded by problems unique to the region. For example, the lack of good base maps and the presence of cloud in the wet season and smoke from bush fires in the dry season which inhibit the availability and hence the usefulness of optical satellite imagery. There is also a general lack of knowledge in the region of environmental processes (such as seasonal changes in vegetation growth patterns) and stochastic processes (eg cyclones and fires) which are captured in remotely sensed data.

Northern Australia is one of the largest, most diverse and geographically under-studied areas in the world. The region includes tropical savannas and rainforests, coral reefs, tablelands, sandstone plateaux, stony and sandy deserts as well as wetlands. Many of these zones contain habitats that are unusual and in some cases unique. Research and development in remote sensing and GIS are advancing rapidly in northern Australia. This technology is being applied to a wide range of activities including agriculture, park management, erosion control, fauna management, geological and mineral exploration, mapping and vegetation studies. A number of significant RS/GIS projects which will increase our knowledge and understanding of the environment are underway. However, the opportunities for further research and application of RS/GIS in northern Australian are substantial.

Acknowledgments

We would like to thank the many organisations who provided us with mailing addresses and published our request for information in their newsletters. Thanks are also due to the individuals who have taken the trouble to respond to our request either on their own behalf or that of their organisation. Library staff from a variety of organisations have been most helpful. Particular thanks go to Steven Riley and Max Finlayson of the OSS for their comments on the final draft. We trust that the end result provides a worthwhile compensation for all their efforts.

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Devonport CC, Riley SJ, Ringrose SM (eds) 1992. *Proceedings of the GIS and Environmental Rehabilitation Workshop.* Darwin, 4–5 September 1992, Supervising Scientist for the Alligator Rivers Region, AGPS, Canberra.

Graetz D & Pech R 1984. The utility of Landsat for monitoring the ephemeral water and herbage resources of arid lands: An example of rangeland management in the Channel Country of Australia. In *Northern Australia: The arenas of life and ecosystems on half a continent,* ed D Parkes, Academic Press, Sydney, 173–189.

Honey F 1984. Northern Australia: A view from space. In *Northern Australia: The arenas of life and ecosystems on half a continent*, ed D Parkes, Academic Press, Sydney, 21–28.

Parkes D (ed) 1984. *Northern Australia: The arenas of life and ecosystems on half a continent.* Academic Press, Sydney.

Riley SJ, Devonport C, Waggitt PW & Fitzpatrick B (eds) 1993. *NARGIS 93: Proceedings of the North Australian Remote Sensing and Geographic Information Systems Forum.* Darwin 9–11 August, Supervising Scientist for the Alligator Rivers Region, AGPS, Canberra.

Appendix 1

Summary information on organisations involved in RS/GIS in northern Australia

This is a list of organisations which are, or have been, involved in RS/GIS in northern Australia together with their addresses and contact numbers, a brief outline of work to date, and names of some of the personnel working in RS/GIS areas. This information is primarily derived from responses to the request for information.

Alligator Rivers Region Research Institute

Office of the Supervising Scientist for the Alligator Rivers Region
Private Mail Bag 2
Jabiru NT 0886
Tel: (089) 799 711
Fax: (089) 792 076

Developing environmental monitoring and risk/hazard assessment techniques using GIS/remote sensing. See bibliography.

Steven Riley	Principal Research Scientist	Tel: (089) 799 789
Peter Waggitt	Principal Environmental Assessment Officer	Tel: (089) 814 230

Atherton Shire Council

PO Box 573
Atherton QLD 4883
Tel: (070) 911 311
Fax: (070) 914 300

Projects in progress include the survey of an accurate cadastral database, a predictive catchment model for Lake Tinaroo, and asset management. Internal reports have been prepared on GIS database construction, environmental modelling, use and benefits of remote sensing, predictive catchment modelling. Workshop on Predictive Catchment Modelling of Tropical Freshwater Lakes, held in conjunction with James Cook University Centre for Remote Sensing, 23–26 November 1992.

Papers on:

- Preparing Your Own GIS Database (1991)
- Cadastral Data Input Methodology (1991)
- GIS Alignment of Local Authority Divisional Boundaries (1992)

Bob Peever	GIS Manager	Tel: (070) 911 311

Australian Geological Survey Organisation (AGSO)

Geophysical Mapping Section
GPO Box 378
Canberra ACT 2601
Tel: (06) 249 9111
Fax: (06) 249 9999

The Geophysical Mapping Section of AGSO holds databases of airborne magnetic and gamma-ray spectrometric digital data and gravity digital data covering large areas of northern Australia. Data are held in point located form and as grids. Reconnaissance point located airborne data are held at 60–70 m intervals along lines 1500 – 3200 m apart. Gridded reconnaissance airborne geophysics data have a mesh size of about 400 m. Some areas have data at closer than reconnaissance line spacing. A set of data from the Kakadu Conservation Zone has a line spacing of 250 m. The NGMA airborne geophysical surveys have point located data at 6–15 m along lines 400 m apart. The gamma-ray data are at about 70 m intervals along those lines. Gravity data are on a basic 11 km station spacing, with in-fill in some areas such as the Canning Basin and along some roads. Maps of the data have been published.

Ian Hone	Manager	Tel: (06) 249 9306
Michael Morse	Gravity database	Tel: (06) 249 9251

Australian Geological Survey Organisation (AGSO)
Environmental Geoscience and Groundwater Program
GPO Box 378
Canberra ACT 2601
Tel: (06) 249 9377
Fax: (06) 249 9983

Participating in a new federal government working group created to explore ways of establishing a national GIS network for natural hazards data management in the Australasian Region.

Wally Johnson	Natural Hazards GIS Working Group	Tel: (06) 249 9377

Bureau of Meteorology
Darwin Region
PO Box 735
Darwin NT 0801
Tel: (089) 824 711

The Bureau of Meteorology operates a station for the reception of NOAA AVHRR data in Darwin. Apart from purely meteorological purposes, the data is used for detection of volcanic ash clouds in this region. Planned extensions of its uses include monitoring sea surface temperatures and curing of grassland vegetation.

Jim Arthur	Regional Director	Tel: (089) 824 711

Bureau of Meteorology
Natural Hazards GIS Working Group
GPO Box 1289K
Melbourne VIC 3001
Tel: (03) 669 4000
Fax: (03) 669 4548

This group consists of officers from the Bureau of Meteorology, the Australian Geological Survey Organisation and the National Resource Information Centre. The group was created to explore ways of establishing a national GIS network for natural-hazards data management in the Australian region. Tropical cyclones have been targeted as part of a pilot project to demonstrate the value of GIS in indentifying and assessing natural hazards.

Christopher Ryan	Severe Weather Warning Services	Tel: (03) 669 4546
Wally Johnson	Australian Geological Survey Organisation	Tel: (06) 249 9377

Cape York Peninsula Land Use Strategy (CYPLUS) and the CYPLUS GIS

CYPLUS Stage I (the first of three stages) is composed of three broad programs:

- Natural Resource Analysis Program (NRAP) (of 19 projects listed below)
- Public Participation Process (for community involvement in the development of CYPLUS)
- Land Use Programs (Community based projects focussing on the three primary areas and information needs: nature, people, land use)

The NRAP projects are collecting a wide range of broad based information about Cape York Peninsula including geology, soils, vegetation, water resources and fauna. Each of the projects are using GIS technology to collate and present their project information which will be supplied to the CYPLUS GIS. The common database and basis for data compilation and integration for CYPLUS will be through the CYPLUS GIS which commenced early in 1992 and is programmed to continue until mid 1994.

The prime responsibility of building the initial CYPLUS GIS is with the National Resource Information Centre (NRIC) and is being jointly coordinated with the Queensland Lands Department (DoL) on behalf of Queensland agencies. NRIC and DoL are the respective Commonwealth and State coordinating agencies for the CYPLUS GIS. Queensland agencies will develop their CYPLUS information consistent with the charter for the Queensland Land Information System (QLIS) so that this information will be compatible with QLIS guidelines and specifications. (Note: QLIS is not a centralised system and will not hold or provide access to CYPLUS data).

