Cocos (Keeling) Islands
Geographic Information System

System Documentation

Prepared for
Territories Office,
Commonwealth Attorney-General's Department

by Keith Porritt and others
GEOSCIENCE AUSTRALIA

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Disclaimer

The data in this GIS were assembled by the Mineral Resources and Advice Project of Geoscience Australia (GA). In compiling the product, GA has translated and integrated data as received from many other sources. GA has undertaken initial checks as to the accuracy or completeness of these externally supplied datasets and the result of these examinations are reported throughout this documentation manual.

It should be noted that the Cocos GIS datasets may contain information that is not totally accurate or complete. Therefore you should not rely solely on the information in this GIS when making a commercial decision. Please read the accompanying documentation and where further information is required please contact:

Eddie West
Territories Office Perth,
Department of Transport and Regional Services.
PO BOX Z5048, Perth, 6831
Ph: (08) 9225-1404
Fax: (08) 9225-1419

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Acknowledgments

Cocos GIS Team

The Mineral Resources and Advice Project of Geoscience Australia would like to acknowledge the support of Ms. Debra Blaskett and Mr. Peter Lawler of Territories Office whose efforts made the undertaking of this work possible.

A number of people from GA contributed to the Cocos (Keeling) Islands GIS. Jane Bryan processed the satellite imagery and utilities data, projected the data to UTM(WGS84) and provided documentation updates. Martin Sholtez developed a substantial proportion of the HTML documentation and contributed data edits and documentation for a number of datasets. Dr. William McKay provided management support and advice and reviewed the 2001 release of this documentation. Neal Evans advised on and checked data and documentation issues. Geoff Lawford contributed quality assurance and quality control checks.

Through this team effort valuable spatial and attribute data, that over time may have become lost, are now readily accessible in one integrated system.

Cocos GIS Data

Data capture was commissioned by Territories Office in a variety of projects over the last fifteen years for all data sets except for the November 2003 satellite image which is from the Department of Environment and Heritage under a limited multi-user licence:

LandInfo Canberra generated orthophotography from aerial photography flown by the Australian Survey Office Canberra on 5-Apr-87.

The Australian Land Information Group (AUSLIG) digitised cultural and topographic themes for the Cocos (Keeling) Islands at both Canberra and Western Region offices in the early 1990's on behalf of Territories Office.

The National Capital Planning Authority (NCPA) was commissioned by the Commonwealth Government to carry out a planning study that assembled the *Land Use Plan and Planning Scheme* data dated February 1992.

The Western Australian Department of Lands Administration (DoLA) extracted the cadastre snapshot packaged on this CD-ROM set from the DoLA database on 30-Dec-99. Responsibility for the cadastral information passed from AUSLIG to DOLA in 1992. On-going maintenance of cadastre is undertaken by DLI under a Memorandum of Arrangement with Territories Office.

AUSLIG, DOLA and the Australian Valuation Office (AVO) jointly developed data underpinning the March 1996 ground audit of Cocos (Keeling) Islands through Australian Estate Management (AEM) as consultants to Territories Office.

Environment Australia is the custodian of the marine environment data referred to as *Environment Australia (1998) Whelans Cocos GIS (1998).* A separate licence agreement applies to this data set (see Chapter 8).

Gutteridge Haskins &Davey (GHD) Pty Ltd assembled the utilities data and the 2003 cadastre from Computer Assisted Drawing (CAD) over a period from 1994 to 25-03-2003.

The Cocos (Keeling) Islands

The Cocos (Keeling) Islands are one of Australia's Indian Ocean Territories. They are located in the Indian Ocean 2,950 kms north-west of Perth, 3,700 kms west of Darwin, and 900 kms south west of Christmas Island (96° 52' East' 12° 10' South). There are 27 coral islands in the group, with a total land area of approximately 14km^2.

Geography and Climate

Apart from North Keeling Island, which is approximately 30kms from the main group, the islands form a typical horseshoe-shaped atoll surrounded by a coral reef.
Each island has rough coral beaches to seaward and sandy beaches or mudflats on the lagoon side. The Islands are low lying and most are thickly covered with coconut palms.

Wildlife consists mainly of seabirds, such as frigatebirds and booby birds, which are restricted to uninhabited islands, especially North Keeling. Land crabs are common on all islands.

The climate is tropical with high humidity. Temperatures range from 20°C to 30°C. The average rainfall is 2000mm per annum, falling mainly from January to August. The south-east trade winds blow most of the year, producing pleasant weather conditions.

Social Aspects

The population of the Cocos (Keeling) Islands was estimated at 675 persons in November 1998. This represents a slight increase from the figure of 655 persons reported at the 1996 census. The 1998 population comprised 552 persons on Home Island and 123 persons on West Island.

Home Island is the location of the Cocos Malay community. The Cocos Malays have significant social and cultural links to communities in Asia (particularly Sabah) and Western Australia. West Island's population comprises mainland-based public servants and contractors, long term residents and their families.

Copra provided an initial base for the Cocos (Keeling) Islands economy. The public sector is now the largest area of economic activity, although contracting out of activities has provided increased opportunities for the private sector. Tourism is potentially a significant area of economic activity in the Cocos (Keeling) Islands. Local attractions include diving, fishing and wind-surfing.

Chapter

1

Introduction

Background

This documentation accompanies the delivery of the Cocos (Keeling) Islands Geographic Information System (Cocos GIS) to the Department of Transport and Regional Services (Territories Office), on completion of Stage 2 (October 2000). The major tasks and activities associated with the project are as set out in the Memorandum of Arrangement (MoA) with Territories Office dated 10th October 1999 (Chapter 7).

General Features

The Cocos (Keeling) Islands Geographic Information System is a collection of spatial data, viewing and analysis tools dealing with the Cocos (Keeling) Islands. The data include orthophotography, topographic, cultural and environmental features both of the islands and the ocean immediately surrounding them.

Compilation of data and its organisation into a GIS together with documentation was undertaken by the Geoscience Australia (GA) at the request of the Territories Office, Department of Transport and Regional Services (DoTaRS).

The data are presented in both ESRI ArcView and ArcExplorer projects. The ArcView projects require a licensed copy of ArcView. ArcExplorer is a free viewer and is distributed with the Cocos GIS CD-ROM. Data are stored as ESRI shapefiles and therefore readily useable with most modern GIS applications.

Data were received from a variety of custodians and in many cases had no accompanying documentation. Lack of documentation made it increasingly difficult for GA with interpretation, translation and documentation of data. GA has attempted to include metadata for all datasets to ANZLIC core metadata standards, but the value of this is limited by the poor initial documentation. In addition to limited documentation, many datasets had inconsistent spatial accuracy.

In some cases further work could be done by GA to improve the value of the data, but this would be beyond the scope of the current MoA.

Getting Started

CD-ROM # 1 automatically runs a web (HTML) document containing details and tools for getting started with the Cocos (Keeling) Islands GIS. A hard copy of this document is included with this documentation in Chapter 5.

Chapter 2

Thematic Layers and Data

Viewers

The Cocos GIS CD-ROM # 1 contains ESRI's free data viewer ArcExplorer 2.0. This enables viewing of all the vector data and the TIFF versions of the raster data.

If editing or more complex GIS analysis is required, ArcView GIS should be used. GA has made every effort to correct errors in the source data. Use in ArcInfo or most other available GIS software packages should be straightforward.

Data Formats

The Cocos GIS uses ESRI shapefiles as its major vector format. This enables editing within ESRI ArcView GIS rather than requiring a more expensive software package. It also allows preservation of 3-D data components. The existence of a 3-D component, which enables easy viewing in a 3-D viewer such as ArcView's 3-D Analyst, was preserved wherever possible to maximise data value. In cases where this may limit shapefile portability to other software packages, the 3-D component can be removed by saving as a 2-D shapefile from ArcView.

The primary format for raster data is uncompressed Tagged Image File Format (TIFF) full colour. A secondary format is Enhanced Compressed Wavelet (ECW) format (a compressed format distributed with ERMapper and viewable in ArcView after the installation of a plug-in). This format significantly reduces file size and is quick to view. GA has observed some spatial accuracy variability at higher resolutions with some ECW format images.

Source files are in a variety of formats, as received from the data custodian. Source formats include Microstation Design Files (DGN), ESRI Shapefiles, ESRI Coverages, ESRI ArcInfo Export (E00), MapInfo (TAB, MID/MIF) as well as various tabular and database formats.

Projection

The 2006 Cocos GIS stores data in the UTM(WGS84) projection. Previous versions of the Cocos GIS used the Cocos (Keeling) Islands Grid 1992 (CKIG92). This data has been projected to UTM(WGS84) Zone 47 using the ArcView projection wizard, and the ERMapper Geocoding wizard.

COCOS (KEELING) ISLAND GRID 1992 (CKIG92)

Projection: Universal Transverse Mercator Zone 47 South
Datum: WGS 1984
Spheroid: WGS 1984
False Easting: 500000
False Northing: 10000000
Central Meridian: 99
Latitude of Origin: 0, 0
Scale Factor: 0.9996
Units: metres.

For more information about projecting using ArcView, refer to 'CocosGIS\document\ reprojecting_shapefiles_arcview.doc' located on cd-rom#1. For more information about adding the CKIG92 projection to ERMapper , refer to 'CocosGIS\\document\Adding_CKIG92_to_ERmapper.txt' located on cd-rom#1.

If creating ArcView projection files (PRJ), be aware that this can cause problems with loading shapefiles into ArcExplorer 2.

Satellite Imagery

Please read the license for terms and conditions of using the satellite imagery contained on cd-rom #1. It is located in the '/CocosGIS/document/licenses' directory under the name of 'MULTIPLE_ORGANIZATION.TXT'. There is also a copy in Chapter 8: Data Licensing and Agreements of this manual.

If you are unsure whether you are a registered user of the satellite imagery please consult the 'registered_users.pdf' file in the same directory. Alternately there is a list of registered organisations at the end of this section and also in Chapter 8: Data Licensing and Agreements.

Quickbird satellite imagery of Cocos (Keeling) Islands was commissioned by the Department of Environment and Heritage in mid 2003. All of the Southern Atoll was supplied to the Australian Government by DigitalGlobe in November 2003 and North Keeling Island was sensed in January 2004. The Quickbird satellite recorded reflectance data of the islands in the red, green, blue, near infra-red and panchromatic bands, in 11 bit format. The resolution of the sharpened satellite imagery is 0.6m/pixel.

Geoscience Australia was supplied with the full multi-spectral data for the Cocos (Keeling) Islands in the form of an 8 bit TIFF image containing the red, green, blue and near infra-red bands. The panchromatic band was also supplied as an 8-bit TIFF. DigitalGlobe undertook pan-sharpening of the satellite imagery, in the process dividing the imagery into four sections. Four 8-bit pan-sharpened TIFFs, one for each of the four sections, containing the red, green and blue bands was supplied to GA. Each pixel on the pan sharpened imagery represents 0.6m. Further details regarding the satellite imagery can be viewed in the full DigitalGlobe documentation
'CocosGIS\data\sat_imagery\ DigGlobe_productguide_2003.pdf'.

Figure 1: The Cocos (Keeling) Islands as reprojected as one whole image.

All satellite images were supplied to Geoscience Australia in UTM WGS84 Geographics. GA joined the images using ER Mapper 6.4 and then using the ER Mapper Geocoding Wizard GA reprojected the full image into UTM GDA94. [Previously due to restrictions in computer processing power and a file size limit in ER Mapper 6.3 the four pan sharpened images were reprojected separately which led to gaps appearing at the joins in the four sections.]

Also received from Digital Globe was a satellite image of North Keeling Island. As with the other satellite imagery this was supplied as a multi-chromatic, a pan-chromatic image and a pan sharpened. Using the ER Mapper Geocoding Wizard Geoscience Australia reprojected the image into UTM GDA94.

DigitalGlobe advise that the positional accuracy of the imagery is +/-14.7m RMSE (Root Mean Square Error). Due to this low level of positional accuracy, an XY shift was also applied to more accurately position the imagery by correlation with the lodged cadastre on screen as follows:
Before cadastral re-alignment (see cadastre section of manual):
X=16.9m East
Y=6.9m South
After cadastral re-alignment
X=2.4m West
Y=3.14m South
This shift brought the imagery inline with the current cadastre and reprojected orthophotography.

Figure 2: North Keeling Island satellite imagery after reprojection. Notice that shallow waters around the island become obvious.

Due to disk space limitations these images are stored in ECW (Enhanced Compressed Wavelet) format. The main Cocos Island group is stored in the 'CocosGIS\data\sat_imagery\ecw' directory under the filename of 'cocos_satim.ecw'. The North Keeling Island ECW is located in the same directory with the filename 'nth_keeling.ecw'

	Registered Organisations
1	Department of Transport and Regional Services
2	Cocos (Keeling) Islands Shire
3	Geoscience Australia
4	WA Department of Industry and Resources
5	WA Department of Land Administration
6	WA Department for Planning and Infrastructure
7	Cocos Island Co-operative Society Ltd
8	Cocos Dive
9	WA Department of Education and Training
10	Cocos (Keeling) Islands Tourism Association

Table 1: Registered users of the satellite imagery bundled with this manual.

Full Notes from The Cocos GIS 2003 release

The satellite imagery was supplied in UTM WGS84 Geographics. Due to limitations of software and hardware Geoscience Australia projected the four 8 bit pan-sharpened TIFF images of the main atoll into UTM WGS84. The four reprojected TIFFs were then joined. As a result gaps between the four sections of imagery were apparent.

