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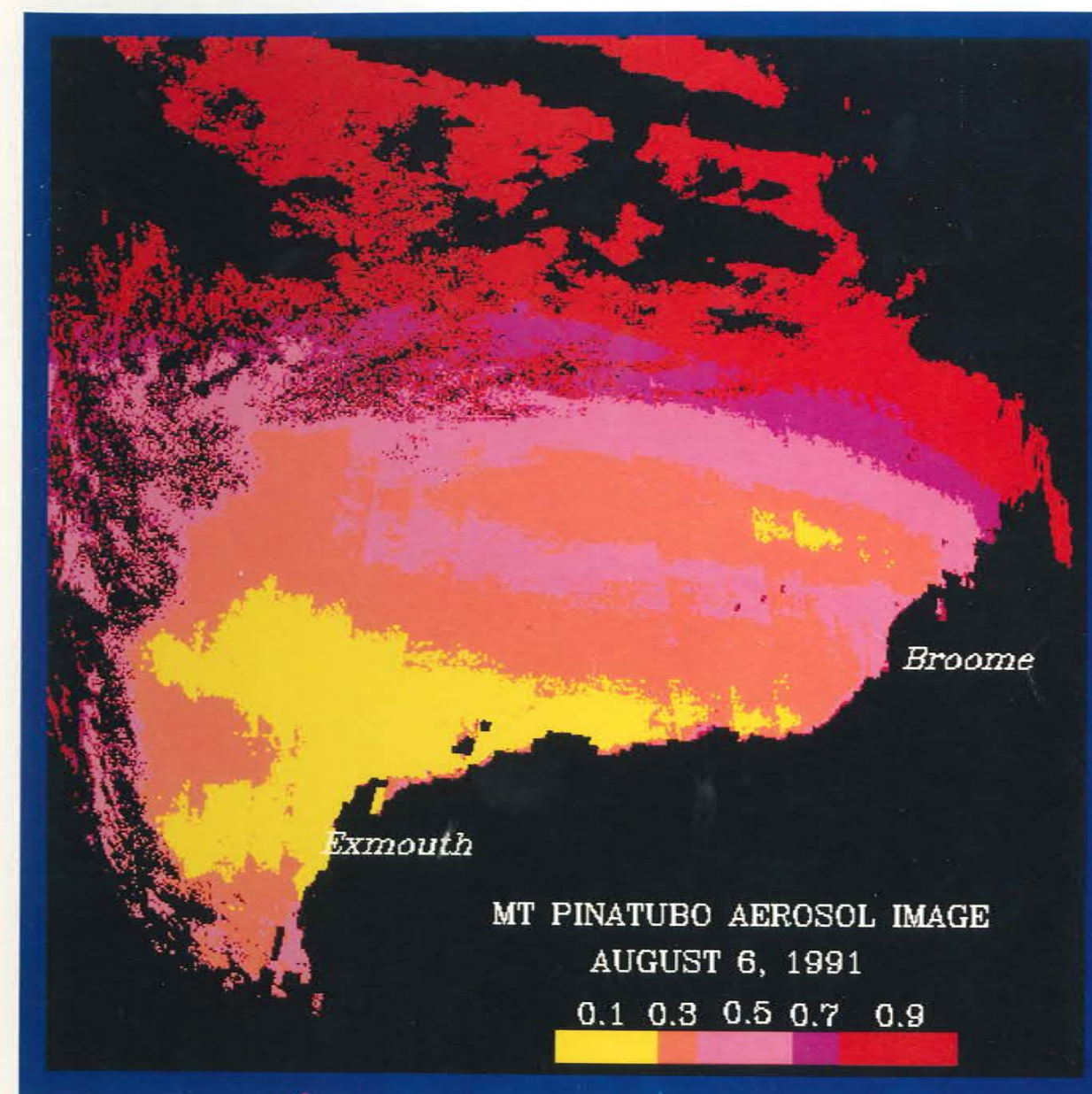
WASTAC

Western Australian Satellite Technology and Applications Consortium

REMOTE SENSING APPLICATIONS CENTRE
DEPARTMENT OF LAND ADMINISTRATION
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ANNUAL REPORT 1991