Various general articles on the NRAP projects and the CYPLUS GIS have been published in the official CYPLUS Newsletter *CYPLUS talkback*. Three issues have been published to June 1993 (Aust Post publication PP 4340 44/00015).

Natural Resource Analysis Program (NRAP) projects:

NR01 Cape York Peninsula Vegetation Mapping (Qld Herbarium/QNPWS)

John Clarkson	Queensland Herbarium, Mareeba
John Nelder	Queensland Herbarium, Mareeba
Damian Milne	Queensland Herbarium, Mareeba
John McDonald	Queensland Herbarium, Indooroopilly
Jack Kelly	Queensland Herbarium, Indooroopilly
Peter Stanton	Queensland National Parks and Wildlife Service, Cairns
David Fell	Queensland National Parks and Wildlife Service, Cairns
Steve Goosem	Queensland Department of Environment and Heritage, Brisbane
Peter Young	Queensland Department of Environment and Heritage, Brisbane

NR02 Land Resource Inventory (QDPI)

Peter Wilson	Queensland Department of Primary Industries, Bundaberg
Andrew Biggs	Queensland Department of Primary Industries, Mareeba
Seonaid Phillip	Queensland Department of Primary Industries, Mareeba
Len Lesleighter	Queensland Department of Primary Industries, Mareeba

NR03 Terrestrial Fauna Survey (QNPWS)

Dave McFarland (consultant)	Queensland Department of Environment and Heritage, Moggill
John Winter (consultant)	Queensland National Parks and Wildlife Service
Philip Lethbridge (consultant)	Queensland National Parks and Wildlife Service
Peter Young	Queensland Department of Environment and Heritage, Brisbane
Steve Goosem	Queensland National Parks and Wildlife Service

NR04 Mineral Resource Inventory (QDME)

Les Culpepper	Queensland Department of Minerals and Energy, Brisbane

Terry Denaro	Queensland Department of Minerals and Energy, Brisbane
Dave Morwood	Queensland Department of Minerals and Energy, Brisbane
Cec Murray	Queensland Department of Minerals and Energy, Brisbane

NR05 Bedrock Geological Data: Digitising & Integration (AGSO)

John Bain	Australian Geological Survey Organisation, Canberra
Ian O'Donnell	Australian Geological Survey Organisation, Canberra
Liz Truswell	Australian Geological Survey Organisation, Canberra

NR06 Marine Plant (Seagrass/Mangrove Distribution) (QDPI)

Karen Danaher	Queensland Department of Primary Industries, Brisbane
Dan Maher	Queensland Department of Primary Industries, Brisbane
John Beumer	Queensland Department of Primary Industries, Brisbane
Malcolm Dunning	Queensland Department of Primary Industries, Brisbane
Dan Mayer	Queensland Department of Primary Industries, Brisbane
Mike Potter	Queensland Department of Primary Industries, Cairns

NR07 GIS Creation/Maintenance (NRIC)

Christine Petersen	National Resource Information Centre, Bureau of Resource Sciences
Chris Malouf	National Resource Information Centre, Bureau of Resource Sciences
Ian McNaught	National Resource Information Centre, Bureau of Resource Sciences

NR08 CYPLUS GIS Development & Qld Coordination (DoL)

Ian Beitzel	Department of Lands, Woolloongabba
Graham McColm	Department of Lands, Woolloongabba
Richard Eden	Department of Lands, Woolloongabba

NR09 Wetland Fauna Survey (ERIN)

P Driscoll (consultant)	Department of Environment and Heritage, Brisbane
Philip Lethbridge	Queensland National Parks and Wildlife Service, Cairns
Steve Goosem	Queensland National Parks and Wildlife Service, Cairns
Peter Young	Department of Environment and Heritage, Brisbane

NR10 Fish Fauna Survey (Freshwater & Estuarine) (QDPI)

Brett Herbert	Queensland Department of Primary Industries, Cairns
John Peeters	Queensland Department of Primary Industries, Cairns
Mike Potter	Queensland Department of Primary Industries, Cairns
Alf Hogan	Queensland Department of Primary Industries, Cairns
Peter Jackson	Queensland Department of Primary Industries, Brisbane

NR11 Environmental Regional Analysis (ERIN)

David Crossley	Environmental Resources Information Network, Australian Nature Conservation Agency (ANCA)
Maria Cofinas	Environmental Resources Information Network, ANCA
Matt Bolton	Environmental Resources Information Network, ANCA

NR12 CYPLUS Regolith Terrain Mapping (AGSO)

John Wilford	Australian Geological Survey Organisation
Colin Pain	Australian Geological Survey Organisation
Liz Truswell	Australian Geological Survey Organisation

NR14 Coastal Environment Geoscience Survey (AGSO)

Trevor Graham	Australian Geological Survey Organisation
Bob Byrne	Australian Geological Survey Organisation
Liz Truswell	Australian Geological Survey Organisation

NR15 Airborne Geophysical Survey (AGSO)

Ian Hone	Australian Geological Survey Organisation
Liz Truswell	Australian Geological Survey Organisation

NR16 CYP Groundwater Investigation (AGSO/QDPI)

Rob Lait	Water Resource commission, DPI, Mareeba
Graham Herbert	Water Resource commission, DPI, Mareeba
Tony Horn	Water Resources Commission, Brisbane
John Hillier	Water Resources Commission, Brisbane
M A Habermehl	Australian Geological Survey Organisation
Liz Truswell	Australian Geological Survey Organisation

NR17 Insect Fauna Survey (QDPI/CSIRO Entomology/Qld Museum)

Paul Zborowski	Department of Primary Industries, Mareeba
R J Storey	Department of Primary Industries, Mareeba
G B Monteith	Queensland Museum, Brisbane
E S Neilsen	CSIRO Division of Entomology, Canberra
I Cunningham	Department of Primary Industries, Mareeba

NR18 Flora Data & Modelling (ERIN)

David Crossley	Environmental Resources Information Network, Australian Nature Conservation Agency (ANCA)
Maria Cofinas	Environmental Resources Information Network, ANCA
Matt Bolton	Environmental Resources Information Network, ANCA

NR19 Fauna Distribution Modelling (ERIN)

David Crossley	Environmental Resources Information Network, Australian Nature Conservation Agency (ANCA)
Maria Cofinas	Environmental Resources Information Network, ANCA
Matt Bolton	Environmental Resources Information Network, ANCA

NR20 CYPLUS Data into the NRIC Directory of Databases Facility, FINDAR (NRIC)

Paul Shelley	National Resource Information Centre, Bureau of Resource Sciences
Ian McNaught	National Resource Information Centre, Bureau of Resource Sciences

Central Land Council

PO Box 3321
Alice Springs NT 0871
Tel: (089) 516 244
Fax: (089) 521 590

Developing GIS and RS databases and techniques for the purpose of aiding the activities of the Central Land Council.

Ian Bestow	Land Information Officer	Tel:(089) 516 244

Commonwealth Environment Protection Agency (CEPA)

PO Box E305
Queen Victoria Terrace ACT 2600
Tel: (06) 274 1999
Fax: (06) 274 1666

CEPA has been given a mandate to undertake national state of the environment reporting (SoE) with the objective of documenting changes in the condition of Australia's atmospheric, terrestrial, freshwater, marine and urban environments. The SoE indicators together with other

environmental, natural resource, and social information will be integrated into a new GIS and database.

Shaun Andrews	Environment Review Branch	Tel:(06) 274 1656
Tony Fleming	Director, Monitoring and Reporting	Tel:(06) 274 1607

Conservation Commission of the Northern Territory – GIS Unit
PO Box 496
Palmerston NT 0831
Tel: (089) 89 4488
Fax: (089) 89 4510

The GIS Unit within CCNT is responsible for providing support to all users of the GIS within the Commission. This includes training, data maintenance, specialist assistance and advice, map production, and undertaking key projects within the Commission for units with no expertise.