The image in it's entirety was saved as an Enhanced Compressed Wavelet (ecw) image, where each pixel represented 0.6 metres. Nineteen 1km x 1km TIFF images, and two 1.5km x 1km TIFF images covering Home, West and Direction Island were created from the image and are included with the 2006 release of the Cocos GIS.

Geoscience Australia shifted the ecw image (X +16m, Y – 7m) to match the more accurately positioned 2003 cadastre shapefile and the orthophotography. The TIFFs over Home and Direction Islands (X +16m, Y -7m) and West Island (X +14m, Y -9m) were also shifted to align with the orthophotography and 2003 cadastre.

Utilities

GHD Surveys supplied waste water, water supply, gas, fuel, power, and telecommunications data in ESRI shapefile format as well as Computer Assisted Drawing (CAD) file format. The utilities data were supplied in the CKIG92 projection. The CAD files are not stored in the GIS CDs due to disk space limitations. GA projected the utilities data to UTM(WGS84) using ArcView and the shapefiles are stored in the 'CocosGIS\data\utilities' directory. Data manipulation prior to receipt by GA can be seen in the original documentation by opening the file 'CocosGIS\document\GHD_meta_util.pdf' located on cd-rom #1.

Figure 3: Data from the Utilities directory includes water supply and power infrastructure points, lines and polygon.

The cd-rom supplied by GHD contained a number of customisations to enhance ArcView's interface. These included a 'metatool' (for viewing the utilities metadata sheet), hotlinks to CAD files and a GHD special font set.

The GHD-supplied custom font allows ArcView to generate point theme legends with custom symbols preferred by GHD. Examples of these can be seen in Figure 4. GA considers that GHD did not adequately document how to implement this special font.

Some of the GHD enhancements required registry edits, installation of DLLs in addition to ArcView extension (AVX) files. This is requires a level of system access not available on most public service PCs. Consequently these particular enhancements were not implemented by GA.

The font used for GHD symbology is stored on CIGIS CD1 as ‘CocosGIS\data\utilities\Ghdsym.ttf’. In order to view the symbols as GHD intended, install this font by opening your windows font directory (eg. C:\winnt\fonts), clicking ‘File|Install New Font…’, navigating to ‘cd-rom #1 CocosGIS\data\utilities’, selecting 'GHD Utilities Geocomp Symbols (TrueType)' and pressing ‘OK’.

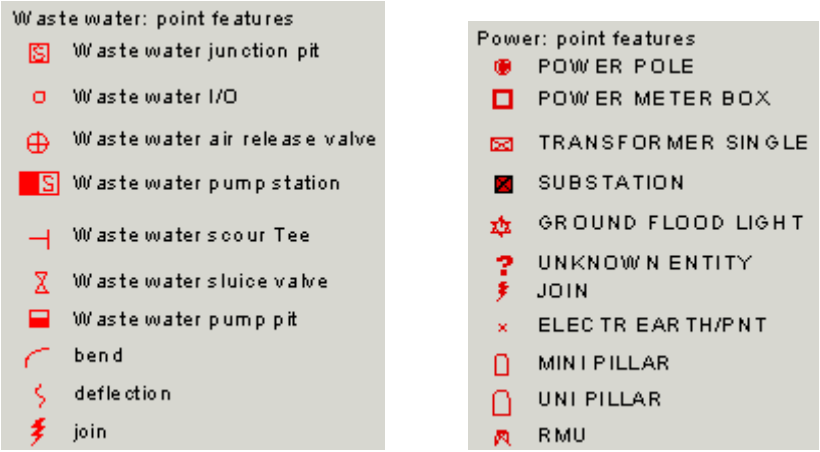

Figure 4: Examples of utilities legends in ArcView after installation of the font containing the GHD symbol set.

Orthophotography

The current release of the Cocos (Keeling) Islands GIS includes repositioned and reprojected versions of the orthophotography matching the included satellite imagery.

Using ERMapper a mosaic of the orthophotography was projected into GDA94 in BIL (Band Interleaved by Line) format. This was then sliced into separate tiles using the 'erswarp' utility which comes included with ER Mapper. An example of usage is shown on the left.

```
erm_run erswarp -j 269529.8070216110
-k 8661242.5412299900 -l
270519.8070216110 -m
8660242.5412299900 -t map -z
G:\\atlas\\anima~aq\\cocos~h_\\home_
~dq.ers
G:\\atlas\\anima~aq\\cocos~h_\\output\
\home2.ers

This command must be run from the
'\ERMapperX\bin\win32' folder.

Note that due to changes in version of
ERMapper to 6.4, the erm_run command
must be used to initialise erswarp.

To access a full list of usage commands
for erswarp run the following in the
'\ERMapperX\bin\win32' folder:

erm_run erswarp -u
```

The full batch file used to create the tiles has been included on cd-rom #1 under CocosGIS\document\cocos_tiles.bat.

Notes on Previous Versions

Digital orthophotography has been prepared from aerial photography flown on the 5th April 1987 by the Australian Survey Office Canberra. GA commissioned LandInfo Canberra to generate orthophotography from the 1987 aerial photography as a component of this Cocos GIS project that GA undertook on behalf of Territories Office.

The orthophotography has a 25cm on-the-ground pixel size. A 'pixel' or 'picture element' is the smallest component in a digital image — a pixel is an individual square of colour. The quality of the orthophotography is impressive, with acceptable resolution down to 1:400 scale.

Figure 5: An image captured from the Cocos (Keeling) Islands GIS orthophotography at approximately 1:500 scale, showing clarity and resolution of land and underwater features. Of all the datasets in the GIS, the orthophotography (created from aerial photography flown in 1987) is considered to have the highest overall spatial accuracy.

The orthophotography is considered to be the most accurately located dataset overall. This high quality locational accuracy results from the use of surveyed ground control points in conjunction with recognisable features and a 3D model. In addition, the southern atoll is bridged by an intersecting flight line pattern, which also underpins the high positional accuracy. The triangulation report for the survey control is stored on cd-rom #2 at 'CocosGIS\data\orthphto\source\control\aig_ls3.doc' (Microsoft® Word 97 format — a text only version is also stored at that location) and shows there was a good fit of the control from a mathematically rigorously method and pattern. Hardcopy sketches of the survey ground control points are held in archive and are available for inspection.

Orthophotography was generated in Cocos (Keeling) Islands Grid 1992 (CKIG92) by transforming the aerial photography survey control to CKIG92. This involved a projection of the survey control file "aig.ctl" (cd-rom #2

CocosGIS\data\orthphto\source\control\points\original) from UTM47S (WGS72) to Transverse Mercator (WGS84) with the following parameters plus an XY shift[1] of X=16.86mE and Y=4.12mN:-

False Easting	50000.000
False Northing	1400000.000
Central Meridian	96˚ 52' 30"
Central Scale Factor	1.000000

From experience with similarly created orthophotography and subsequent GPS checks, GA would expect the Cocos orthophotography over the main atoll to be within a meter of its true position. Exceptions to this high level of accuracy are Horsburgh Island and North Keeling Island, which are on unconnected flight lines and did not have reliable ground control available[2]. Initial indications are that the North Keeling orthophotography could be around 35 meters out, and the Horsburgh Island orthophotography could be up to 20 meters out.

The original orthophotography consists of 24-bit colour Tagged Image File Format ('.tif') files taking up about 4.7Gb of disk space. To decrease storage, GA has supplied orthophotography in two reduced size formats:

1. as 256 colour '.tif' tiles suited to both ArcExplorer and ArcView use, and
2. as full colour Enhanced Compressed Wavelet (ECW) compressed images which can be viewed in ArcView using a plug-in[3] provided on the CD-ROMs.

Also supplied are ArcView Image Catalogs, which use a single theme to represent all the orthophotograph '.tif' tiles. An attempt has been made to match the digital orthophotography colour to that of the source aerial photography.

In 2003 GA projected the 256 ‘.tif’ orthophotography images to UTM (WGS84) using ERMapper.

ORTHOPHOTOGRAPHY DETAILS

Aerial Photography:
- Australian Survey Office, Canberra
- Aerial Photography for the Cocos Keeling Islands
- Film No: SOC 760
- Film Type: colour
- Photo Scale: 1:10000
- Date: 5-4-87
- O/Lap: 80%
- Project Name: COCOS KEELING ISLANDS
- Run No(s): 1 - 7

Scanning for COCOS GIS: Kevron Aerial Surveys
Orthorectification for Cocos GIS: LandInfo (Canberra)

[1] The XY shift is necessary to accord AUSLIG and ERIN data with the DoLA cadastre data, which has been chosen by GA as the authoritative vector dataset.

[2] Two datasets covered Horsburgh and North Keeling Islands. GA judged the planning data to be more reliable, but the ERIN marine environment data had more resolution. GA warped the ERIN data to match the Planning data, and supplied the resultant coastline data to LandInfo to aid in georeferencing the orthophotography.

[3] File ' ArcView_3.2a_ECW_Plugin_v2.5.exe' in folder 'CocosGIS\util\arcview\extensions'.

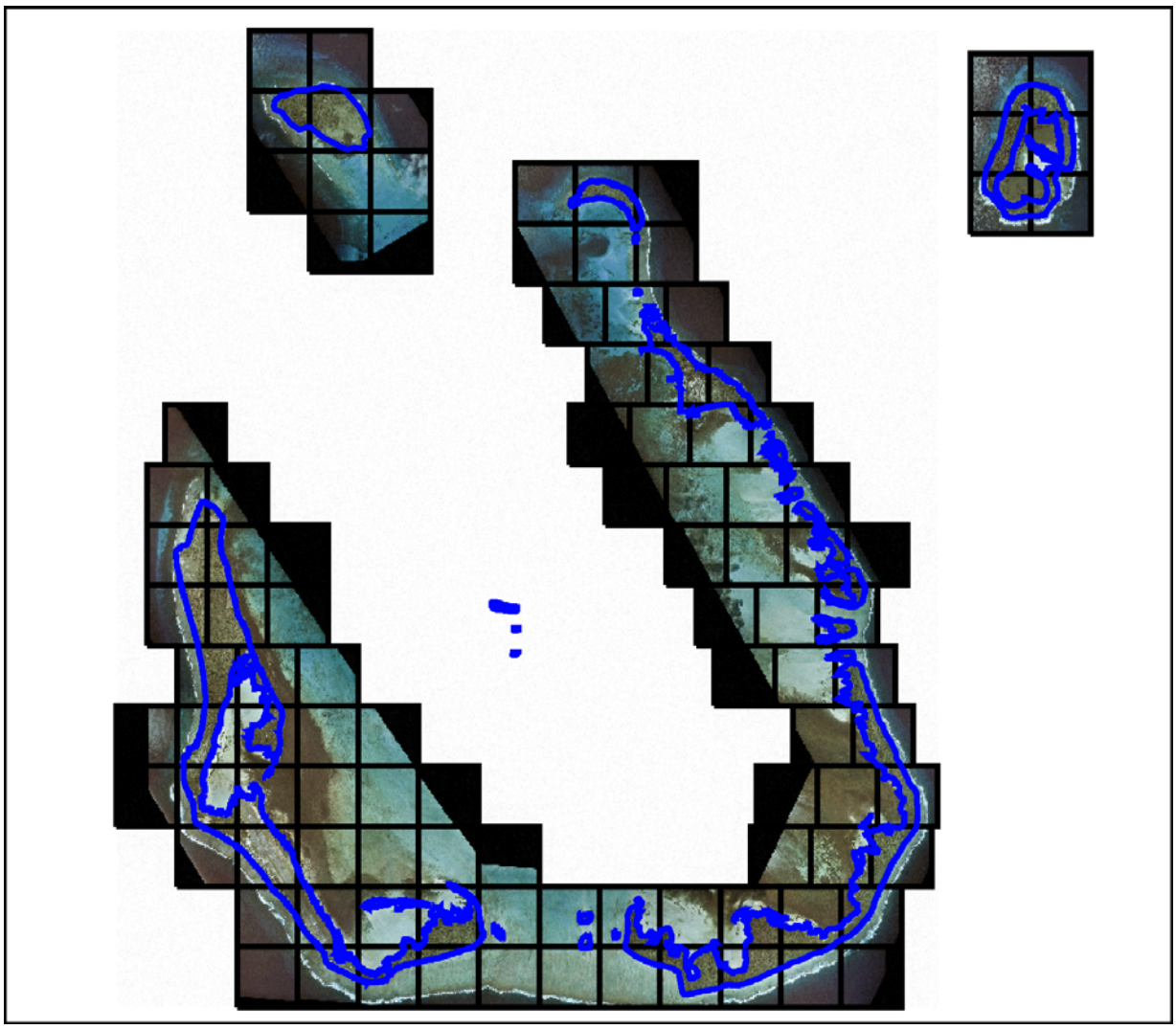

Figure 6: Layout of all 105 1Km X 1Km orthophotography tiles created for the Cocos GIS from the 1987 aerial photographs.