WASTAC members

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COVER IMAGE

"An image of the aerosol optical depth (AOD) of the Mt Pinatubo volcanic cloud as it crosses the equator and mixes into the southern hemisphere atmosphere on August 6, 1991. The image is derived from NOAA 11 satellite pass No. 14753. The normal background AOD off WA is from 0.1 to 0.2. To the North of WA the AOD, due to the Mt Pinatubo eruption, reaches levels of order 1.0 indicating that only 37% of the incoming solar radiation penetrates the volcanic layer and reaches the Earth. Atmospheric aerosols impact the accuracy of measurements of surface variables (ocean colour, ocean turbidity, vegetation index, surface albedo) from satellites. They also are expected to lead to 1°C cooling of the ocean surface. Monitoring of ash clouds by satellite assists in minimising hazard to aircraft".

Western Australian Satellite Technology and Applications Consortium

ANNUAL REPORT 1991

Produced by
Remote Sensing and Satellite Research Group
- Curtin University of Technology

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MAJOR OUTCOMES FOR 1991

- ❑ State Government approval for the formation of the Western Australian Remote Sensing Industry Development and Education Centre (WARSIDEC) and construction of a \$5.6 million building at Floreat Park. Participants include CSIRO, DOLA, Curtin University of Technology, TAFE, other tertiary institutions and Industry groups.
- ❑ Development of a 3 year vegetation cover monitoring programme commencing January 1992 and funded by the Rural Industries Research and Development Corporation (RIRDC).
- ❑ Development of sea surface temperature (SST) images which are now available to the fishing industry.
- ❑ Bush fire and smoke plume assessment for environmental pollution monitoring in the south west of the state by Conservation and Land Management.
- ❑ Establishment of upgraded computing facilities.
- ❑ Improved storage and maintenance of data archive.
- ❑ Use of SST imagery by Environmental Protection Authority, Western Australian Water Authority and CSIRO for metropolitan water condition study.
- ❑ Monitoring of the "KIRKI" oil spill off the Western Australian coast using SST images.
- ❑ Supply of digital data to Defence Science and Technology Organisation for microwave signal propagation studies.
- ❑ Research at Curtin University Remote Sensing and Satellite Research Group including development of atmospheric retrieval algorithms, aerosol optical depths, global atmospheric methane sensing, and estimation of soil moisture and crop productivity, degraded agricultural land studies and meteorological and climate change detection.
- ❑ Joint Murdoch University/CSIRO/DOLA study on remnant vegetation.
- ❑ Drought detection, 1991, in the eastern wheatbelt.
- ❑ Research into recruitment of commercial fisheries as a joint CSIRO/WA Fisheries Department project.
- ❑ Research into the surface dynamics of the Leeuwin Current by CSIRO.

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CHAIRMAN'S REPORT

WASTAC achieved a major objective during 1991 : to provide regular NOAA/AVHRR Satellite data to Consortium members and the wider community in an acceptable format and in a timely manner. This was achieved early in the year with the commissioning of two computers and the installation of high density storage devices. The net result has been the archiving of over 2,500 passes for the year, an increase of over 100% on 1990 figures. New storage technology has provided major archive efficiencies with savings in both storage media costs and space.

In achieving a reliable and accessible archive Consortium members have been able to focus on the operational use of the data through initiatives such as regular regional bushfire and smoke plume assessment, ongoing study into the surface dynamics of the Leeuwin Current and its influence on the fish industry, meteorological and climate change detection, and the development of a three year vegetation cover monitoring programme to commence early 1992.

The original WASTAC agreement will be reviewed in 1992 to redefine objectives and establish future directions. As is evident from the application reports of Consortium members, there are many applications which require derived products from the archive, and research is concentrating on routine production of those products required to better service both research and resource management demands.

I would like to acknowledge the ongoing support given by all Consortium members throughout the year. Without their enthusiasm these operational, research and applications objectives of WASTAC would not have been achieved.