Projects completed or underway include:

- Coastal Resource Atlas (CRA) of the NT which includes a variety of spatial data sets linked to an Oracle database with a graphics frontend for ease of access, and a sub-system using ArcView on a mobile platform
- Rainforest Atlas of the NT involving individual maps showing collection sites and herbarium vouchers for over 600 species (and associated data analyses)
- collation of data sets and production of standard map products for the parks and reserves of the NT. This will form the basis of a GIS system within individual parks connected to central offices through modems
- a graphical enquiry system for firebreak management developed using ArcView. This required a graphical display of property information and transfer of the address details selected graphically to an automated correspondence production system

Craig Walker	GIS Manager	Tel: (089) 89 4500
Jenny Malone	Technical Officer 3	
Marian McCabe	Technical Officer 2	

Conservation Commission of the Northern Territory – Land Conservation Unit
PO Box 496
Palmerston NT 0831
Tel: (089) 89 4455
Fax: (089) 89 4403

The purpose of the Land Conservation Unit is to conserve the land resources of the Northern Territory and promote their sustainable utilisation. The Unit has considerable expertise in Geographic Information Systems and Remote Sensing. The Unit operates ARC/INFO Rev 6.1.1 GIS software (on a Vax Workstation platform) and ER Mapper (on a Sun Sparc 10) and MicroBRIAN (on a 486PC) image processing software.

The main GIS/RS tasks are:

- capture of land resource survey data (landform, soils, vegetation) over the entire Northern Territory
- rectification of resource survey data to standard topographic series maps
- development and integration of soils and vegetation data bases (INFO, ORACLE, DECODA, WARIS)
- integration of spatial data layers to assist property management planning
- production of hard copy satellite imagery for base maps
- use of imagery for rangeland change detection and monitoring

- GIS/RS integration
- development of user friendly front-ends to allow non-expert access to GIS/RS technology
- development of Land Management Decision Support System for the Semi-arid Tropics (collaborative project with CSIRO Tropical Crops and Pastures, Brisbane)
- production of user specific data analyses and map outputs

Geographic Information Systems:
Peter Wilson Land Conservation Unit Tel: (089) 89 4455
Dave Hadden
Darryl Clift
Mark Anderson (CCNT Katherine)

Remote Sensing:
Paul Frazier
Rod Applegate

Conservation Commission of the Northern Territory (CCNT) – Southern Region
P O Box 1046
Alice Springs NT 0871
Tel: (089) 518211
Fax: (089) 555190

Wildlife Division (South)

1 Brenda Pitts and David Berman are using GIS to determine the areas of Mitchell Grassland on the Barkly Tableland which have low grazing pressure, based on distance from water. Flora and fauna surveys are used to measure grazing impact.

2 David Berman is using GIS to map the routes followed by feral camels fitted with satellite transmitter collars in Central Australia. Satellite fixes are taken and converted to GIS coverages.

3 Brenda Pitts is using GIS for National Park planning and management. Vegetation and soil data are analysed spatially to provide managers with an information-base to determine such things as fire management strategies, placement of infrastructure, routes of walking trails, and areas of high conservation significance. The areas involved are the West MacDonnell National Park, Longreach Waterhole Reserve, and Finke Gorge National Park. A GIS based project to map the distribution of the rare *Acacia undoolyana* to provide data for its conservation is planned for 1994.

4 Angus Duguid is coordinating a collaborative project between the CCNT and CSIRO (Wildlife and Ecology Division, Alice Springs) entitled the MacDonnell and Central Ranges GIS Study. Geology, topography, geochemistry, flora and fauna data are combined with remotely sensed data for predictive modelling of flora and fauna. The study is due for completion in early 1994. The ARC/INFO database produced will be accessible by managers, planners and researchers.

5 Grant Allan has mapped the fire history of central Australia using Landsat MSS and NOAA-AVHRR data, as part of the Bushfires Research Project. The project's objective was to develop and use satellite and computer models in combination with basic research on the ecology of the spinifex communities to construct a regional fire management strategy. The strategy includes image processing methodologies for fire history mapping and assessing spinifex fuel loads using Landsat and NOAA data.

6 Andrew Willson and Grant Allan are involved in establishing an ARC/INFO database for Watarrka (Kings Canyon) National Park. The study aims to test the usefulness of GIS to park

management and to determine the time and resources required to set up such a database. The database has recently been transfered to the park-based GIS (Environmental Resource Mapping System) to be used directly by rangers. A second project at Connells Lagoon Conservation Reserve in the Barkly Tablelands involves calibrating remotely sensed data with field biomass data to gain an understanding of the seasonal changes of Mitchell grass communities under the influence of cattle grazing and fire.

7 Geoff Lundie-Jenkins and Nicki DePreu are using ARC/INFO to plot movements of Mala from radio tracking data collected in the Tanami Desert. ARC/INFO routines written by Angus Duguid have enabled them to calculate changes in home range over time for individual animals. Rick Southgate is using a similar process to examine the home ranges of Bilbies in a reintroduction program at Watarrka National Park.

8 Amanda Brook and Mike Fleming are using NOAA-AVHRR data to monitor the ephemeral wetlands of central and northern Australia, to determine the amount of wetland habitat available for waterbirds. ARC/INFO will be used to store the mapped history of wetland filling.

9 Amanda Brook completed an Honours thesis in 1992 with assistance from the CCNT, entitled 'The use of NOAA-AVHRR data to discriminate spatial variation in vegetation cover in hummock grasslands of central Australia'.

Parks Division (South)

Denis Matthews and Darren Schunke are using ARC/INFO to map the distribution of all rare plants in the Finke Gorge National Park with emphasis on the palm *Livistona mariae* and the cycad *Macrozamia maconnellii*. They are also examining the use of GIS for assisting in management on-Park particularly for fire management.

Other Parks are using GIS to aid various management operations. These include Watarrka National Park, West MacDonnell National Park and Arltunga Historical Reserve. Mike Heywood and Angus Duguid are using GIS to examine the distribution of *Eucalyptus thozetiana* in the East MacDonnell Ranges.

Land Conservation Unit (South)

1 Technical Report on Land Unit Mapping from Satellite Remote Sensing. Guy Hodgson. June 1993.

The project aimed to produce a computer map of land unit tracts on part of a pastoral lease in the Barkly District using digital satellite imagery instead of aerial photography. A 'wet' and a 'dry' Landsat TM scene from the station were analysed using a MicroBRIAN image analysis system. The image classification maps of land units proved of little assistance to the mapping of land resources on the station.

2 Technical Report on Tree and Shrub Cover Assessment from Satellite Remote Sensing. Guy Hodgson. June 1993.

This project was designed to evaluate whether the present tree and shrub cover on a project area in the Alice Springs District could be assessed from Landsat imagery. Three 'dry' images (2 MSS and 1 TM) were analysed using microBRIAN. Four remote sensing techniques for assessing the vegetation cover on arid rangelands were evaluated. There was generally a significant linear regression of reflectance values on tree and shrub cover.

3 Land unit maps for pastoral leases and national parks are produced by the Land Resource Survey section of the Land Conservation Unit.

Land units are areas of similar landform, soil and vegetation. The maps are produced from interpretation of aerial photography combined with field verification. There is currently a

program to transfer these maps to the Commission's ARC/INFO GIS system. Ultimately the field site data will be stored in an ORACLE database and linked to the GIS. Watarrka National Park and four stations are on the system or are being put on the system. Technical reports describing the land units are in preparation.

Park Development Unit
Syd Milgate is using Autocad to produce mapping products for Park management plans and reports.

CSIRO Division of Exploration and Mining

Private Bag,
Wembley WA 6014
Tel: (09) 387 0200
Fax: (09) 387 8642

Vegetation Watch (a joint venture between RIRDC, DOLA and CSIRO) is a system for the routine monitoring of vegetation at continental scale using the Advanced Very High Resolution Radiometer (AVHRR) on the NOAA satellite. Vegetation cover is estimated from the NDVI and cloud cover is removed by combining successive overpasses. These data are integrated with other geographical information and distributed to users for rangeland management, conservation, bushfire management, and agricultural forecasting. Vegetation watch includes coverage of northern Australia in latitude/longitude projection.