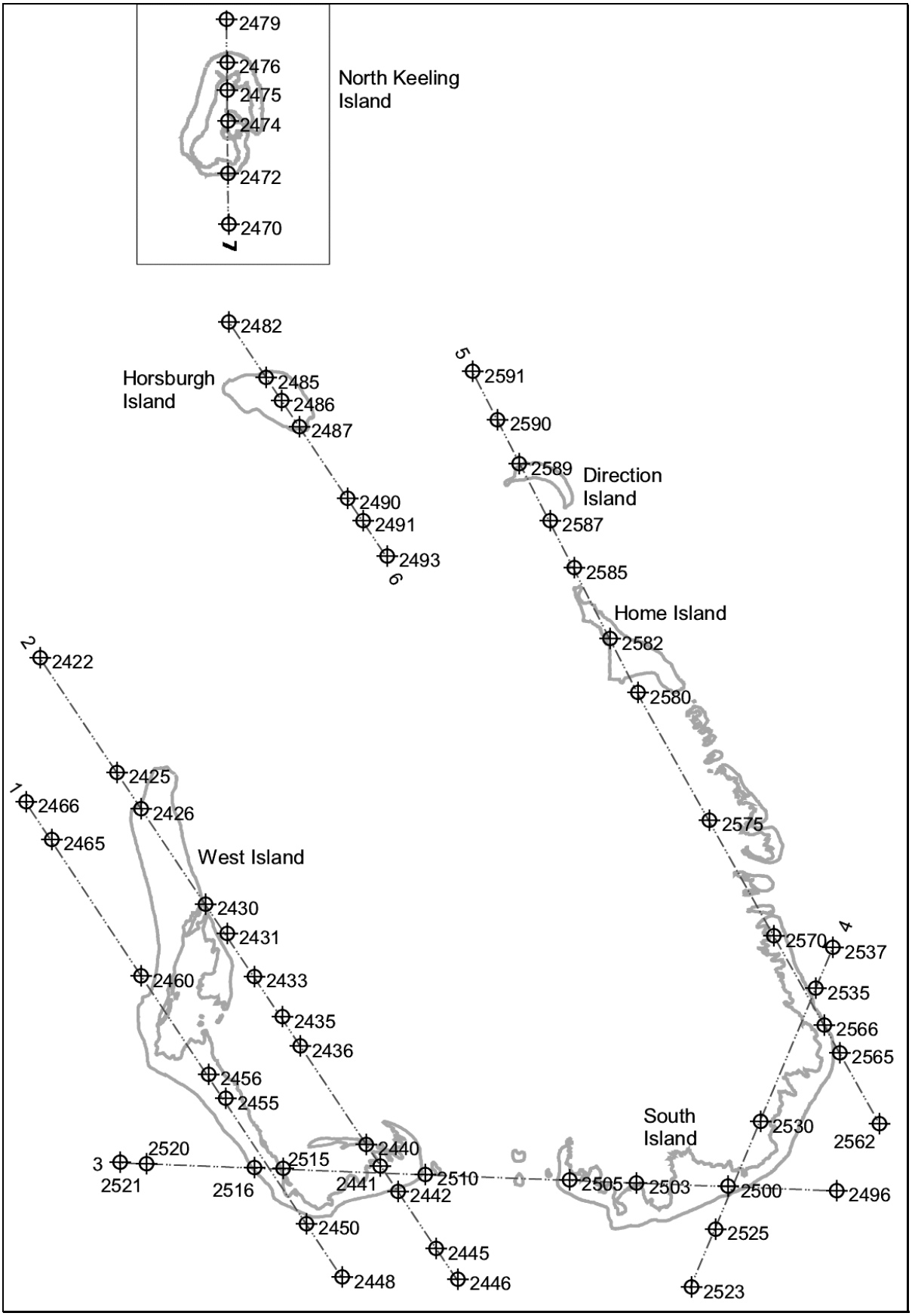

Figure 7: Flight lines and photo centres of the 1987 aerial photographs used for the Cocos GIS orthophotography. Flight lines are numbered at one end of the line.

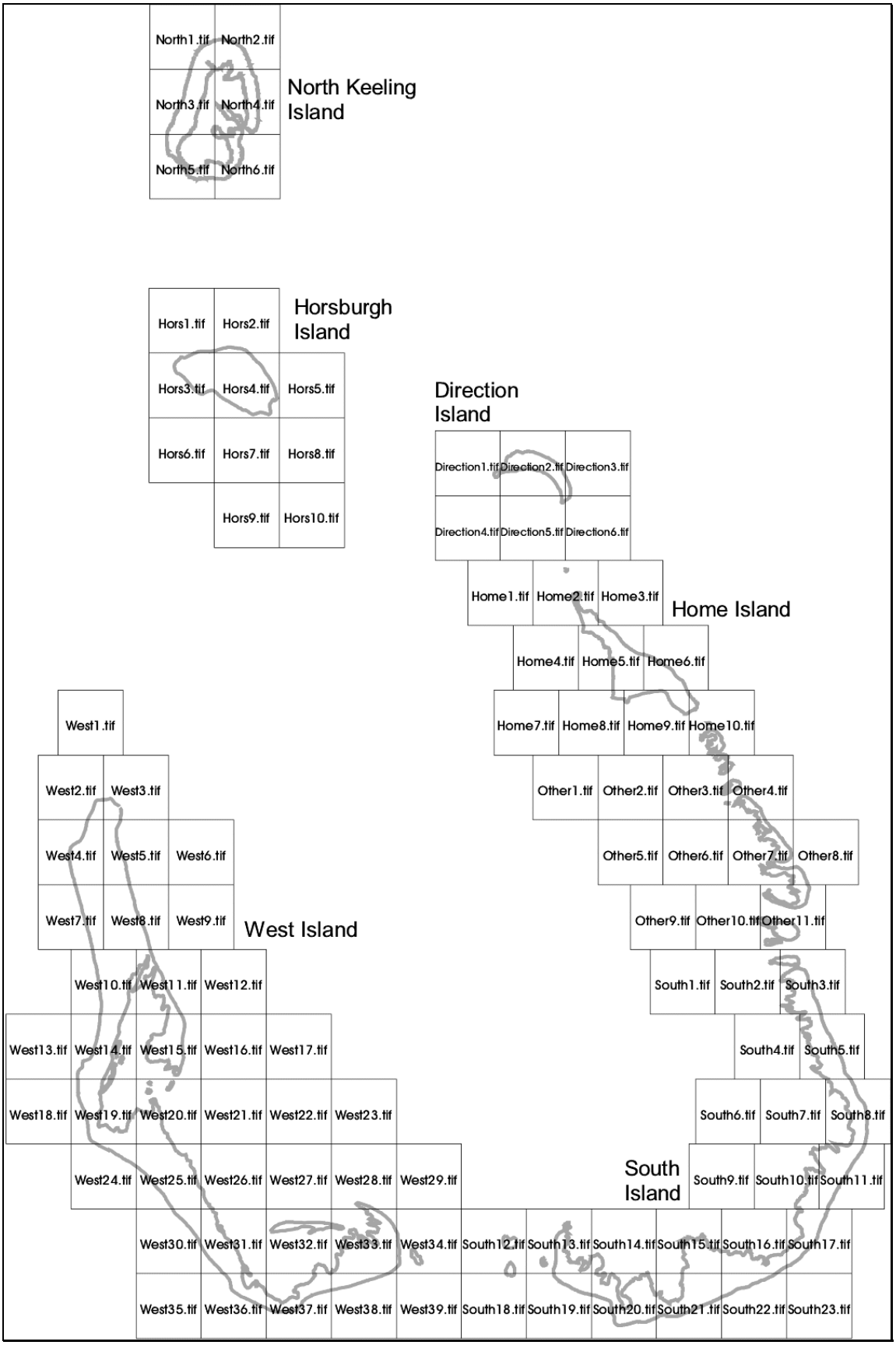

Figure 8: Index of the orthophotography showing the names and extents of each orthophotograph tile. Each '.tif' file is associated with a '.tfw' file which georeferences the image. The index file is stored as a shapefile ('orthindx.shp') for use within ArcView and ArcExplorer projects.

Cadastre and Ground Audit

In December 2004 Geoscience Australia received the scheduled cadastral update from Tony Yeomans of the Department of Land Information (DLI, formerly DoLA). This update consisted of two ESRI shapefiles and two access databases.

One of the ESRI shapefiles contains current property boundary information and the other contains lodged changes to property boundaries. Both ESRI shapefiles arrived at Geoscience Australia pre-projected in UTM (GDA94).

The reason for differences between the lodged cadastre and the current cadastre is that current data could have been calculated or digitized, etc. When lodged data is integrated into current, the area is spatially upgraded with the new survey data (lodged data) as this would be more accurate[4].

One access database contained data relating to tenure information including address. The other contained data on reserves.

In January 2005 Geoscience Australia also obtained ground audit data from Peter Brockmulen of the Department for Planning and Infrastructure (DPI, formerly DoLA). This ground audit was conducted in 2004 at the request of the Department of Territories and Rural Services (DoTaRS) in Western Australia. It contains data describing land use and reserve usage.

To produce the final cadastral information the files were modified and combined as follows.

Due to initial consultation with users of the Cocos GIS it was decided to keep the cadastre containing current property boundaries and the cadastre containing lodged changes to property boundaries separate. As such the following changes were made to each file separately. Additionally the cadastral boundary for North Keeling Island, taken from the last version of the cadastre, was joined to the current cadastre shapefile.

From discussion with users of the Cocos GIS it became apparent that the field LOT_TYPE was causing confusion with it's meaning. This is because it is a computer generated field that does not reflect the tenure of the land. Instead land tenure is derived from the PI_PARCEL field. To avoid this problem GA removed the LOT_TYPE field and replaced it with a TENURE field derived from the PI_PARCEL field and based on the definitions from the NORM manual[5] as supplied by DLI.

Using tenure information from the database supplied by DLI and from the land audit information supplied by Peter Brockmulen, GA joined on the fields ADDRESS, ZONING, RESERVE, PURPOSE and MANAGEMENT were joined on lot number. For multiple instances of lot numbers information was entered manually based on the land audit information supplied by Peter Brockmulen. From reserve data supplied by DLI the fields RSV_VESTIN, RESERVE_US and LGA were joined using the PIN field.

Finally GA made the decision to move the cadastral data to be in line with previous data such as orthophotography. As such the following XY shift was used on both the cadastre and the

[4] Email from Tony Yeomans of DLI, 14th February 2005.

[5] NORM files are a series of sequential files which DLI (formerly DoLA) uses to disseminate spatial and tenure data. Each of the files contains attribute data for a single tenure or spatial entity. The content of the NORM files is generally normalised, with data from different files related through common key attributes. *Taken from 'NORM files' September 2—2, by DoLA*

lodged shape files:

X+3.26m

Y-1.04m

This set cadastre data within 0.1m of older versions. In the future GA plans to asses the positioning of the cadastre based on the GPS ground control station on West Island and the satellite imagery.

In the 'CocosGIS\cadastre\cadastre_dli' folder is the lodged and cadastre shape files as projected by DLI but with all data joined.

Figure 3: Cadastre.shp and Lodged.shp overlayed on satellite imagery of Home Island.

Notes of Previous Versions

In August of 2004 DoLA supplied GA with the scheduled update to the cadastre in the form of and ESRI shapefile. The data was supplied to GA pre-projected in UTM (GDA94). Through observation this was found to be accurate and as such GA did not reproject this data.

For the first time this included a positioned cadastral outline of North Keeling Island. Also for the first time the dataset included both the current cadastral tenure boundaries and the lodged changes to tenure boundaries.

To produce the final cadastre the current tenure boundaries and the lodged tenure boundaries were combined (this is no longer the case). Data from previous cadastral tables was then joined using pin number.

In 2003, GHD Surveys Pty Ltd provided GA with an updated cadastre in ESRI shapefile format. This cadastre was supplied in the CKIG92 projection. GA projected the 2003 cadastre to UTM (WGS84) using ArcView.

The 2003 cadastral data cover most of the main group of islands. Horsburgh Island and North Keeling Island were not included in the cadastre.

By observation spatial accuracy was good across all the islands. This can be difficult to check, since cadastral boundaries do not usually correspond to natural features. When compared to the orthophotography (which should be spatially accurate for the southern atoll), features matched well on all the islands.

For previously supplied datasets (eg 30-DEC-99) GA confirmed the coordinate system to be geographic (World Geodetic System 1984). DoLA are confident of the transformation of the original WGS72 data to WGS84 but note earlier co-ordinates are based on a doppler survey and so may not be so accurate[6]. The cadastre is however the most rigorously surveyed vector dataset and so the cadastre was selected by GA to be the authoritative vector dataset.

GA projected the cadastral dataset to CKIG92 using the ArcView 3.2, a projection utility.

The cadastral data cover most of the main group of islands. Horsburgh Island and North Keeling Island were not included in previous versions of the cadastre.

By observation spatial accuracy is variable (the cadastre is difficult to check, since cadastral boundaries do not usually correspond to natural features). When compared to the orthophotography (which should be spatially accurate for the southern atoll), West Island features match well over the whole island. Home Island matches well for the majority of the island, but with significant offset of features at the northern end of the island. Direction Island matches well.

The cadastre for South Island and the small islands of southeast Cocos appears poorly located. For this area, different groups of islands in similar vicinities have different offsets from the orthophotography, suggesting erroneous positioning of the cadastre rather than a general projection error. For the final cadastre version, GA moved some of these individual small islands, and occasionally stretched the features in an X and/or Y direction. The majority of this work was done at a scale of 1:2500. South Island required warping to get a reasonable match to the orthophotography. GA used the ArcView Extension ShapeWarp to register and warp this island and small islands surrounding it. Movements of cadastre features for southeast Cocos tend to be up to 20 meters, but can be around 40 meters.