Henry J Houghton
WASTAC CHAIRMAN

WASTAC BOARD FOR 1991



(L-R) Mr Don Ward, Bureau of Meteorology; Dr Richard Smith, CSIRO; Dr Doug Myers, Curtin University of Technology; Mr Henry Houghton (Chairman), Department of Land Administration; Mr Alan Pearce, CSIRO; Mr Richard Stovold (Secretary), Department of Land Administration; Assoc. Prof. Merv Lynch, Curtin University of Technology; Mr L Broadbridge (absent), Bureau of Meteorology.

FINANCE

Following the successful upgrade of the WASTAC computer system, hardware purchases have been minimal with major expenditure items being consumables, comprising data archive exabyte tapes, stationary and incidentals to support the quicklook archive.

System maintenance costs have been significantly reduced through a negotiated contract with a local computer maintenance and supply firm.

Consulting fees associated with the Earth System Science Application Centre proposal were not required for 1991 following the unsuccessful application for federal funding.

Revenue for the financial year comprised annual contributions from consortium members, and several major research programmes for CSIRO and Curtin University of Technology. The end of financial year statement to 31st December 1991 is attached in the APPENDICES together with a statement of income and expenditure and auditors report.

BUDGET

The WASTAC budget for the financial year January 1992 to December 1992 was formulated and passed at the September 5, 1991 meeting.

Estimated expenditure has been reduced from the previous years budget to \$44,500 for the year, with member contributions being again maintained at \$10,000 each. Details of the budgeted items are contained in the APPENDICES.

ARCHIVE REPORT

The size of the data archive has been rapidly expanding requiring efficient management procedures to collate all passes in a reliable and quickly accessible database.

During the year in excess of 2599 passes, both day and night, were archived from NOAA 9, 10, 11 and 12. Of these the majority were acquired from NOAA 11 (1457 passes). A total of 412 passes are stored on 206 magnetic tapes to May 25, 1991 and a further 2235 passes (some duplicated from the magnetic tapes) stored on 84 8mm exabytes from April 8, 1991.

A comprehensive quicklook archive of most passes is held together with the original raw data at the Remote Sensing Applications Centre within the Department of Land Administration. Particular mention should be made of John Adams and Robert Shaw from Remote Sensing Applications Centre for their enthusiastic support in the running of the archive.

Extensive processing facilities and support for the analysis of NOAA data exist within the Centre. Product sales and enquires should all be directed to the Remote Sensing Applications Centre.

1991 NOAA DATA HELD BY WASTAC

	NOAA 9	NOAA 10	NOAA 11	NOAA 12	TOTAL
JAN			82		82
FEB			90		90
MAR			89		89
APR		32	78		110
MAY		51	113		164
JUNE		149	154		303
JULY		149	166		315
AUG	82	84	128		294
SEPT	44	28	125	85	282
OCT		1	143	148	292
NOV			153	153	306
DEC			136	136	272
	126	494	1457	522	2599 passes

Magnetic Tapes: 412 passes on 206 tapes to 25 May 1991.

Exabytes: 2235 passes on 84 exabytes from 8 April 1991.

Total Data Received: 150 Gigabytes.

OPERATIONAL STATUS

WASTAC facilities consist of antenna and antenna controller at Curtin University of Technology, ingest and display computers with hard disk storage located at the Bureau of Meteorology, Perth. A microwave and dial up link exists between the two sites to facilitate realtime satellite data relay and acquisition scheduling.

Black and white grey scale pictures are produced at 180 dpi by a HP Paintjet inkjet printer and these are passed to DOLA (Remote Sensing Applications Centre) for archive, indexing and distribution.

The AVHRR ingest and display system modelled on the Bureau of Meteorology's facilities at Casey in Antarctica and Darwin consists of two IBM PS/2 model 80 computers and this has replaced the Dual system will be decommissioned early in 1992.

One PS/2 is dedicated to automated data ingest and the other to providing display, processing and backup facilities. The Bureau's MCIDAS software provides for display and post processing. It is hoped to produce SST's (sea surface temperatures) and NDVI in the near future.

Resulting from equipment failures acquisitions were not possible for 27 days of the year.