Peter Hick	Vegetation Watch, bathymetry work for pearl industry, Kimberley rain forest mapping	Tel: (09) 387 0243
Richard Smith	Vegetation Watch, current AVHRR production and research project	Tel: (09) 387 0321
Ian Tapley	Canning Basin work, geology, Kimberley geomorphology, rangelands	Tel: (09) 387 0263

CSIRO Division of Mathematics and Statistics, WA

Private Bag
PO Wembley WA 6014
Tel: (09) 387 0200
Fax: (09) 387 6046

Currently conducting a research project in rangeland remote sensing in WA shrublands (near Carnarvon) and grasslands (Kimberley-Ord River); in association with Alec Holm and Paul Novelly (WA Dept. Agriculture). Project to conclude in June 1994.

Norm Campbell
Jeremy Wallace

CSIRO Division of Soils, Townsville

Private Mail Bag
PO Aitkenvale
QLD 4814
Tel: (077) 719 511
Fax: (077) 252 099

The CSIRO Division of Soils in collaboration with the Division of Exploration Geoscience and Queensland Department of Primary Industries, Townsville, is involved in a project entitled *Soil degradation in the semiarid tropics: assessment, processes, and risk prediction.* This project aims to develop new methods to assess the current status of land degradation in the soils of

tropical Australia, to determine the nature of the degradational processes, and to predict the risk of increased degradation (focussing on salinity) arising from changed land use practices, especially tree clearing in semiarid rangelands. The study is integrating results from field-based soil survey with remote sensing and geographic information system approaches to provide guidelines for improved soil and land management strategies. The project is expected to be completed by June 1995.

Elizabeth Bui Senior Research Scientist
Michael Cannon CSIRO
Ross Coventry Project leader
Steve Fraser
Anne Kinsey-Henderson
Gary Rogers QDPI

CSIRO Division of Tropical Crops and Pastures – Land Resource Management Unit

The group has two major projects underway:

- Spatial decision support system for the sustainable management of grazing lands:
  Aims to develop a Decision Support System (DSS) to assist the user to assess the current state of the land resource within a grazing management unit, and to evaluate the risks associated with alternate management strategies
- Coastal zone management:
  Aims to evaluate the impact of rural land use on river nutrient loads in tropical coastal catchments

Cunningham Laboratory based staff
306 Carmody Road
St Lucia QLD 4067
Tel: (07) 377 0257
Fax: (07) 377 0328

Jenny Bellamy	Project leader, land resource management, GIS Email: jenny.bellamy@lrm.tcp.csiro.au	Tel: (07) 377 0345
Ian McCleod	GIS, RS, computing Email: ian.mcleod@lrm.tcp.csiro.au	Tel: (07) 377 0327
Duncan Lowes	Expert systems, GIS Email: duncan.lowes@lrm.tcp.csiro.au	Tel: (07) 377 0290

Davies Laboratory based staff
Private Mailbag
PO Aitkenvale
Townsville QLD 4814
Fax: (077) 719 009

Andrew Johnson	Agricultural economics, land evaluation, GIS Email: andrew.johnson@lrm.tcp.csiro.au	Tel: (077) 719 507

CSIRO Division of Water Resources, Canberra

GPO Box 1666
Canberra ACT 2601
Tel: (062) 464 911
Fax: (062) 479 958

This Division is involved in using remote sensing in northern Australia (see bibliography). Key contributors currently employed at Division of Water Resources include:

Peter Crapper Tel: (062) 246 5798
Barbara Harrison Tel: (062) 246 5719
David Jupp Tel: (062) 246 5716
Joe Walker Tel: (062) 246 5725

CSIRO Division of Wildlife and Ecology, Alice Springs

Centre for Arid Zone Research
PO Box 2111
Alice Springs NT 0871
Tel: (089) 500 111
Fax: (089) 529 587

The Centre for Arid Zone Research has two major research areas involving GIS and remote sensing technology.

The first is the area of land degradation assessment where satellite data and grazing gradient techniques are used to determine grazing impact in the arid and semi-arid rangelands. Vegetation cover levels are derived from Landsat MSS data and then analysed with respect to distance from stock watering points to determine if grazing gradients persist after rainfall events that produce maximum vegetation recovery. Variants of the method allow vegetation response to rainfall to be examined on a pixel-by-pixel basis and information to be extracted about forage quality.

The second project involves building a GIS to model the physical and biological resources of the central Australian mountain ranges, an area of some 200 000 km^2. The aim is to identify key conservation areas to assist in the future land use planning and management of this region. Topographic (DEM, slope, aspect, catchment), geological and solar radiation information have been used to model the physical resource while biological information has been obtained from flora and fauna surveys, and satellite data. These data are being used to develop relationships between the land, biota, and the potential impact of different land uses such as pastoralism or tourism.

The Centre is also currently developing an aircraft-mounted video data collection system to assist in the capture of ground truth information. Images are captured directly onto the computer hard disk in the aircraft. Spatial resolution at 9–18 cm allows the identification of individual plants.

Staff who have an association with GIS in the Northern Territory include:

Gary Bastin Tel: (089) 500 111
Vanessa Chewings Tel: (089) 500 127
Graham Griffin Tel: (089) 500 111
Graham Pearce Tel: (089) 500 111
Geoff Pickup Tel: (089) 500 141
Garth Tier Tel: (089) 500 142

CSIRO Division of Wildlife and Ecology, Canberra

The Division of Wildlife and Ecology has done considerable work in northern Australia on fire patterns in particular. Dean Graetz has also been involved in work using remote sensing on greenness indices for Australia as a whole. Doug Cox has done extensive GIS work for the continent as a whole.

Doug Cox
Dean Graetz Tel: (06) 242 1720

Defence Science and Technology Organisation (DSTO)
Information Technology Division
PO Box 1500
Salisbury SA 5108
Tel: (08) 259 5555
Fax: (08) 259 5619

The DSTO Electronics Research Laboratory has a number of projects which are located in or impinge on remote sensing and GIS in northern Australia. These include:

- operational applications of remote sensing
- development of a digital geographic exchange standard (DIGEST) for defence purposes
- using remote sensing data for mapping, charting and surveillance in the Weipa district
- development of and data acquisition for a spectral signature bank for northern Australia

DSTO Tasks ARM 86/100 and 91/238 'Operational applications of Remote Sensing' (1986–1993) Task Manager Dr GA Morgan, Contract Botanist Tony Orr: The DSTO Research Task ARM 86/100 was initiated in April 1986 following preliminary work under interim Task ARX 85/863 'Remote Sensing Applications'. The stated aim of the research task was '...to demonstrate to Army several state-of-the-art technologies for acquiring, processing analysing and presenting data from airborne and space-based sensors to enable Army to define its future requirements for terrain intelligence from such systems...'

Research Study Areas: From the outset the study was limited to selected regions of Northern Australia at latitudes above the Tropic of Capricorn (23°26.5'S) and adopted a policy of addressing the higher-priority defence-related areas by combining requisite field truthing with preparations for and participation in the major 'Kangaroo' series of military exercises. Basic ground truth data for the compilation of terrain products (TIPS) has been collected for Lakeland Downs on Cape York Peninsula, Qld., for Katherine/Tindal, Port Keats (Wadyeye), Roper River (Urapunga), Melville Island, Mount Bundey Training Area, Pine Creek/McDonald Airfield, and the greater Darwin/Cox Peninsula area in the NT and for Kununurra and the Kununurra-Wyndham corridor in WA. Of these, the Melville Island (at both 1:100,000 and 1:250,000 scales) and Katherine/Tindal (at 1:100,000 scale) datasets have each been processed to a final suite of hardcopy Terrain Products (TIPS). These have been widely circulated within the ADF in report form and the basic remote sensing methodology has been presented, in DSTO-approved scientific paper format, at major remote sensing and space technology conferences.