The original shapefile had some erroneous polygons (43 regions), which had small visible representations and large areas. As these areas did not have attributes and in all cases checked were not unique, they were deleted from the projected shapefile.

The majority of attributes in the final cadastre shapefile are from the Ground Audit data, which were joined to the cadastre using the Pin field.

[6] Pers Comm and e-mail; Linda Morgan, DOLA 21&27/1/00, Ph 08 9273 7135.

Topography and Culture

Data representing topography and culture were received from LandInfo Canberra (on behalf of the Australian Surveying and Land Information Group (AUSLIG)) in design file format (DGN). Documentation was not supplied with this data and is apparently not available. Coverage is restricted to Home and West Islands.

It is probable that the nominal scale of this data is 1:1000 as similar data collected by AUSLIG for Christmas Island are of this scale.

Evaluation of the data suggests that the probable source coordinate system is Universal Transverse Mercator (UTM) Zone 47 (World Geodetic System 1972 (WGS72)). Using this input coordinate system, projection to CKIG92 resulted in a mismatch of coordinates. Using similarly digitised features in the coastlines, GA found that an X-shift (16.86mE) and a Y-shift (4.12mN) of the AUSLIG data resulted in a match with the cadastre for West Island.

Home Island did not match as well and a further X-shift of 2.22 metres East matched the centre of the township on Home Island to ± 0.25 metres. The far Northern end of Home Island is the worst located with features approximately 5 metres West of the orthophotography. In the wharf area, features are approximately 1.5 metres West of the orthophotography. The road features in the far East of the island are approximately 2.5 metres East of the orthophotography, and the South-West of the island matches the orthophotography to ± 0.5 metres. Attempts to warp Home Island features to match the orthophotography were not acceptable.

Figure 11: Topography and culture data from LandInfo Canberra (on behalf of AUSLIG). Labels refer to vegetation polygons (extracted and corrected by GA). These codes cannot be sensibly decoded by reference to the AUSLIG code sheets; they will probably require someone with local knowledge to add a description.

Data derived from topography

Two coverages have been derived from the AUSLIG topography by GA in order to enhance the useability of the data in a GIS. These are a vegetation layer (vegetatn.shp) and a road centrelines layer (roads.shp).

There are a number of features in the original topography data that do not have valid AUSLIG codes. Comparison with the orthophotography indicates that all these codes represent vegetation. GA has extracted these codes and created a polygon layer (in ArcInfo) by including common lines as well as those coded as a particular type. The resulting layer is coded according to the erroneous codes in the original data. Because the level of detail is different from the vegetation layers in the planning data, correlation was not conclusive. Re-coding according to actual vegetation types is recommended if this layer is to be used for analysis. The vegetation appears to match the 1987 orthophotography, and would therefore be out of date in some areas due to the fact that the 1992 planning data documentation reveals that areas have been cleared since the 1987 air photos.

For GIS analysis using a road network, GA has created a road centreline layer based on the topographic data. This was accomplished using the ArcInfo 8.0.2 CENTERLINE command and then manually correcting (in ArcEdit) at intersections and elsewhere based on the original dataset and, to a lesser extent, the orthophotography. Converting to ArcInfo format necessitated dropping the third dimension from the data. GA did not attempt to digitise road features from the orthophotography where digital data did not exist. Users should be aware that the road centreline coverage is therefore incomplete. It would be useful if future work included the addition of further attributes (especially road names — which none of the available topographic and cultural data include).

In 2003 GA projected the topography and culture data to UTM(WGS84) using ArcView.

Detailed Survey

LandInfo Perth supplied detail survey data on behalf of AUSLIG. No documentation was available for this data except for working notes on the CD-ROM. The spatial component of the data was supplied in design file format (DGN). As Ground Audit databases were also supplied with this data, it is possible that the detail survey was associated with the ground audit, which would date it at around 1996. This dataset is valuable in that it contains features such as services (utilities) that are not available in other datasets.

Coverage is restricted to the populated areas of Home and West Islands for the detailed data, with lower resolution data for general coverage of Home and West Islands.

It was assumed that the data was supplied in the UTM Zone 47 (WGS72) coordinate system. Projection to CKIG92 with the addition of an X-shift of 16.86 metres East and a Y-shift of 4.12 metres North appears to confirm this. This is the same XY shift that was applied to both the Topography & Culture dataset and to the Marine Environment dataset. In contrast to other datasets, a good match of features with the orthophotography at the northern end of Home Island has been achieved (this area matches the cadastre). Inside the detail survey area features generally match the orthophotography locationally to within ±0.25 metres. Outside the detail survey area features may be up to ±7.5 metres displaced with respect to the orthophotography.

Many building shapes do not match the orthophotography, to the extent that their shapes are not even close to a match. One row of buildings is consistently displaced by approximately three metres. Many features are mislabelled. For example, map tic marks are labelled as

drainage pipes. It appears that this dataset is incomplete and has certainly not gone through rigorous quality control. Some housing shapes appear to be from an early conceptual plan rather than a survey of housing at the time of this data's creation. Although there is a lot of potentially useful data in this dataset, the logical consistency of both the spatial and attribute components appears flawed. In 2003, GA projected the Detailed Survey data to UTM(WGS84) using ArcView.

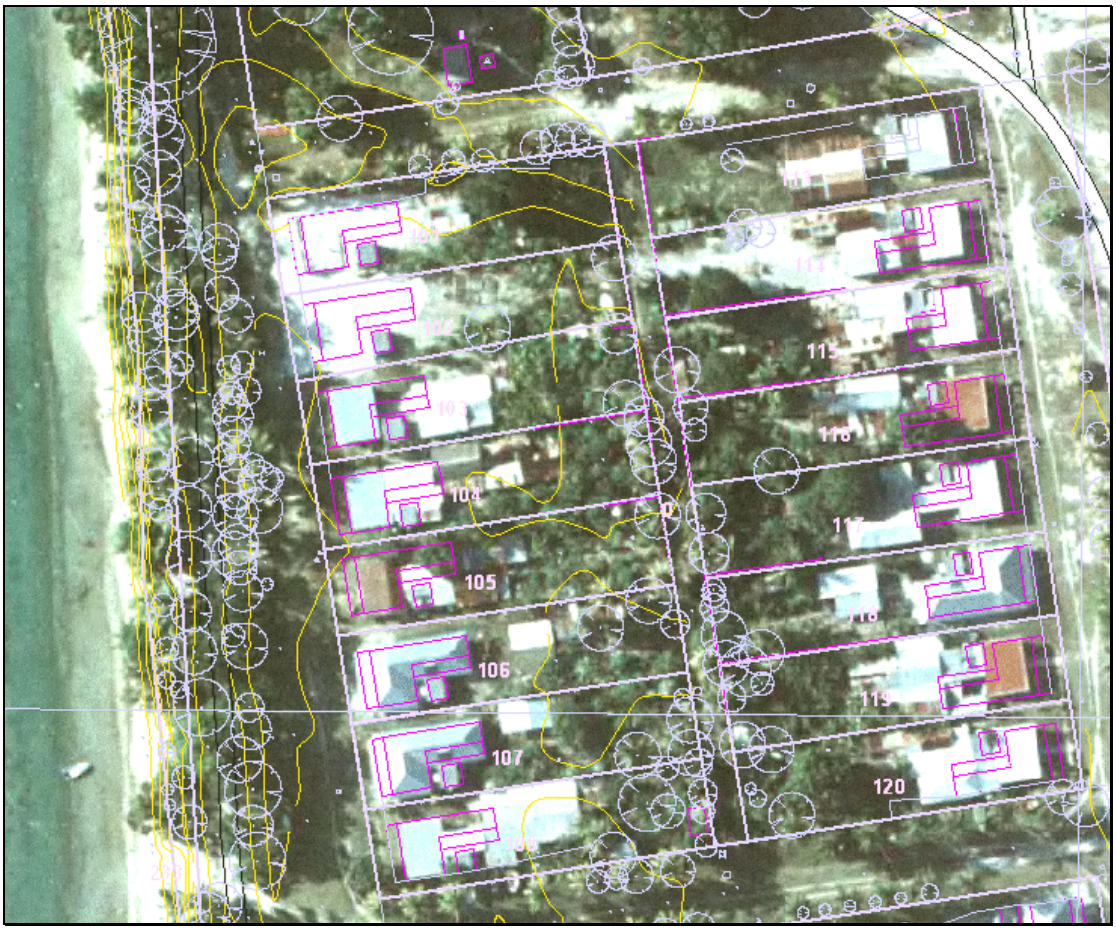

Figure 12: Screen capture of part of Home Island showing poor spatial accuracy for some housing features of the detail survey data. The right hand row of houses has features offset by approximately ± 2.5 metres compared to the orthophotography. Many of the houses also have very different shapes in the data when compared to the orthophotography. It seems probable that these features are not surveyed but retrieved from an earlier, perhaps conceptual, plan.

Side Scan Sonar Paths & Interesting Features

In August 2005, Parks Australia North Cocos (Keeling) Islands (PANCKI), (courtesy of Robert Thorn) provided Geoscience Australia (GA) with sidescan sonar video footage taken from the shipping channel from the north-eastern lagoon entrance through to the blue hole or the oil-tanker moorings. The video footage was supplied on CD-Rom viewable with accompanying software (Imagenex Model 881 Sportscan Digital Sidescan Sonar V1.20).

The video footage was taken over eight days (20-23/11/2002; 4/12/2002; 5/3/2003; 11/3/2003 & 17/3/2003) by Don Shepherd, subcontracted by GHD Pty Ltd and funded by DoTaRS. The purpose of this survey was to confirm the shipping channel and was the final survey before the shipping channel could be opened. It was conducted to ensure that previous contractors had adequately removed obstructions such as coral bombies and placed markers appropriately. Positional accuracy of the sidescan sonar has not yet been received by GA. The instrument trails the shipping vessel on a cable of variable length. Errors are introduced

depending on the length of this cable, and also depending on the currents within the water body. GA is as yet to receive information regarding the cable length used or whether corrections have been made to the sidescan sonar data. GA has tested various locations along the sidescan sonar paths for accuracy. This was done by correlating the path with features distinguishable in the 1987 Orthophotography. From these test locations, GA believes errors to be within +/- 10m. An example of these test locations can be seen in Figure 17 below.

Figure 13: IMAGENEX Sportscan Digital Sidescan Sonar device

Shapefiles have been built from this data to show the paths taken by the sidescan sonar vessel. These were created using the longitude and latitude displayed from the beginning and end of the image paths. It should be noted however that this method assumes the vessel to be moving in a straight line throughout the footage. As the lines have been compiled with only the beginning and end point data it is possible that the vessel did not maintain this straight path and therefore errors may be evident due to this assumption. A coverage of lines was built and projected into UTM Zone 47S (WGS84).

A second shapefile has also been created which shows anomalies noticed by GA within the sidescan sonar footage that may be of interest, such as that in Figure 14 below. The shapefile was produced using the latitude and longitude of the particular point of interest, and was then projected to UTM Zone 47S (WGS84). These two shapefiles are shown below overlayed on the 2003 satellite imagery.

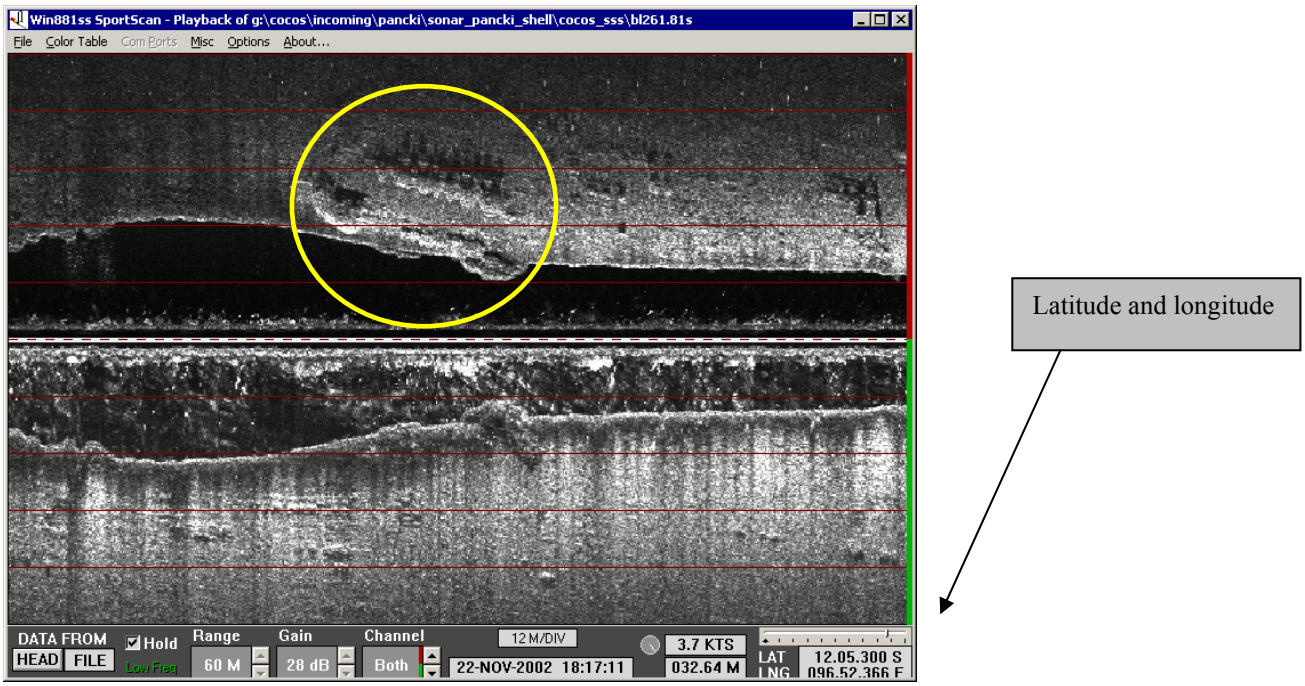

Figure 14. An anomaly within the Side Scan Sonar footage.