Despite these problems, and due to the dedicated efforts of Ron Craig and Rob Lund, over 2599 passes were recorded for the year.

DOLA is currently holding all WASTAC archived data which is now on EXABYTE 8mm tapes. Orders for digital data are provided on EXABYTE or 6250/1600 bpi magnetic tape in raw or SHARP (band interleaved or band sequential internationally compatible) format.

(See photograph of WASTAC satellite receiving antenna on page 7).

DATA APPLICATIONS AND RESEARCH

Satellite Remote Sensing of the Leeuwin Current

Mr A Pearce, CSIRO Division of Oceanography, Marine Laboratories, Marmion.

The routine monitoring of the structure of the Leeuwin Current using NOAA/AVHRR imagery is continuing, and 80 rectified images of Western Australian waters between January 1988 and the present are now available. The objective is to have a time-series of weekly images from 1988 to 1994, to be used in our studies of the Leeuwin Current and its influence on the fisheries of Western Australia.

Apart from this routine monitoring of the Current, the imagery is being increasingly used to assist in planning oceanographic/fisheries research cruises and in interpreting the resulting data. A cruise by the FRV Southern Surveyor off the Abrolhos Islands in September 1991 relied on AVHRR imagery to determine the position of the Leeuwin Current and its role in the distribution of various stages of rock lobster larvae. Satellite imagery has also been used to examine whether variations in the flow of the Leeuwin Current near Cape Leeuwin may have influenced the settlement of lobster larvae in local reefs. During the summer of 1991/92, the Japanese research vessel Shoyo Maru studied the distribution of both larval and juvenile southern bluefin tuna in relation to the Leeuwin Current using AVHRR images.

The potentially disastrous oilspill from the Greek tanker Kirki in July 1991 seemed to move away from the coast despite the strong south-westerly winds, and satellite imagery provided by WASTAC indicated that a meander of the Leeuwin Current was probably responsible for transporting the slick away from the sensitive coastal nursery reefs. A number of images are now being analysed in a more detailed study of the Leeuwin Current at that time.

Acknowledgments

The work is being supported by a grant from the Western Australian Fisheries Research and Development Trust Account.

Publications

Pearce, A.F. (1992). Hunting for rock lobster larvae. Western Fisheries Magazine, autumn edition (in press).