Exercise Evaluation: Results were evaluated during Exercise Diamond Dollar-87, then wider Army evaluation of the products was sought during Exercise Kangaroo-89 and in Tactical Exercises Without Troops (TEWTS) Distant Trumpet-89 and-90 and Northern Explorer-90. The most recent Exercise, Kangaroo-92, provided an opportunity to prepare TIPS in advance of the high activity phase of the Exercise, to monitor utilisation of TIPS through the Army map distribution system and to receive and evaluate feedback from individual Units on acceptability of these products for their specific operational applications. To date it has been demonstrated, during these major ADF exercises, that thematic mapping of vegetation by remote sensing is a practical tool well suited to the cost-efficient mapping of large areas of tropical Australia and to the provision of operationally useful decision support information to military planners.

Publications: Morgan and Orr have individually and cooperatively published extensively on their work. See bibliography under Morgan, Orr, Morgan and Orr, and Orr and Morgan.

Spectral signature bank: For successful application of remote sensing in surveillance or mapping, spectral signatures are necessary. But there is no spectral signature library readily available in Australia. To alleviate this problem the Opto-Electronics Division (OED) of DSTO Surveillance Research Laboratory and Information Technology Division (ITD) of DSTO Electronics Research

Laboratory have been working together to collect spectral signatures of objects of defence significance in 0.4–2.5 micron band. During the project spectral signatures were collected at Tindal, NT, with the help of CSIRO. More spectral signatures were collected in Cape York, Qld. All legitimate users should be able to use these spectral signatures in the future. A data base of spectral signatures of natural objects (0.4 to 2.5 microns) is available from Dr Vittala Shettigara.

Garth Morgan	operational applications of remote sensing Tel: (08) 259 5190 Fax: (08) 259 5980 Email: garth_morgan@itd.dsto.gov.au
Vittala Shettigara	Information Acquisition and Processing Group mapping, charting and surveillance; spectral signature bank Tel: (08) 259 7176 Email: vis@itd.dsto.gov.au
Bob Williams	geographical information exchange standards Tel: (08) 259 7008 Email: bob_williams@itd.dsto.gov.au

Department of Conservation and Land Management (CALM)

PO Box 104
Como WA 6152
Tel: (09) 334 0333
Fax: (09) 334 0466

Geographic Information Systems:

Peter Bowen	Manager Land Information Branch	Tel: (09) 334 0343
Bernie Nebel	Project Manager (GIS) Land Information Branch	Tel: (09) 334 0349

Remote Sensing:

Graeme Behn	Project Officer (RS) Land Information Branch	Tel:(09) 387 0270

Published material (see bibliography):
Australian Remote Sensing Conference – Perth and Wellington;
Australian Institute of Cartographers Conference – Darwin Adelaide

CALM successfully used remote sensing to map the location of rainforests in the Kimberley region.

Department of Land Administration (DOLA)

Central Government Buildings
Cathedral Avenue
Perth WA 6000
Tel: (09) 323 1222
Fax: (09) 323 1201

The following projects have been extracted from the RSAC database and should reflect most of the work done in the north of Western Australia to date.

1 Bush fire monitoring – Kimberley Region
Investigators: Bush Fires Board of WA (Mr P Saint), RSAC (Dr Richard Smith, Ron Craig, John Adams)
Publications and products: Internal project report (Govt), Photographic prints
Date: 1990–1992
Data used: NOAA-AVHRR
RSAC reference: 911024, 911076, 911116, 901071, 921067

2 Remote Sensing of Kimberley Rainforests
Investigators: CALM WA (NL McKenzie), CSIRO RS Group Perth (PT Hick), RSAC (RJ Kay, HJ Houghton)
Publications and products: Fifth Australian Remote Sensing Conference, Kay, Hick and Houghton (1129–1131), Photographic products
Date: 1990
Data used: Landsat TM and aerial photographs
RSAC reference: 891030-901007, 901011, 901012

3 Lithological mapping in the Kimberley using Landsat TM data – Halls Creek Region
Investigators: Geol Survey WA (Bob Gozzard), RSAC (Andrew Buchanan)
Publications and products: Internal file report (govt), Photographic prints
Date: 1991–1992
Data used: Landsat TM and SPOT
RSAC reference: 901069, 911064, 921064, 931047

4 Fitzroy River Flooding – Kimberley
Investigators: State Government Departments (Agriculture, Water, MRD), RSAC (Andrew Buchanan)
Publications and products: Internal file report (Govt)
Date: 1993
Data used: Landsat TM and NOAA-AVHRR
RSAC reference: 931035

5 Trochus Shell Habitat Mapping – Kimberley
Investigators: UWA (K Magro – PhD thesis), RSAC (Andrew Buchanan)
Publications and products: PhD thesis to be published 1993, Photographic prints
Date: 1993
Data used: Landsat TM
RSAC reference: 931031

6 Monte Bello Islands Shallow Water Mapping
Investigators: CALM WA, RSAC (Fiona Chapman)
Publications and products: Internal file report (Govt), Photographic prints
Date: 1992
Data used: Landsat TM
RSAC reference: 921057

7 Houtman Abrolhos Islands Shallow Water Mapping
Investigators: CALM WA, RSAC (Fiona Chapman)
Publications and products: Internal file report (Govt), Photographic prints
Date: 1992
Data used: Landsat TM
RSAC reference: 921074

8 Barrow Island Survey and Area Statements
Investigators: WA Petroleum (WAPET), RSAC (Fiona Chapman)
Publications and products: Internal file report (Govt), Photographic prints
Date: 1993
Data used: Landsat TM and aerial photographs
RSAC reference: 921093

9 Rangeland Image Maps – Kimberley
Investigators: Agriculture Dept (T Hodge), RSAC (K Dawbin)
Publications and products: Internal file report (Govt), Photographic prints
Date: 1991
Data used: Landsat TM
RSAC reference: 911134

10 Kimberley Wetlands Conservation Project
Investigators: Agriculture Dept – Derby, RSAC (K Dawbin)
Publications and products: Internal file report (Govt), Photographic prints
Date: 1992
Data used: Landsat TM
RSAC reference: 921099

11 Fortesque River Floods – Pilbara
Investigators: Water Authority (A Waugh), RSAC (K Dawbin)
Publications and products: Internal file report (Govt), Photographic prints
Date: 1990
Data used: Landsat TM
RSAC reference: 901082

12 Kimberley Pastoral Station Cadastral
Investigators: CSIRO (Dr R Smith), RSAC (Fiona Chapman)
Publications and products: Intergraph design file
Date: 1991
Data used: Digitised station boundaries
RSAC reference: 911016

13 Land Use, Soil Mapping Ord River Study
Investigators: Agriculture Dept (G Gardiner), RSAC (R Stovold)
Publications and products: Internal file report (Govt), Photographic prints, Digitised cadastre
Date: 1990
Data used: Landsat TM and digitised cadastre
RSAC reference: 901043

14 Road Building Materials Identification – Kimberley
Investigators: MRD (F Butkus), RSAC (R Kay, A Wyllie)
Publications and products: Sixth Australian Remote Sensing Conference, A Wyllie and references therein, Photographic prints
Date: 1988–1992
Data used: Landsat TM and MSS
RSAC reference: 881011, 901111, 901045, 911156

15 Woody Weed Infestation – Pilbara
Investigators: Agricultural Protection Board (WA), RSAC (A Wyllie)
Publications and products: Internal file report (Govt), Photographic prints
Date: 1988, 1991
Data used: Landsat TM and MSS
RSAC reference: 881015, 911089

16 Lake Gregory Paleo-drainage – Kimberley
Investigators: UWA (Dr K Wyrhvol), RSAC (P Catalano)
Publications and products: Photographic prints
Date: 1992

Data used: Landsat TM
RSAC reference: 921051

17 Pilbara Vegetation Enhancements
Investigators: Agriculture Deptartment WA, RSAC (A Wyllie)
Publications and products: Internal file report (Govt), Photographic prints
Date: 1993
Data used: Landsat TM
RSAC reference: 921040

Department of Mines and Energy NT
PO Box 2655
Alice Springs NT 0871
Fax: (089) 817 861

Roger Clifton is working in remote sensing at the NT Geological Survey as a geophysicist. Using TM, MSS, ERS1, low-flight geomagnetism and gamma radiometrics. Based in Alice Springs.