GA is as yet unable to provide an explanation of what these anomalies are. Evidence suggests they could be a combination of natural features such as coral bombies or rock strata, or

anthropogenic features such as foundations of past or present navigation markers or perhaps a sunken vessel or war wreckage. Screen captures of these areas have been included on the adjoining pages.

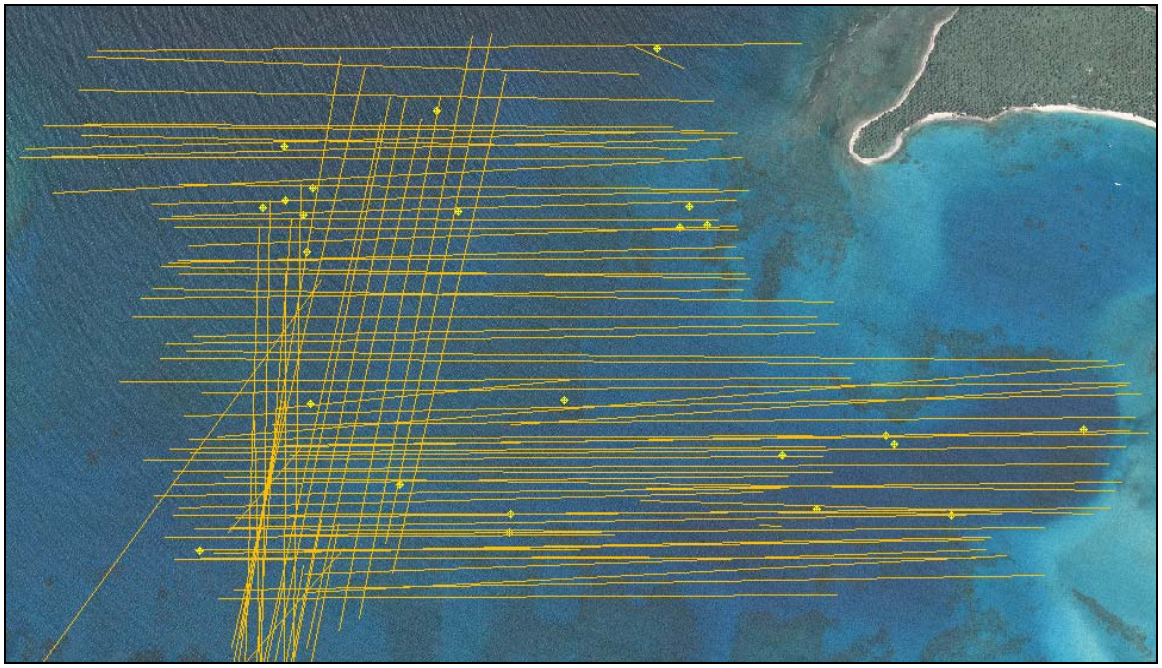

Figure 15: Side Scan Sonar paths and interesting points overlayed onto the 2003 satellite imagery.

By overlaying these shapefiles with the 2003 satellite imagery and, where available, the 1987 orthophotography, correlation is evident between rock and coral covered patches of the sea-floor and that data footage captured by the sidescan sonar. This can be seen by comparing the following sidescan sonar image and the 1987 orthophotography of the same area.

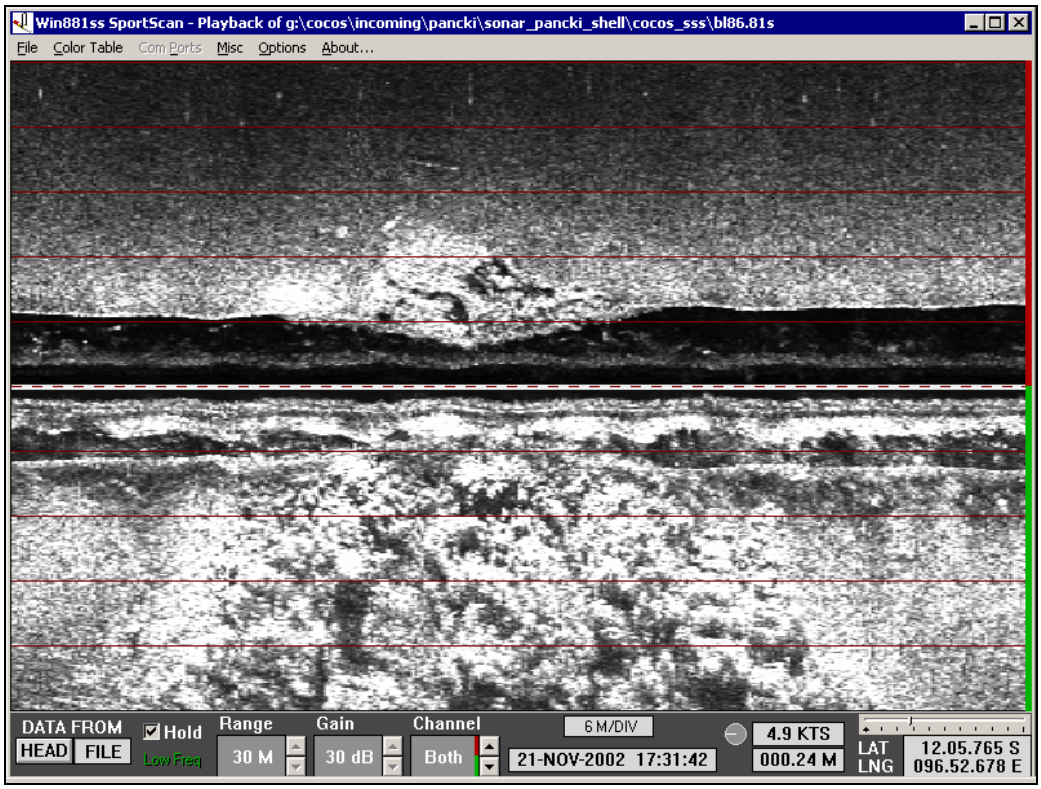

Figure 16: Sidescan sonar image of an area near the Blue Hole. Correlation can be seen between the sonar footage and the satellite image shown below.

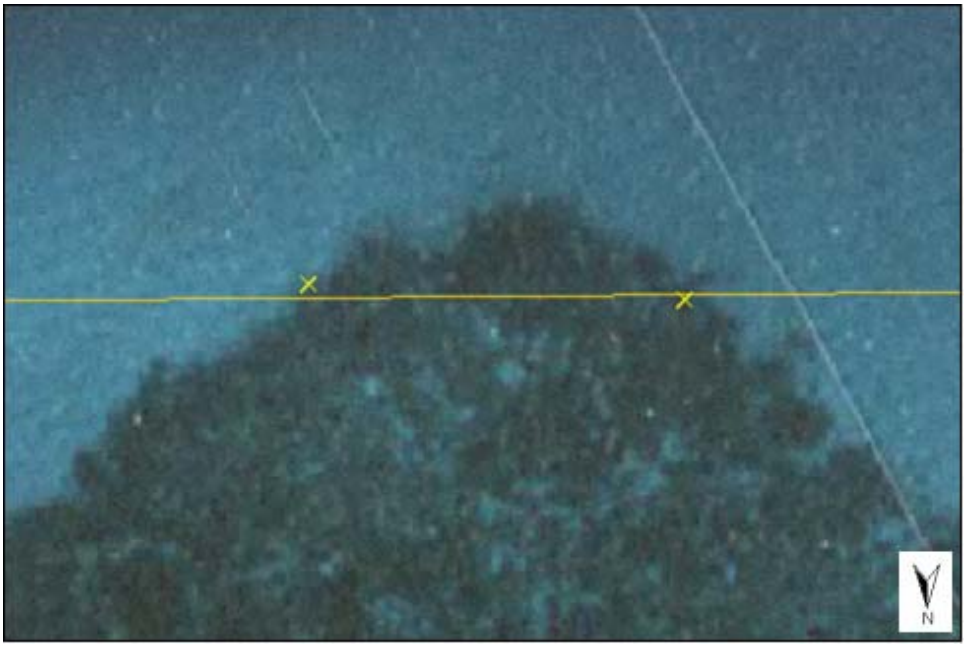

Figure 17: 1987 Orthophotography of the area captured in the sonar footage displayed in Figure 4.

Correlation can be seen between the two images (note that the vessel was travelling from east to west).

GA understands the dark band in the middle of the sidescan sonar footage to represent the wake of the boat. Due to the sonar equipment needing to drop 3-4 meters below the boat, it was necessary for water depth to be at least 5 meters. Paths are attributed with the video footage filename. (e.g. bl96.81s, where bl=blue hole and .81s refers to the equipment model. Other prefixes are ch=channel, cl=clearance area, tr, newcl, and south). PANCKI have expressed an interest in investigating some of these anomalies by diving the areas.

Marine Environment

Marine environment data were obtained from the Environmental Resources Information Network (ERIN). ERIN refers to this dataset as *Environment Australia (1998) Whelans Cocos GIS (1998).* This includes coastlines, bathometric contours, coral outcrops and other features.

This data is now supplied on CD-ROM #2 of the Cocos (Keeling) Islands GIS.

The data were supplied as ArcInfo export files, but relevant documentation was not available. Documentation provided by ERIN with the data actually referred to a different dataset, namely the Cocos (Keeling) Islands Land Use Plan of 1992.

Evaluation of the marine environment data established a match with the cadastre on West Island using a projection from UTM Zone 47 (WGS72) to CKIG92 plus an X-shift of 16.86 metres East and a Y-shift of 4.12 metres North. This is the same XY shift that was applied to both the Topography & Culture dataset and to the Detailed Survey dataset. However all other islands are significantly mis-located. Attempts to warp these features or to derive a coordinate transformation were not successful. The actual marine zone features appear to be of a relatively low resolution anyway, defining approximate rather than exact boundaries. Interestingly they seem to match the spot image. In 2003 GA projected the Marine Environment data to UTM(WGS84) using ArcView.

CAUTION

It is recommended that the use of the Marine Environment data be restricted to broad-scale applications and that caution be exercised (especially away from West Island) due to poor spatial accuracy.

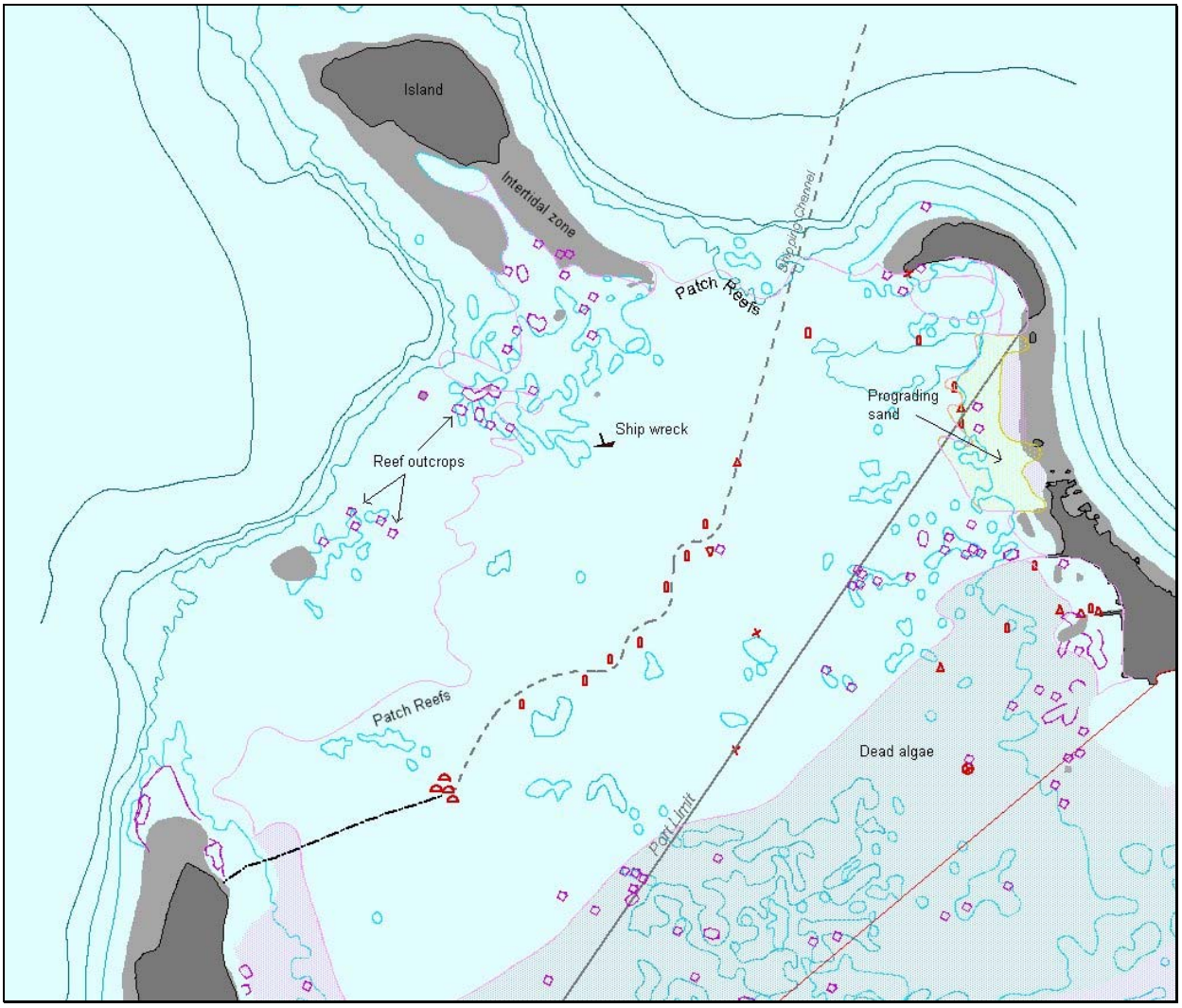

Figure 18: Data from ERIN include marine environmental data, some marine infrastructure and management zones.