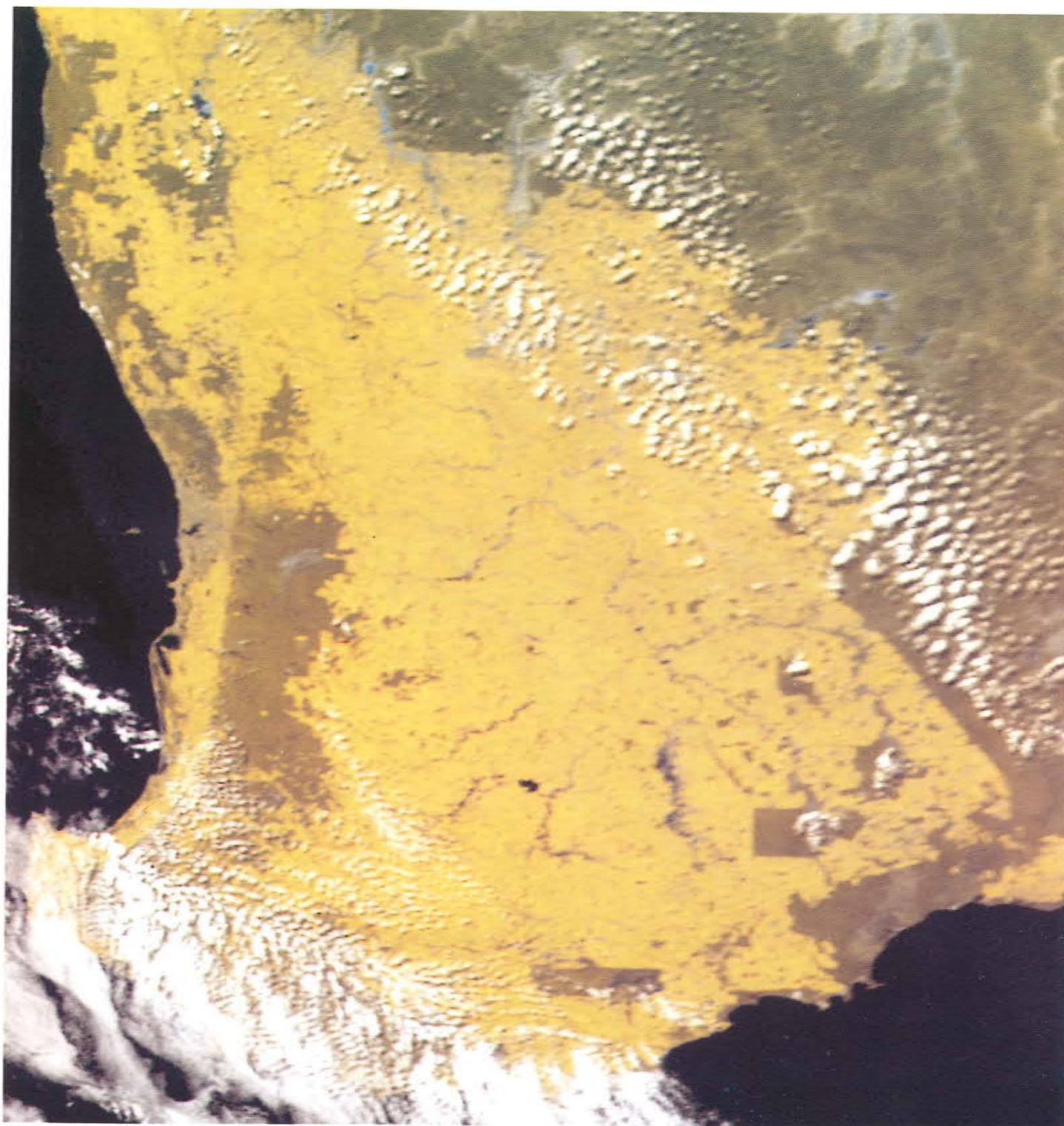
Pearce, A.F. & R.W. Griffiths (1991). The mesoscale structure of the Leeuwin Current: a comparison of laboratory models and satellite imagery. Journal of Geophysical Research 96 (C9): 16739-16757.

Pearce, A.F., B.F. Phillips and C.J. Crossland (1992). Larval distributions across the Leeuwin Current: Report on RV Franklin cruise FR 8/87. CSIRO Marine Laboratories Report (in press).

Phillips, B.F., A.F. Pearce and R.T. Litchfield (1991). The Leeuwin Current and larval recruitment to the rock (spiny) lobster fishery off Western Australia. Proceedings of the Leeuwin Current Symposium, Perth, 16 March 1991, in Journal of the Royal Society of Western Australia 74:93-100.