Roger Clifton Geophysics Section Tel: (089) 515 661

Environmental Resources Information Network (ERIN)
Australian Nature Conservation Agency
GPO Box 636
Canberra ACT 2601
Tel: (06) 250 0375
Fax: (06) 250 0360
See CYPLUS project
Richard Thackway Tel: (06) 250 0200

Far North Queensland GIS Users Group (FNGIS)
Fax: (070) 521 280

Geoimage Pty Ltd
GPO Box 3499
Darwin NT 0801
Tel: (089) 413 677
Fax: (089) 413 670

Geoimage Pty Ltd, established in Brisbane in 1988, is a consultancy company specialising in image processing and remote sensing applications. The company, now with offices in Brisbane and Darwin, has developed a number of value-added image products to meet the growing market. Originally the company's major thrust and client base was the mining, and mineral and petroleum exploration sectors, however, the company has broadened its base to undertake remote sensing product and market development in the renewable resources and geographical information systems sectors. Geoimage Pty. Ltd. is an official Australian Centre for Remote Sensing (ACRES) distributor for satellite remote sensing data in Queensland and the Northern Territory. The company also undertakes project work and offers a range of image processing and related services.

Bernard Fitzpatrick, Darwin Office Tel: (089) 413 677

Geological Survey of Western Australia

Mineral House
100 Plain Street
East Perth WA 6004
Tel: (09) 222 3333
Fax: (09) 222 3633

Bob Gozzard has produced a range of Landsat TM image maps in support of the geological mapping of parts of the eastern Pilbara and Kimberley regions. This work has included the integration of TM and SPOT data to produce image maps at larger scales. Image maps produced to date have been rectified to AMG and are as follows:

- 1: 100 000 scale TM image maps include Rudall (3352), Angelo (4361), Dockerell (4360), Dixon (4562), Connaughton (3452), Ruby Plains (4460), Ellendale (3862), Halls Creek (4461), Macintosh (4462), Oscar Range (3962)
- 1: 50 000 scale TM/SPOT merge image maps include Halls Creek (4461) SW and SE

Work in progress includes merging TM and SPOT stereo-pairs for part of the Oscar Range (3962) and Ellendale (3862) sheets covering Windjana Gorge area. This area includes the world famous Devonian Reef complexes. The processed imagery will also be draped over DEMs.

Bob Gozzard Tel: (09) 222 3333 Email: bobg@per.dms.csiro.au

Great Barrier Reef Marine Park Authority

PO Box 1379
Townsville QLD 4810
Tel: (077) 81 8811
Fax: (077) 72 6093

A GIS is being consolidated within GBRMP. Applications include use of GIS/RS for Zoning Plans in the GBRMP, and a spatial allocation model for rating reefs as potential sites for research and monitoring. James Aston is studying the measurement of volumes of shifting sediment on sand cays using RS/GIS.

James Aston GIS Coordinator
Michael Hartcher Planning Officer (GIS)
Jamie Storrie Project Officer, Management

James Cook University of Northern Queensland (JCU)

Townsville QLD 4811
Tel: (077) 81 4111
Fax: (077) 79 6371

Undergraduate and postgraduate education, research and development in remote sensing (through the Centre for Remote Sensing) and geographic and land information systems (through the Geography Department).

Pauline Catt Centre for Remote Sensing Email: P.Catt@jcu.edu.au
Jim Monaghan Geography Department Email: jmonaghan@cathar.jcu.edu.au

Mapping & Monitoring Technology Pty Ltd

37 Tully Street
South Townsville QLD 4810
Tel: (077) 71 6622
Fax: (077) 71 6626

Production of satellite image base maps, environmental audits, environmental monitoring, resource assessment, image processing of thematic satellite imagery and aerial photography, plotting, digitising, data translation, and training.

Debbie Kuchler
Michele Townsend

Monash University
Department of Geography and Environmental Science
Clayton VIC 3168

Jason Beringer is writing his thesis on the mapping of burnt off areas in the monsoonal north using weather satellite imagery.

Dave Bulman Tel: (03) 565 2919

National Resource Information Centre
Bureau of Resource Sciences
PO Box E 11
Queen Victoria Terrace
Parkes ACT 2601
Tel: (06) 272 4688
Fax: (06) 272 4687

The following projects have had at least some association with the National Resource Information Centre, Bureau of Resource Sciences:

- Fordham, D.P (1992) Cattle distribution and density, Australia 1:10 000 000 sheet area.
- Fordham, D.P (1992) Sheep distribution and density, Australia 1:10 000 000 sheet area.
- Mt Isa/Cannington portfolio (unpublished):
  A selection of NRICs continental datasets clipped to a specific boundary supplied to the Carpentaria/Mt Isa Mineral Province Study.
- Radwaste:
  Many of the NRIC continental scale natural resource datasets were accessed or prepared for this project to develop a methodology for radioactive waste site selection.
- National Forest Inventory:
  In the case of Northern Australia, interest is for Tropical Rainforests and *Acacia Shirlii*. The NFI data held by the Commonwealth is a copy of what is held by the states who could be contacted in the first instance. The Commonwealth has however dealt with the challenges with both attribute and cartographic differences between the states.
- Shoalwater Bay:
  The capture, collation and reporting on certain aspects of the natural resources of the Shoalwater Bay defence area in Northern Queensland.
- Kakadu GIS (Geovision):
  This was one of NRICs early projects whereby Geovision compiled a GIS in Geovision format using data supplied from the Resource Assessment Commission's Conservation Zone Inquiry.
- National datasets:
  NRIC has compiled or fostered a wide range of national coverages for various natural resource themes in a GIS format using mainly published material; where possible doing so in association with the original compilers of the data, eg the Northcote Atlas of Australian Soils (1960©1968), captured at the published scale of 1:2 000 000.

- Cape York Peninsula Land Use Strategy (CYPLUS):
  NRICs present involvement in CYPLUS is through two projects funded under the Natural Resource Analysis Program. NR07 GIS Creation/Maintenance. NR20 CYPLUS Data into the NRIC Directory of Databases Facility, FINDAR

The following people have worked or are working with GIS/RS in northern Australia:

Dr Mary Bomford	Ian Musto
Dr Julie Bowyer	Dr Peter O'Brien
Dr Roger Bradbury	Christine Petersen
Nick Dexter	Paul Shelley
Peter Dyce	Phil Tickle
Dr Dawn Fordham	Simon Veitch
Chris Malouf	Dr George Wilson
Deborah McConnell	Dr Graham Yapp
Ian McNaught	

Northern Territory ARC/INFO Users Group

Fax: (089) 89 4403

Northern Territory University

GIS Laboratory
PO Box 40146
Casuarina NT 0811
Tel: (089) 466 711
Fax: (089) 410 460

The Northern Territory University (NTU) offers undergraduate and postgraduate programs in remote sensing and geographic information systems. A well equipped GIS Laboratory is used for teaching, professional development and research. Consultancy services are available with emphasis on the application of RS/GIS technology to environmental problems in northern Australia.