Planning

The Cocos (Keeling) Islands Land Use Plan and Planning Scheme (June 1992) was prepared for the Cocos (Keeling) Islands Council by the National Capital Planning Authority (NCPA) and the Commonwealth Department of Arts, Sport, Environment and Territories (ref). As part of the planning study, a geographic information system (GIS) database was established in order to prepare base and thematic maps and to enable the production of high quality figures to illustrate the planning report and to present the plans for public consultation.

The GIS data was stored by NCPA as ESRI coverages and includes planning-related cultural and environmental layers. The data coverage is primarily for the southern atoll, but some include North Keeling Island.

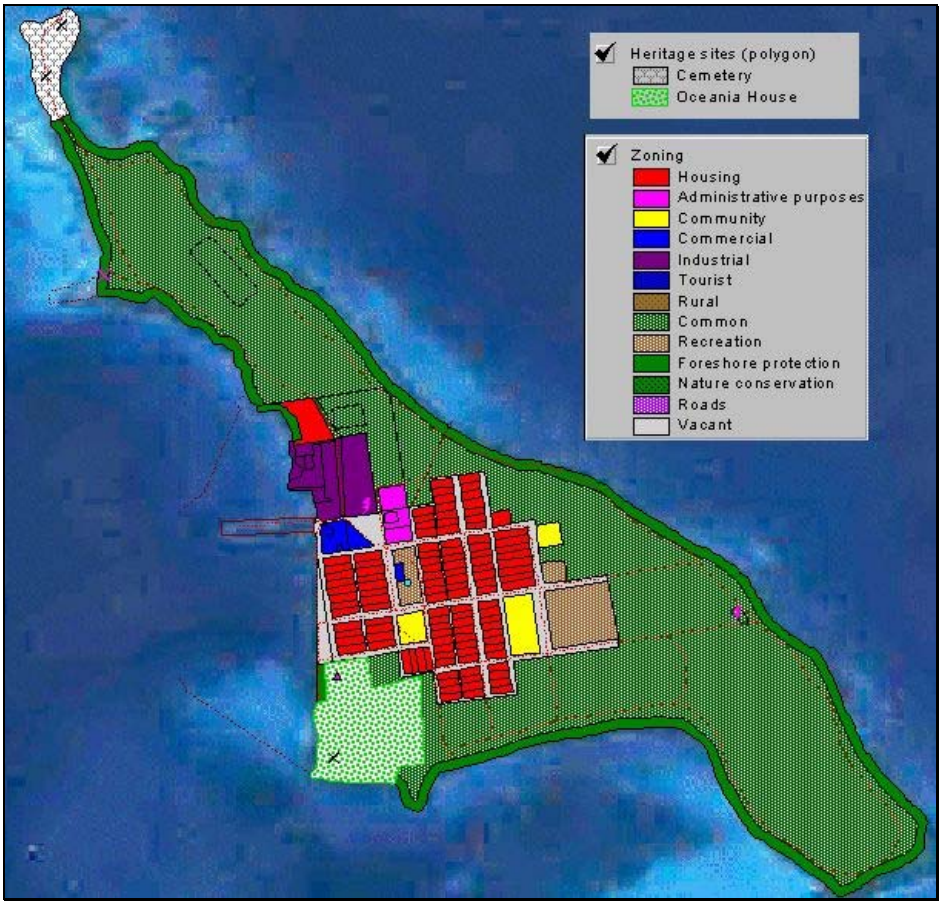

Figure 19: Data from NCPA include the 1992 Planning Scheme, together with over twenty supporting layers — all documented to a high standard.

The source coordinate system is UTM Zone 47 (WGS72). In 2003, GA projected the data to UTM(WGS84). Data accuracy is variable depending on the dataset and location.

Documentation for this dataset is of a high standard (hard copy only was supplied) and includes attribute descriptions and metadata for each dataset. (Chapter 4 is a digital version created by GA of the original 1992 GIS data documentation).

Although this data is often broad scale in nature, it has a large range of useful layers. Some of the NCPA marine data boundaries are more detailed than those received from Environment Australia.

The original digital data includes numeric feature codes whose descriptions were stored in the hard-copy documentation and for some in ArcInfo look-up tables. In some cases the look-up tables' code definitions were different from the hard copy. GA has added fields to the shapefile attribute tables to contain these feature codes and descriptions.

Water Resources

Figure 20: Water resources data supplied by ECOWISE Environmental Ltd includes freshwater lens extents, galleries and other water resources infrastructure.

ECOWISE Environmental prepared water resources data for the Cocos (Keeling) Islands. They were delivered in April 2001 in association with a report prepared for Cocos (Keeling) Islands Administration, Department of Transport and Regional Services and GA. Data was collected for incorporation into the Cocos GIS and subsequent distribution to stakeholders and other authorised users. ECOWISE Environmental supplied the data in the CKIG92 projection. GA projected the ECOWISE data to UTM(WGS84) using ArcView.

GA has now incorporated the layers into the Cocos (Keeling) Islands GIS and will prepare ANZLIC compliant metadata. Good non-compliant metadata was supplied with the data and is in the ECOWISE report at 'CocosGIS\data\waterres\source\documentation\Report.doc' and Chapter 10 of this report.

These data supersede the water resources layers in the planning dataset.

National Estate

Figure 21: Data from the Register of the National Estate includes point and polygon representations of registered significant sites (historic and natural).

The Australian Heritage Commission, Environment Australia, supplied data of sites on the Register of the National Estate in May 2001. The data were supplied as a polygon shapefile and a point shapefile. The data cover the whole island group, including North Keeling Island. This was supplied in the geographic coordinate system (WGS84). No other metadata was supplied with the data. However the Australian Heritage Commission (AHC) have a website (http://www.ahc.gov.au/register) which contains detailed descriptions of each heritage site and, in most cases, a photograph of the site.

After projection, the majority of polygon boundaries closely match the cadastral boundaries. If they are derivatives, they may have similar positional accuracy. The points, however, have very variable accuracy. Some seem to be based on centroids of cadastral polygons, but many appear to represent the general vicinity of a site.

This dataset includes a number of points and areas which do not appear in the 1992 planning data. The planning data includes a number of points “of heritage interest” which do not appear in this dataset, including Direction Island’s cable station ruins, the wrecks of the *Phaeton* and the *RCL*, West Island’s cemetery and the Twiss Memorial.

Other Data

There are a number of other datasets and digital products supplied on the Cocos GIS CD-ROMs.

The 'graphics' directory contains a spot-derived image covering the entire Cocos (Keeling) Islands in JPG format (Cocos_Spot.jpg). Because the original image was very large and had a substantial proportion of featureless ocean, a 256 colour clipped image covering just the southern atoll has been supplied ('CocosGIS\data\misc\spot\sthaspot.tif'). It is recommended that this clipped image be used in the GIS as a backdrop only - the positional accuracy is not sufficient for full GIS use. This is a scan of a DoTaRS poster, with the scanned image pixel size representing about 5 metres on the ground. Poster printing, scanning and JPEG resampling have degraded colour information. It is not recommended for scales closer than 1:50,000. This image does however give some indication of marine features in the central lagoon beyond the extent of the orthophotography.

The 'data/misc/property' directory (cd-rom #2) contains spreadsheets with property information. GA has converted these Microsoft® Excel format spreadsheets to Dbase V tables for use in ArcView. This involved changing some field names to comply with Dbase limitations. The DBF tables can be added to ArcView as tables, and where a Pin or Loc/Lot No exists in the table, can be joined or linked (for 1 to many relationships) to the cadastre attribute table.

The 'CocosGIS\data\misc\oceansub' directory contains data relating to an Expression of Interest and subdivision proposal for the Oceania House lot on Home Island. This is an example of use of the Cocos GIS prior to its completion. Of most interest in this directory is a CAD (DXF) file of the subdivision. This file is supplied in 'CocosGIS\data\misc\oceansub\Lot14.dxf'. It is not geographically located so cannot be overlayed on Cocos GIS layers. GA could easily do the geolocation as part of future work, but future Department of Land Inforamtion (DLI) cadastre updates should reflect the new subdivision. The data can be viewed in ArcView if the Cad Reader extension is enabled.

In the 'CocosGIS\graphics' directory are digital copies of several maps and posters. The maps are stored as postscript (EPS) and Adobe® Acrobat (PDF) files. The poster is stored as a JPEG image file.

Chapter
3

Further Work

GA has identified areas where improvement could be made in several datasets. These could be addressed in future work if required.

Annotation Capture

Some datasets have annotation that is yet to be captured as attributes. The capture of annotation as attributes is useful for full GIS functionality. An important example is the contour labels in the detail survey, which are the only height information stored in that dataset. A height attribute for this data would vastly improve the value of the data. A particular example is the wreck of the Emden, which is identified only as a shipwreck in the attributes but as the Emden in annotation.

Cadastre Updates

The digital cadastre will need regular updates to maintain currency. DoLA has indicated that revision of the cadastral layer is ongoing. These should be incorporated into the system as resources allow. In addition further entries and updates could be made in the ground audit table.

Geographic Names and Road Names

Probably the most authoritative feature layers (the cadastre and the topography/culture data) do not have geographic names as attributes or annotation. The planning scheme data does have some named features (eg. island names in English and in Malay) and these could be transferred as attributes to more detailed feature layers if this is appropriate. Most road names are missing from all datasets that are currently in the Cocos GIS.

Other Data Improvements

A number of other limitations and weaknesses in the current datasets could be addressed in future. Some important potential improvements are:

- joining of the contour lines where broken (ideally completion of the contour coverage of the islands);
- improved spatial accuracy of orthophotography over North Keeling Island and Horsburgh Island (this would require authoritative coastline and/or recognisable survey marks);
- checking and correction of erroneous attribution in detail survey data;
- update of metadata to ANZLIC version 2, and storage as XML files;
- proper coding of vegetation layer and resurveying if and where necessary; and
- surveying of authoritative coastlines (especially south of Home Island and east of West Island, North Keeling Island and Horsburgh Island), remaining aware that the coastline in detail is variable over time.

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GA Catalog details for the Cocos GIS (#61840):

Cat # : 61840 Flags **Product :** Y **Publication :** N **Dataset :** N **Resource :** N **WWW :** N
Title : Cocos (Keeling) Islands GIS
Medium : **Scale :** **Contact :** Keith Porritt
Type : One-Off Product **Sub Type :** No Subtype Available **Project Id :**
Pub'n Source : **Pub'n Year :** 2005 **Vol / Part :** **ISBN :**
Abstract : The Cocos (Keeling) Islands Geographic Information System (Cocos GIS) is a collection of spatial data, viewing and analysis tools dealing with the Cocos (Keeling) Islands. The data include orthophotography, topographic, cultural and environmental features both of the islands and the ocean immediately surrounding them.
---------- Bounding Rectangle ----------
N Latitude : -11.8 **S Latitude :** -12.25 **W Longitude :** 96.8 **E Longitude :** 96.95
Comments :
Data projection is Cocos (Keeling) Islands Grid 1992. Data scale is variable, due to the data being collated from various sources.
---------- List of Authors ----------
Name :
1 Porritt, K.P.
2 Petersons, S.I.
Theme :
GIS
culture
information management
topography