People working in the remote sensing/GIS area include:

Chris Devonport	Tel: (089) 466 711	Email: chris@ironwood.ntu.edu.au
Bill Hazelton	Tel: (089) 466 824	Email: bill@ironwood.ntu.edu.au
Waqar Ahmad	Tel: (089) 466 805	Email: waqar@ironwood.ntu.edu.au

Power and Water Authority NT

Sasco House
8 Cavenagh Street, Darwin NT 0800
GPO Box 1096
Darwin NT 0801
Fax: (089) 41 0703

- Water Resources Division utilises remotely sensed data in the form of Landsat MSS and TM imagery, SPOT imagery, airborne magnetics and airborne electromagnetics. With respect to the satellite imagery, the data is acquired in both digital (on 1600 bpi CCT) and photographic forms. The digital data is processed and displayed using MicroBRIAN V3.1 remote sensing software on a 486-33MHz personal computer.
- Remotely sensed imagery is applied to assist in geological interpretation, hydrogeological interpretation, vegetation classification and monitoring and hydrological monitoring as they relate to the study of the water resources of the Northern Territory. Particular areas in which remotely sensed data has been used include groundwater resource investigations,

identification of groundwater recharge and discharge areas, floodplain salinisation, hydrogeological mapping and the hydrology of internal drainage systems.

Don Pidsley	Supervising Engineer Groundwater	Tel: (089) 82 7246
Daryl Chin	Project Engineer Groundwater	Tel: (089) 82 7237

Queensland Department of Environment and Heritage (Mareeba)
Queensland Herbarium (Mareeba Office)
PO Box 1054
Mareeba QLD 4880
Tel: (070) 921 555
Fax: (070) 923 593

Vegetation survey and mapping based on photointerpretation of aerial photographs and using GIS. See bibliography under Neldner and CYPLUS project.

John Neldner	Principal Botanist	Tel: (070) 921 555

Queensland Department of Primary Industries (Brisbane)
Central Document Exchange
Box D32
Brisbane QLD 4001
Tel: (07) 239 3417
Fax: (07) 229 8146

See CYPLUS project

Bruce Pearce	Remote Sensing Section, Survey Services Group, Water Resources

Southern Remote Sensing
24 Curtis Street
North Adelaide SA 5006
Tel: (08) 267 3983
Fax: (08) 267 3983

Southern Remote Sensing is currently mapping and monitoring firescars in Kakadu National Park in the Northern Territory

Richard DuRieu

Technical and Field Surveys Pty Ltd
Building 3, CSIRO Complex
30 Delhi Road
North Ryde NSW 2113
Tel: (02) 887 8642/43
Fax: (02) 887 8647

Projects undertaken (subject to client confidentiality) include:

- Large scale photomap development for habitat mapping using Russian satellite photography. Production of 1:50 000 and 1:25 000 scale photomaps by precision scanning and rectification (June 1993 ongoing)
- Classification of lithological characteristics in the North Arnhemland region (Part 1 September 1989; Part 2 April 1990)
- Environmental impact on vegetation – Koongarra Mine area Landsat multidate classification (August 1983)
- Structural intepretation of the Alligator River Province from Landsat MSS (May 1980)

- Image analysis of part of the Mt Evelyn mapsheet for structural and stratigraphic assessment (October 1979)
- Digital analysis and classification of land cover over Kakadu (1978)
- Development of a spatial database of uranium exploration and occurrance distribution (1975–1990)

Mike Aubrey Managing Director Tel: (02) 887 8642/43

University of Central Queensland
Faculty of Applied Science,
Rockhampton Campus, QLD 4702
Tel: (079) 309 570
Fax: (079) 309 209

Leo Duivenvoorden has 102 sites on a MAPINFO database which includes details of the aquatic plant species found at those sites in 1989, 1990, and 1991. Some results of the study were presented at the Fitzroy Catchment Symposium (see bibliography).

Appendix 2

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This bibliography includes both published and unpublished material. Citations for published material have been checked wherever possible. Some conference papers and reports may not have been published. Investigators wishing to follow up any such entries should approach the organisers of the function concerned directly.

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Appendix 3

Respondents to request for information

Shaun Andrews
Environment Review Branch
Commonwealth Environment Protection Agency
PO Box E305
Queen Victoria Terrace ACT 2600
Tel: (06) 274 1999
Fax: (06) 274 1666

Jim Arthur
Regional Director
Bureau of Meteorology
PO Box 735
Darwin NT 0801
Tel: (089) 824 711
Fax: (089) 824 702

Mike Aubrey
Managing Director
Technical and Field Surveys Pty Ltd
30 Delhi Road
North Ryde NSW 2113
Tel: (02) 887 8642
Fax: (02) 887 8647

Gary Bastin
CSIRO Division of Wildlife & Ecology
Centre for Arid Zone Research
PO Box 2111
Alice Springs NT 0871
Tel: (089) 50 0111
Fax: (089) 52 9587

Ian Bestow
Land Information Officer
Central Land Council
PO Box 3321,
Alice Springs NT 0871
Tel: (089) 516 244
Fax: (089) 521 590

R W Braithwaite
Program Leader
CSIRO Tropical Ecosystems Research Centre
PMB 44
Winnellie NT 0821
Tel: (089) 22 1711
Fax: (089) 47 0052

Andrew Buchanan
Research Officer
Remote Sensing Applications Centre
Department of Land Administration
Central Government Buildings, Cathedral Avenue
Perth WA 6000
Tel: (09) 323 1222
Fax: (09) 323 1201

Elizabeth Bui
Senior Research Scientist
CSIRO Division of Soils
Private Mail Bag
PO Aitkenvale QLD 4814
Tel: (077) 71 9511
Fax: (077) 25 3099

Dave Bulman
Dept Geography and Environmental Science
Monash University
Clayton VIC 3168
Tel: (03) 565 2919
Fax: (03) 565 2948
Email: dbulman@arts.cc.monash.edu.au

Grant Bywater
Acting Head
Policy Development Branch
NSW National Parks and Wildlife Service
PO Box 1967
Hurstville NSW 2220
Tel: (02) 585 6444
Fax: (02) 585 6555

JA Carnahan
17 Currong Street
Reid ACT 2601
Tel: (06) 247 7304

Daryl Chin
Project Groundwater Engineer
Power and Water Authority N.T.
GPO Box 1096
Darwin NT 0801
Tel: (089) 82 7237
Fax: (089) 41 0703

Roger Clifton
Geophysics Section, NT Geological Survey
Dept Mines and Energy NT
PO Box 2655
Alice Springs NT 0871
Tel: (089) 515 661
Fax: (089) 817 861
Email: rogerc@dme.nt.gov.au

Chris Devonport
GIS Laboratory
Northern Territory University
PO Box 40146
Casuarina NT 0811
Tel: (089) 466 711
Fax: (089) 410 460
Email: chris@ironwood.ntu.edu.au

Leo Duivenvoorden
Rockhampton Campus
University of Central Queensland
Rockhampton QLD 4702
Tel: (079) 309 760
Fax: (079) 309 209

Richard DuRieu
Southern Remote Sensing
24 Curtis Street
North Adelaide SA 5006
Tel: (08) 267 3983
Fax: (08) 267 3983

Max Finlayson
Alligator Rivers Region Research Institute
Office of the Supervising Scientist
Private Mail Bag 2
Jabiru NT 0886
Tel: (089) 799 711
Fax: (089) 792 076

Bernard Fitzpatrick
Geoimage Pty Ltd
GPO Box 3499
Darwin NT 0801
Tel: (089) 413 677
Fax: (089) 413 670

Bob Gozzard
Geological Survey of Western Australia
Mineral House, 100 Plain Street
East Perth WA 6004
Tel: (09) 222 3333
Fax: (09) 222 3633
Email: bobg@per.dms.csiro.au

Graeme Greenwood
Research Fellow, Centre for Spatial Information Studies
University of Tasmania
GPO Box 252C
Hobart TAS 7001
Tel: (002) 202 872
Fax: (002) 723 041
Email: G.N.Greenwood@censis.utas.edu.au

Barbara Harrison
CSIRO Division of Water Resources
GPO Box 1666
Canberra ACT 2601
Tel: (062) 464 911
Fax: (062) 479 958

Michael Hartcher
Planning Officer (GIS)
Great Barrier Reef Marine Park Authority
PO Box 1379
Townsville QLD 4810
Tel: (077) 81 8811
Fax: (077) 72 6093
Email: mick@gbrmpa.gov.au