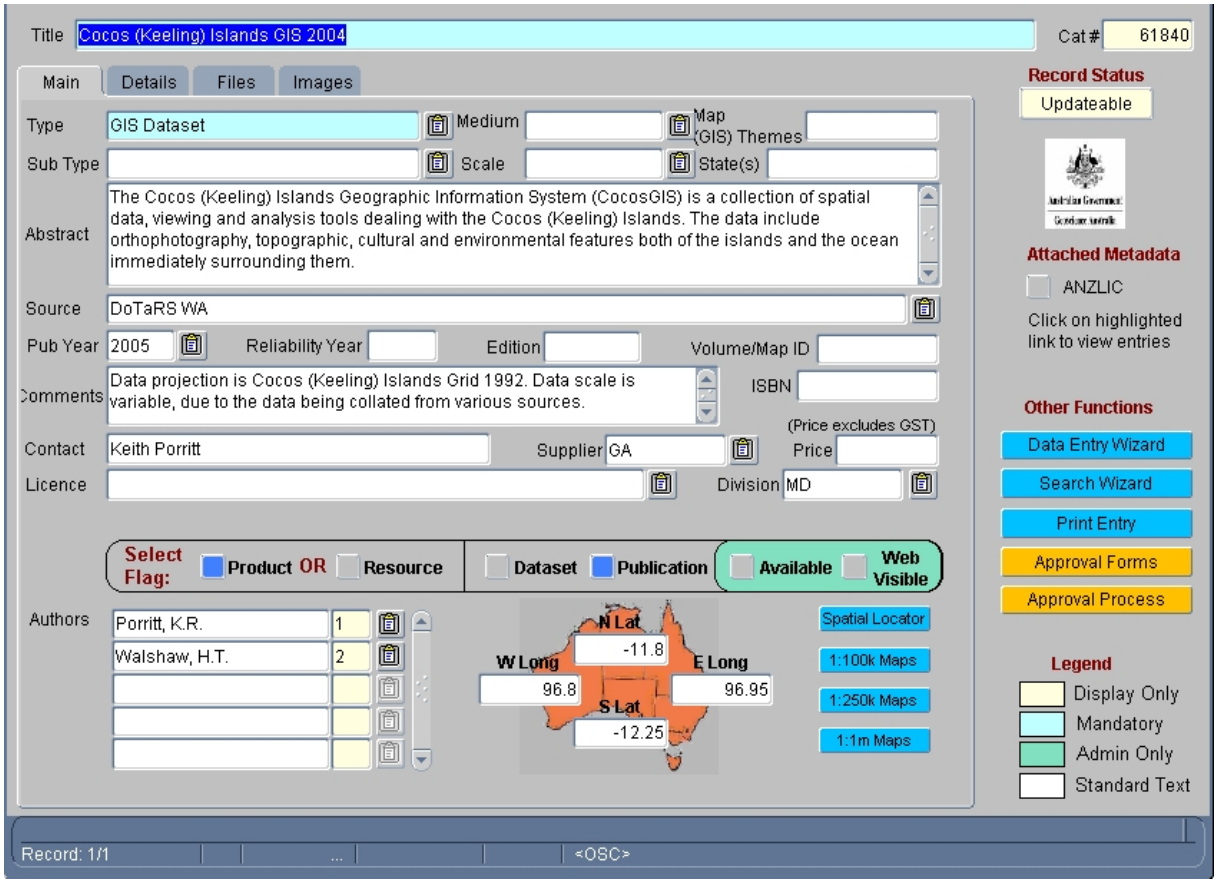

Figure 17: Cocos GIS GA Catalog entry (#61840).-

Chapter
4

Appendix 1: Metadata

Hard copy versions of the electronic metadata sheets. These metadata sheets comply with ANZLIC core metadata standards.

Chapter

5

Appendix 2: CD-ROM HTML documentation

Hard copy print of the HTML pages comprising the autorun content for CD-ROM # 1.

Chapter
6

Appendix 3: Ground Audit and Cadastre Tables

Table 2: Full listing of cadastre.shp and lodged.shp

Table 3: The following two spreadsheets list 66 fields of data from 'cocos_cadastre.xls' and 28 fields of data from 'cocos_lodged.xls' that are displayed in the attribute table. Records are sorted by the 'PIN' field. The page order for columns is 'Down, then over'. The excel spreadsheet files can be found on CD-1.

Cadastre Fields: First Section		Lodged Fields: Second Section	
Locno_str	Date_creat	Lotno_str	Tenure
Pin	Date_modif	Pin	Zoning
LotNumber	Legal_deriv	LotNumber	Reserve1
Houseno	Area_indic	Plan	Stname
Address	Centroid_c	Purpose	Stnamefx
Diagram	Date_retir	Diagram	
Description	Date_bound	Survey	
Improvment	Pityp	Centlat	
Purpose	Lot_type	Centlong	
Housesuffi	Rsv_vestin	Calc_area	
Addresstyp	Reserve_us	Legal_area	
Tenure	Lga	Date_create	
Survey	Owner	Date_modif	
Docno	Management	Lega_deriv	
Ct	Mgr_name	Area_indic	
Piparcel	Saledate	Centroid_c	
Zoning	Saledateno	Usage_code	
Plan	Purchasepr	Date_retir	
Calc_area	Location	Date_bound	
Legal_area	Gprpfx	Pityp	
Usage_code	Gprsfx	Piparcel	
Centlat	Region	Lot_type	
Centlong	Postcode	Mgr_name	

Chapter
7

Appendix 4: Memorandum of Arrangement – Particulars of Services

Memorandum of Arrangement – Particulars of Services

" To develop a Geographic Information System (GIS) for Cocos (Keeling) Islands. GA's proposals, dated 17 November 1998 and 6 May 1999 for the development of the GIS, form part of this MOA. (Attachment 1)

The Services include the provision of detailed orthophotography and feature datasets based on a two stage approach as follows:

Stage 1.

 The creation of a sample of the orthophotography similar to Christmas Island GIS (CIGIS) resolution standards;

 The retrieval and integration of available line and point data held by AUSLIG, the WA Department of Land Administration (DOLA), or the Commonwealth Environmental Resource Information Network covering Cocos (Keeling) Islands;

 The installation and demonstration of the Stage 1 version of the Cocos (Keeling) Islands GIS (CKIGIS) on the Territories Office GIS PC; and

 The provision of sample colour maps, posters and an interim CD backup.

Stage 2.

 The creation of the remainder of the orthophotography;

 The integration of ground audit data with DOLA cadastral boundaries;

 The integration to the extent possible of existing datasets that come to light through the process of carrying out Stage 1;

 The documentation of the system to the CIGIS standards;

 The publishing of the whole system on CD-ROM and delivery of five copies to the Department; and

 The installation and demonstration to the Contact Officer of the GIS at the Department's PC GIS location

The Timetable for the Services is:

Milestone	Due Date
Stage 1 completed	2 months from execution of MOU
Stage 2 completed	3 months after acceptance of Stage 1

Chapter

8

Appendix 5: Data Licensing and Agreements

Data Licensing and Agreements

The collection of nearly all the data sets on the four CD-ROMs comprising the Cocos GIS was commissioned by the Territories Office (Commonwealth Government) under a series of consultancy arrangements with various data suppliers over the past fifteen years. An exception is the Environment Australia Marine Environment data layer. The Cocos GIS is an assembly of multiple data collections (each of which may comprise some man-years of work) into a single easy-to-use integrated system and so represents a valuable Commonwealth asset.

Commonwealth Cocos GIS data licence

The copyright for all the data in the Cocos GIS resides with the Commonwealth (see data acknowledgments on page 6). Legal advice to Geoscience Australia and Territories Office recommends the protection of the Commonwealths interests in any distribution of the Cocos Islands GIS by way of a licence agreement. Following are a one-page licence agreement and an associated covering letter. A key purpose of the Cocos GIS licensing is that the user organisation signifies their acceptance that the data is not error free. This licence relates to all the data except the original content of the Environment Australia (EA) marine data for which a separate EA licence must be used. To simplify usage of the Cocos GIS, the EA data has been moved to CD-ROM 4, which is not included in the standard Cocos GIS distribution.

Risks of not licensing the data include: -

- allegations of liability for damages as a result of errors in the data,
- commercialisation of the data,
- proliferation of faceless data variants,
- inequitable government support between competing businesses,
- perceived breaches of privacy, and
- potential future denial of access by the Commonwealth to the data.

Arguments against licensing include: -

- it may in some cases stultify legitimate and effective use of the data for public good purposes, and
- it introduces a cumbersome overhead for both the data supplier and the data user.

On receipt, this data should have been received with two copies of the license agreement. One original signed copy of the Commonwealth Cocos GIS data licence is to be retained by the licensee and one original signed copy is to be posted back. An electronic copy of the Commonwealth Cocos GIS data licence (for reference) is stored on the Cocos GIS CD-Rom #1 at directory '\document\licenses' in file 'cocosgis_license.doc '.

A generic covering letter is also stored in this directory (file 'generic_licensecover.doc' and together the two documents comprise the licensing advice to each stakeholder. The covering letter should be edited to correctly describe the particular proposed licensee and two copies of both documents printed for packaging with the data. One original signed copy of the Commonwealth Christmas Island GIS data licence is to be retained by the licensee and one original signed copy is to be posted back.

The covering letter is only half a page. The Licence Terms are just over one page in length. It is important to retain this brevity. Experience indicates that long-winded licence agreements are often not read and their conditions are consequently at a greater risk of being ignored. Some users are put off using the data when there is a long and complex licence agreement to come to grips with. Consequently an important public-good benefit that might be delivered by the use of the data may never be realised.

Australian Government
Attorney-General's Department

Our Reference: CocosGIS2009
Contact: Mr. Shane Warnock

Tuesday, 4 August 2009.

Organisation name:
Organisation address:

Dear Sir/Madam,

Thank you for your request for Territories Office to supply *Organisation name* with a copy of the Cocos (Keeling) Islands Geographic Information System ('Licensed Data'), which is in the package accompanying this letter. Territories Office offers *Organisation name* a right to use the Data in accordance with the Licence Terms enclosed with this letter. A copy of the Licence Terms is also inside the package.

BEFORE OPENING THE PACKAGE, all of the Licence Terms should be read and accepted by the User, or an authorised representative of the User. Acceptance of the Licence Terms is indicated by the User's authorised signature in the space provided below on both copies of this letter, and returning one copy to Territories Office. A fee waiver is granted for Use by *Private Organisation*, however such Use is limited to work for the Commonwealth. Use of the data by *Private Organisation* for other clients requires a separate negotiation. *OR* A fee waiver is granted for Use by *Government Organisation*, however provision of new data back to the Cocos (Keeling) Islands GIS pool by *Government Organisation* is expected in return.

If the Data is used, then acceptance of the Licence Terms is deemed to have occurred even if the acceptance procedure described in the preceding paragraph has not been followed. If the Licence Terms are unacceptable, then the package, together with both copies of this letter should be immediately returned to the Territories Office and the Data must not be Used by any person for any purpose. This data licence is not intended to affect the terms of, or any obligation of the parties under any separate services agreement already in place between the Attorney-General's Department and *Organisation name*.

Territories Office grants permission for *Organisation name* to freely distribute hardcopy products or hardcopy digital equivalents (eg bitmap images or powerpoint slides) created from the licensed Cocos (Keeling) Islands GIS.

Yours Faithfully

Mr. Keith Porritt
Geoscience Australia
representing the Commonwealth of Australia
for Territories Office
Date:

……
User / User's Authorised Representative
Name:

Position in User's Organisation:

Date:

PO Box Z5048 Perth, WA, 6831 • Telephone: 08 9225 1427 • Facsimile: 08 9225 1419
Website: http://www.ag.gov.au/ • ABN 92 661 124 436

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the Territories Office of the Commonwealth Department of Transport and Regional Services
('Licence')

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'including' is not a word of limitation.

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This Licence be altered only in writing signed by Territories Office and an authorised representative of the User.

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(a) must be in writing signed by the party entitled to the benefit of that provision or right; and
(b) is effective only to the extent set out in the written waiver.

ENTIRE AGREEMENT

This Licence:
(a) constitutes the entire agreement between Territories Office and the User as to its subject matter; and
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The parties (meaning Territories Office and the User) must attempt to resolve any dispute or difference that may arise between them in relation to this Agreement (**'Dispute'**) through amicable consultation, based on principles of mutual benefit, equality, cooperation and trust. Accordingly, a party must not start arbitration or court proceedings (except proceedings seeking interlocutory relief) about a Dispute unless it has complied with the following **paragraphs (a) - (e)**:

(a) A party claiming that a Dispute has arisen must notify the other party to the Dispute giving details of the Dispute (**'Notification'**);
(b) On receipt of a Notification each party must negotiate in good faith to resolve the Dispute and, if necessary to resolve the Dispute, involve the Chief Executive Officers

or other senior officers of the parties directly in those negotiations;

(c) If the Dispute involves technical matters and has not been resolved by negotiations under paragraph (b) within a reasonable time, then the parties will refer the Dispute for determination by an independent expert agreed by the parties in the technical field the subject of the Dispute;

(d) If the Dispute is not resolved under **paragraph (b) or (c)** within thirty days (or longer period agreed between the parties), and if the User's principal address is in Australia, then the parties must refer the Dispute for mediation by the Australian Commercial Dispute Centre Limited ('ACDC') for resolution in accordance with the Mediation Rules of the ACDC;

(e) If the Dispute is not resolved under **paragraph (b) or (c)** within thirty days (or longer period agreed between the parties), and if the User's principal address is not in Australia, then the parties must refer the Dispute to arbitration for resolution in accordance with the UNCITRAL Model Law on International Commercial Arbitration. Notwithstanding any provision of the UNCITRAL rules to the contrary, the parties agree that:

- (i) the number if arbitrators shall be one;
- (ii) the place of arbitration will be Canberra, Australian Capital Territory, Australia;
- (iii) all proceedings will be conducted in the English Language;
- (iv) the applicable law is the law of the Australian Capital Territory; and
- (v) the determination of the arbitrator shall be final and binding on the parties and the costs of the arbitration shall be borne and paid for as the arbitrator directs.

(f) If the Dispute is not resolved under **paragraph (d) or (e)** within sixty days after referral (or longer period agreed between the parties) either party may initiate proceedings in a court

FURTHER INFORMATION

Historical information may be contained in the Data, metadata or documentation of the Data. If the User requires further information about the Data or it's history, then contact

Territories Office Perth,
Department of Transport and Regional Services.
Ph: (08) 9225-1400
Fax: (08) 9225-1429

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Also here is a copy of the table of registered users, found in the 'registered_users.pdf'.

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Multiple Organization
End User License Agreement

REGISTERED USERS

	Registered Organisations
1	Department of Transport and Regional Services
2	Cocos (Keeling) Islands Shire
3	Geoscience Australia
4	WA Department of Industry and Resources
5	WA Department of Land Administration
6	WA Department for Planning and Infrastructure
7	Cocos Island Co-operative Society Ltd
8	Cocos Dive
9	WA Department of Education and Training
10	Cocos (Keeling) Islands Tourism Association
11	WA Department of Fisheries
12	WA Department of Environment
13	Department of Finance and Administration
14	Department of Environment and Heritage
15	Gutteridge Haskins & Davey Pty Ltd (GHD)

Table 5: Registered users of the satellite imagery bundled with this manual.

Environment Australia Marine Data licence.

For each organisation the current Cocos GIS cd-rom #4 is to be passed to, the following licence agreement with Environment Australia (EA) need first be signed by a representative of the organisiation. This license specifically relates to the marine data sourced from EA. The EA system refers to this data set as the ' Whelans Cocos GIS (1998)'.

An electronic copy of the EA data licence is stored on the Cocos GIS CD-Rom #1 at directory '\document\licenses' in file 'ea_marine_data_licence.doc'. Details for the licensee organisation need be entered in the following fields on the document:-

Name/Title:	[enter your – Name]
Company/Organisation:	[enter your – Organisation]
Address:	[enter your – Address]
Telephone:	[enter your – Telephone]
Facsimile:	[enter your – Fax]
E-mail Address:	[enter your – Email]
The Data will be used by the Licensee for:	[enter your – Data Use]

Licensees would generally need to fill the 'Data Use' item themselves. However, all the other items in the document could be edited in advance to correctly describe the particular proposed licensee and two copies printed for packaging with the data as per the advice in the covering letter.

One original signed copy of the EA agreement is to be retained by the licensee and one original signed copy is to be posted to:-

Mr. Keith Porritt
Geoscience Australia
GPO Box 378,
CANBERRA ACT 2601

in accordance with the current dispensation by Environment Australia for GA to distribute the revised Cocos GIS data on behalf of the Department of Transport and Regional Services, including the data for which Environment Australia is custodian.

Environment Australia
Department of the Environment and Heritage

Agreement for the Supply of Data

Important: The completed Schedule and Licence Conditions set out below will constitute a legal agreement between the Commonwealth of Australia ("the Commonwealth") and you ("the Licensee") in relation to the data. If you agree with the Conditions, please tick the 'Agreed' box, sign and date beside it and ensure your licensee details are filled out below.

If you are entering into this agreement on behalf of a company or organisation, you warrant that you have the authority to do so.

Agreed

Not Agreed

The Schedule

Date:

Commonwealth

The Commonwealth of Australia is represented by the Department of the Environment and Heritage. The contact details are:

Name/Title: Gavan Thomas, Project Officer

Address: Environmental Resource Information Network (ERIN)
Environment Australia
GPO Box 787 Canberra ACT 2601

Telephone: 02 6274 2736
Facsimile: 02 6274 1333

Email Address: gavan.thomas@ea.gov.au

Licensee

Name/Title: *[enter your – Name]*

Company/Organisation: *[enter your – Organisation]*

Address: *[enter your – Address]*

Telephone: *[enter your – Telephone]*

Facsimile: *[enter your – Fax]*

Email Address: *[enter your – Email]*

The Data

The data is referred to as the 'Marine Environment' data in the GA-DoTaRS Cocos GIS. The ERIN system refers to the data as the ' Whelans Cocos GIS (1998)'.

This dataset contains point, line and polygon data of the marine environment surrounding the Cocos (Keeling) Islands. It includes coastlines, bathymetric contours, coral outcrops and other features. Coverage extends to the whole of Cocos Keeling Islands. The themes have been grouped by GA into the following shapefiles so as to increase the ease of use of the data:

Infralin.shp - Infrastructure lines
Boundlin.shp - Boundary lines
Marinelin.shp - Marine lines
Surveylin.shp - Survey lines
Islandlin.shp - Island outlines
Marineply.shp - Marine polygon
Islandply.shp - Island polygon
Boundply.shp - Boundary polygon

These shapefiles retain all spatial and non spatial data as supplied to GA.

Data are provided in shape file format and also as ERIN originally supplied in a zip of ARC export files. Both formats are supplied on CD-ROM No.1 of the Cocos GIS produced in 2000 by GA for Territories Office. Accompanying metadata for the data is also supplied.

Contributors

Item: 'Marine Environment' data referred to by ERIN as the ' Whelans Cocos GIS (1998)'.

Contributor: GA
Data was received by GA from ERIN as ArcInfo Export files. GA converted the data to shape file format. GA projected the data to CKIG92 with a coordinate shift to match the Cadastre (assuming it was received as UTM Zone 47 WGS72).
The many individual layers were checked and those of similar themes were then grouped to provide a smaller set of layers, thus making the data more useable.
The North Keeling atoll was translated and warped to more accurately match the orthophotography. Line themes were built into polygons to allow areas to be queried.

Additional Conditions: The I.P. for work done on the data by GA is not covered in this licence agreement between your organisation and EA. A separate agreement with

the Commonwealth may apply to this particular component of I.P. in conjunction with the remainder of the GA-DoTaRS Cocos GIS data.

Use

The Data will be used by the Licensee for:

[enter your – Data Use]

Licence Conditions

1 Interpretation

1.1 In these Conditions, unless the contrary intention appears:

"Commercialise" in respect of the Data or a product or service derived from the Data, includes distributing, giving away, selling, letting for hire, or by way of trade, offering or exposing for sale or hire any article embodying the Data or any product or service derived from or incorporating the Data;

"Contributor" means:

I. (in relation to the Commonwealth) an agency of the Commonwealth which is custodian of a particular item of Data on behalf of the Commonwealth; or

II. third party contributors

identified in the Schedule to this Agreement as having provided particular items of Data which are the subject of this Licence Agreement;

"Data" means the data to which access is made available, and which is listed in the Schedule and includes any Enhancements to the Data;

"Enhancement", in relation to the Data, includes any modification, adaptation or redevelopment of the Data, any work derived from the Data, machine readable representations of any of the foregoing and any associated material intended at the time of its creation to be used primarily in conjunction with the Data;

"Intellectual Property" includes all copyright, and all rights in relation to registered and unregistered trademarks (including service marks), registered designs and confidential information (including trade secrets and know-how), and all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields;

"Licence" means the licence referred to in Condition 3.

2 Duration

2.1 The Licence commences on the date of the Agreement as set out in the Schedule, and continues in force for a period of five (5) years unless terminated in accordance with Condition 10.1.

3 Licence Conditions

3.1 The Commonwealth grants to the Licensee, a royalty-free, non-exclusive, non-transferable licence to use, reproduce, make Enhancements to and print the Data, and combine it with other data held by the Licensee.

3.2 The Licence is limited to personal use of the Data or use within the Licensee's organisation only.

3.3 The Licensee shall not Commercialise the Data or any product or service derived from the Data.

3.4 The Commonwealth warrants that the grant of the Licence does not infringe the Intellectual Property rights of any person and that it is entitled to grant the licence in relation to the data of third party Contributors.

3.5 Data items identified in the Schedule as having been provided by individual Contributors are subject to the additional conditions (if any) set out in the Schedule. In the event of any conflict between the terms of the Licence Conditions and any additional condition set out in the Schedule, the terms of the Licence Conditions shall take precedence.

4 Intellectual Property Rights Reserved

4.1 All rights not expressly granted to the Licensee under Condition 3 are reserved.

4.2 The Licensee acknowledges that the Data is a special, unique and valuable product in which the copyright and other applicable Intellectual Property rights vest in the Contributors as listed in the Schedule.

4.3 The Contributors of items of Data retain ownership of that Data, whether in its original form or as modified by the Licensee and of the Intellectual Property rights therein.

4.4 Intellectual Property in any Enhancement to the Data vests, upon its creation, in the Contributor named in the Schedule in relation to the relevant item of Data.

5 Custody of the Data

5.1 The Licensee shall maintain the Data in safe custody.

5.2 The Licensee shall take all reasonable steps to ensure that any person given access to the Data is aware of these Conditions and uses the Data only in accordance with this Agreement.

6 Precautions

6.1 THE COMMONWEALTH CANNOT GUARANTEE THAT THE DATA, INCLUDING ANY THIRD PARTY DATA, IS FREE FROM ERRORS, AND DOES NOT WARRANT THE QUALITY, PERFORMANCE OR SUITABILITY OF THE DATA FOR ANY PURPOSE.

6.2 THE LICENSEE ASSUMES RESPONSIBILITY FOR SELECTION OF THE DATA TO ACHIEVE ANY INTENDED RESULTS, AND FOR ITS USE.

6.3 THE LICENSEE ASSUMES RESPONSIBILITY FOR THE INTERPRETATION OF ANY RESULTS OBTAINED FROM USE OF THE DATA, AND MUST EXERCISE ALL APPROPRIATE PRECAUTIONS BEFORE PLACING RELIANCE ON THOSE RESULTS.

7 Release and Indemnity

7.1 THE LICENSEE:

A) RELEASES THE COMMONWEALTH, ITS OFFICERS, EMPLOYEES AND AGENTS AND ALL CONTRIBUTORS IN RESPECT OF ALL LIABILITY FOR LOSS, DAMAGE OR INJURY, WHICH MAY BE SUFFERED BY THE LICENSEE OR ARISING FROM THE LICENSEE'S USE OF THE DATA; AND

B) INDEMNIFIES THE COMMONWEALTH, ITS OFFICERS, EMPLOYEES AND AGENTS AND ALL CONTRIBUTORS IN RESPECT OF ALL LIABILITY FOR LOSS, DAMAGE OR INJURY, WHICH MAY BE SUFFERED BY ANY PERSON ARISING FROM THAT PERSON'S USE OF THE DATA.

8 Retention of Notices

8.1 The Licensee shall not remove, obscure or interfere with any copyright notice, trademark, warning or disclaimer incorporated in the Data.

9. Commercial Exploitation

9.1 The licensee shall not Commercialise the Data or any product or service derived from incorporating the Data without the prior written consent of the relevant Contributor(s).

9.2 A Contributor may grant or refuse consent in their absolute discretion and subject to any condition whatsoever, including payment of royalties.

9.3 Any of the Data or any product or service derived from incorporating the Data which is Commercialised in accordance with this clause, must be accompanied by or incorporate an appropriate acknowledgment of the Contributor as the source of the Data in the terms specified in the Schedule.

10 Termination

10.1 If the Licensee breaches any of these Conditions, the Commonwealth may terminate the Agreement immediately by notice in writing to the Licensee.

10.2 The termination of the Agreement under Condition 10.1 shall be without prejudice to the rights of either party accrued under the Agreement prior to termination.

10.3 The Licensee shall cease using the Data for any purpose from the date of termination of the Agreement and shall return the Data and any copies made of it to the Commonwealth within 30 days of the date of termination.

11 Entire Agreement

11.1 The Agreement supersedes all prior agreements and understandings between the parties relating to the Data and Data Products and constitutes the entire agreement between the parties.

12 Variation

12.1 No addition to or modification of any provision of the Agreement shall be binding unless in writing signed by both parties.

13 Assignment

13.1 The rights granted under the Licence are restricted solely to the Licensee and may not be assigned, transferred or sublicensed without the prior written consent of the Commonwealth.

13.2 The Commonwealth may grant or refuse consent in its absolute discretion and subject to any condition whatsoever.

14 Law

14.1 The Agreement shall be governed by and construed in accordance with the laws of the Australian Capital Territory.

15 Waiver

15.1 No forbearance, delay or indulgence by a party in enforcing the provisions of the Agreement shall prejudice or restrict the rights of that party, nor shall waiver of those rights operate as a waiver of any subsequent breach.

16 Severance

16.1 Any reading down or severance of a particular provision does not affect the remaining provisions of the Agreement.

17 Application

17.1 Where the Licensee is an agency of the Commonwealth of Australia, such that it is not permitted to enter into a binding legal agreement except as the Commonwealth, then the conditions shall be read as merely giving rise to an arrangement between the Department of the Environment and Heritage and the Licensee.

Territories Office—DoLA Arrangement for cadastre

Through Territories Office, the Commonwealth pays the Western Australian Department of Lands Administration (DoLA) to maintain the cadastre as passed from Australian Land Information Group (AUSLIG) in 1992.

Chapter 9

Appendix 6: Land Use Plan 1992 Data Documentation

Note: This land use plan was converted to digital form by GA by a scan/OCR process from a hard copy original: formatting will vary slightly and some errors may exist.

Chapter

10

Appendix 7: ECOWISE Environmental Report of Water Resources Component, Cocos (Keeling) Islands GIS.

Note: Includes maps supplied with the report and data.

Chapter 11

Appendix 8: Cocos GIS Data CD-ROMs.