Ian Hone
Manager, Geophysical Mapping
Australian Geological Survey Organisation
GPO Box 378
Canberra ACT 2601
Tel: (06) 249 9111
Fax: (06) 249 9999

Debbie Kuchler
Mapping & Monitoring Technology Pty Ltd
37 Tully Street, South Townsville QLD 4810
Tel: (077) 71 6622
Fax: (077) 71 6626

Maureen Longmore
The University of Adelaide
GPO Box 498
Adelaide SA 5001
Tel: (08) 228 5333
Fax: (08) 224 0464

Ian McCleod
CSIRO Division of Tropical Crops and Pastures
Land Resource Management Unit
306 Carmody Road
St Lucia QLD 4067
Tel: (07) 377 0327
Fax: (07) 377 0328
Email: ian.mcleod@lrm.tcp.csiro.au

Ian McNaught
National Resource Information Centre
Department of Primary Industries and Energy
GPO Box 858
Canberra ACT 2601
Tel: (06) 272 4688
Fax: (06) 272 4687

Murray Maynard
Chief Librarian
NT Department of Mines and Energy
GPO Box 2901
Darwin NT 0801
Tel: (089) 895 279
Fax: (089) 896 824
Email: mrm@pangaea.dme.nt.gov.au

Garth Morgan
Electronics Research Laboratory
Information Technology Division
DSTO
Tel: (08) 259 5555
Fax: (08)
Email: garth_morgan@itd.dsto.gov.au

John Mott
Department of Agriculture
The University of Queensland
Brisbane QLD 4072
Tel: (07) 365 2165
Fax: (07) 365 1177
Email: agbm@uqvax.cc.uq.oz.au

Helen Neave
Centre for Resource and Environmental Studies
Australian National University
GPO Box 4
Canberra ACT 2601
Email: helen@cres.anu.edu.au

V J Neldner
Principal Botanist
Queensland Herbarium (Mareeba Office)
Queensland Department of Environment and Heritage
PO Box 1054
Mareeba QLD 4880
Tel: (070) 921 555
Fax: (070) 923 593

Ian Noble
Ecosystem Dynamics
Research School of Biological Sciences
Australian National University
Canberra ACT 0200
Tel: (06) 249 5092
Fax: (06) 249 5095
Email: noble@rsbso.anu.edu.au

Toni O'Neill
Department of Geography
The University of Wollongong
Locked Bag 8844
South Coast Mail Centre NSW 2521
Tel: (042) 213 721
Fax: (042) 213 764
Email: t.oneill@uow.edu.au

Tony Orr
Conservation Commission of the NT
PO Box 496
Palmerston NT 0831
Tel: (089) 89 4500
Fax: (089) 89 4510

Bruce Pearce
Department of Primary Industries - Water Resources
GPO Box 2454
Brisbane QLD 4001
Fax: (07) 22 47219

Bob Peever
GIS Manager
Atherton Shire Council
PO Box 573
Atherton QLD 4883
Tel: (070) 911 311
Fax: (070) 914 300

Don Pidsley
Supervising Engineer Groundwater
Power and Water Authority N.T.
GPO Box 1096
Darwin NT 0801
Tel: (089) 82 7246
Fax: (089) 41 0703

Brenda Pitts
Wildlife Research
Conservation Commission of the NT
PO Box 1046
Alice Springs NT 0871
Tel: (089) 518 211
Fax: (089) 555 190

Steven Riley
Principal Research Scientist
Office of the Supervising Scientist for the Alligator Rivers Region
Private Mail Bag 2
Jabiru NT 0886
Tel: (089) 799 711
Fax: (089) 792 076
Email: steven@ironwood.ntu.edu.au

Susan Ringrose
Department of Environmental Science
University of Botswana
Private Bag 0022
Gaberone Botswana
Tel: 351 151
Fax: 356 591

Jeremy Russell-Smith
Kakadu National Park
Australian Nature Conservation Agency
6th Floor, MLC Building
Darwin NT 0800
Tel: (089) 799 136
Fax: (089) 799 198

Christopher Ryan
Severe Weather Warning Services
Bureau of Meteorology
GPO Box 1289K
Melbourne VIC 3001
Tel: (03) 669 4000
Fax: (03) 669 4548
Email: cjr@bom.gov.au

Glyn M. Rimmington
Senior Lecturer, Agricultural Systems
Department of Agricultural Science
The University of Melbourne
Parkville, Victoria 3052.
Ph: (03) 344 5021
Fax: (03) 347 7359
Email: gmr@agriculture.unimelb.edu.au

Kate Sanford-Readhead
Conservation Commission of the NT
PO Box 496
Palmerston NT 0831
Tel: (089) 894 577
Fax: (089) 894 524

Syd Shea
Executive Director
Department of Conservation and Land Management
PO Box 104
Como WA 6152
Tel: (09) 334 0333
Fax: (09) 334 0466

Richard Smith
CSIRO Division of Exploration and Mining
Private Bag,
Wembley WA 6014
Tel: (09) 387 0321
Fax: (09) 387 8642

Stephen Harrison
Library
Northern Territory University
PO Box 40146
Casuarina NT 0811
Tel: (089) 466 176

Marita Thompson
Librarian
CSIRO Division of Wildlife and Ecology
PO Box 2111
Alice Springs NT 0871
Tel: (089) 500 111
Fax: (089) 529 587

Peter Waggitt
Principal Environmental Assessment Officer.
Supervisory and Assessment Branch
Office of the Supervising Scientist
GPO Box 461
Darwin NT 0801
Tel: (089) 814 230
Fax: (089) 814 316

Craig Walker
GIS Manager
Conservation Commission of the Northern Territory
PO Box 496
Palmerston NT 0831
Tel: (089) 89 4500
Fax: (089) 89 4510

Jeremy Wallace
CSIRO Division of Mathematics and Statistics
Private Bag
Wembley WA 6014
Tel: (09) 387 0200
Fax: (09) 387 6046

Andrew Wilson
Remote Sensing and Fire Ecology Unit
Wildlife Division (S)
Conservation Commission of the NT
PO Box 1046
Alice Springs NT 0871
Tel: (089) 518 211
Fax: (089) 555 190

Peter Wilson
Land Conservation Unit
Conservation Commission of the Northern Territory
PO Box 496
Palmerston NT 0831
Tel: (089) 89 4455
Fax: (089) 89 4403

Appendix 4

Request for information

The occasion of the North Australian Remote Sensing and Geographic Information Systems Forum (NARGIS 93) offers an opportunity to assemble and collate a database of all remote sensing and GIS work that has been, or is being, done in northern Australia.

Information we are asking for:

- Names and contact addresses of RS/GIS people who have, or have had, an association with, or worked in, northern Australia
- Details of published material such as journal articles which are specifically relevant to RS/GIS work in northern Australia (including abstracts if available)
- Details of unpublished material such as Master/Doctoral theses, reports by government organisations, reports by consultants, etc. Although access to some of these may be restricted, we would still like to record their existence and note their contents
- Suggestions as to contacts and/or locations where the above information may be found

What we are offering in return:

- The information collected will be published later this year in a document which will acknowledge the names of all contributors
- Every contributor will be sent a copy of the printed publication. You do not have to be an author to make a suggestion or a contribution of information. A summary will be presented at NARGIS 93

Contributions/information/suggestions should be sent to the GIS Laboratory or:

NARGIS 93
PO Box 461
Darwin NT 0801

Tel: 089 814 230
Fax: 089 814 316
Email: nargis93@ironwood.ntu.edu.au

The closing date for inclusion of material in the publication is 12 July 1993.

Enquiries may be addressed to:

Chris Devonport	NTU	089 466 711	Email: chris@ironwood.ntu.edu.au
Bernard Fitzpatrick	CCNT	089 894 444	
Steven Riley	OSS	089 799 711	
Peter Waggitt	OSS	089 814 230	