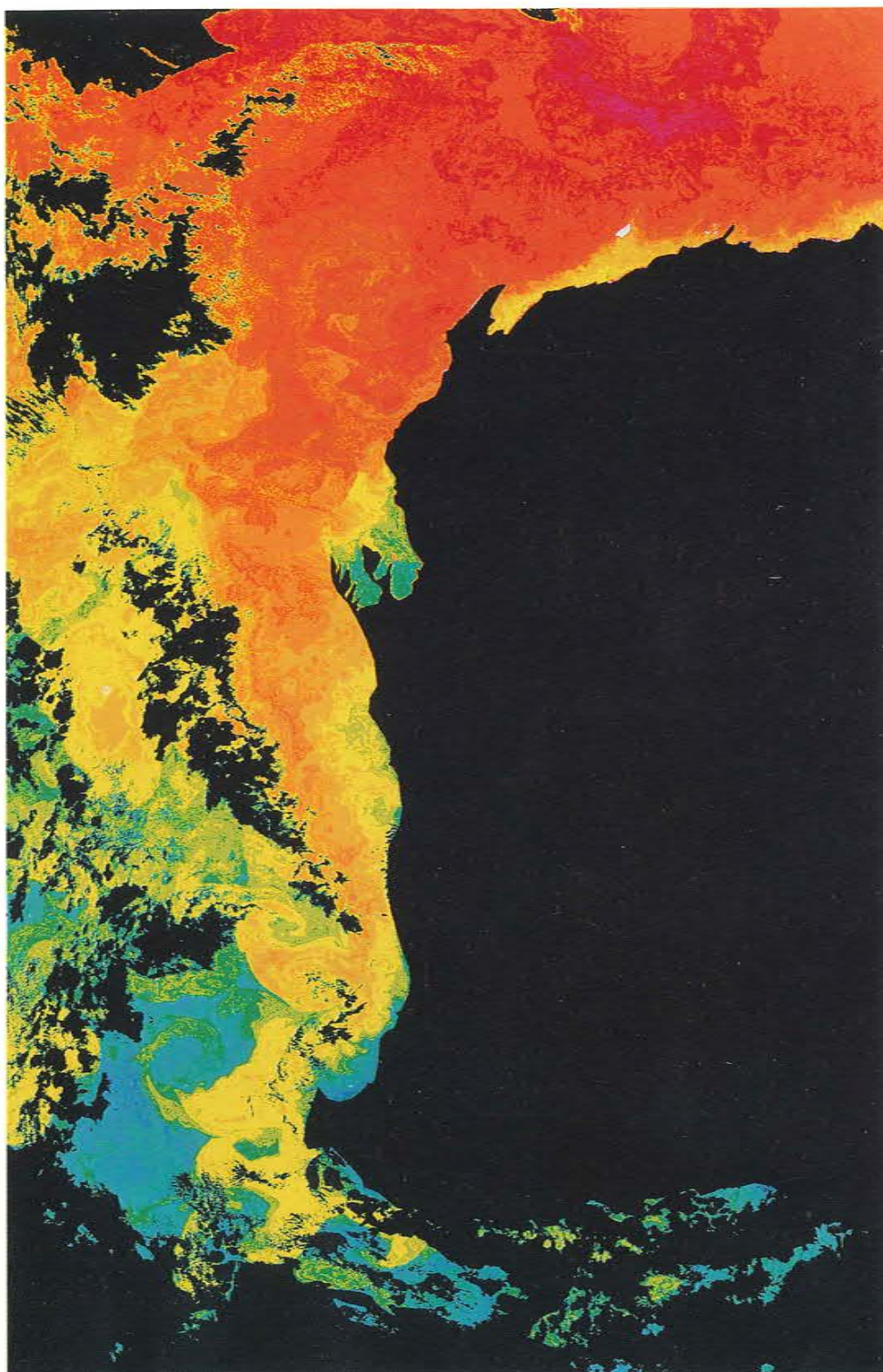
WASTAC satellite receiving antenna mounted on the top of the Engineering and Surveying Building, Curtin University of Technology, Bentley.



NOAA-AVHRR image from the afternoon of 23 September 1991 showing convective cumulus clouds above patches of native vegetation to the west of and above the native vegetation to the east of the rabbit proof fence while the surrounding agriculture is free of cloud.



A NOAA-AVHRR satellite image acquired by WASTAC and processed by the Remote Sensing Applications Centre depicting smoke plumes from controlled fire burns. The three plumes visible on the south coast are being driven offshore by southerly winds. This data enables smoke pollution to be monitored over the state.



NOAA sea surface temperature image dated 27th July 1991 showing the dramatic effects of the Leeuwin Current meanders and swirls which assisted in dispersing the "oil spills" from the stricken ship "KIRKI".

Curtin Remote Sensing Report

By
Assoc. Prof. M J Lynch
Remote Sensing and Satellite Research Group
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Introduction

During the year a significant agreement embracing cooperative research in remote sensing using NOAA satellite data was negotiated and signed by Curtin University and NOAA/NESDIS, Washington DC, USA. This is only the second such Agreement to be signed between NESDIS and a University outside the USA. It is a "first" for the southern hemisphere. Specific cooperative projects are being negotiated currently.

With respect to student research and training in remote sensing 1991 was a very active year. The field continues to attract high student interest. There were four academic staff, two full-time and two part-time research staff, three PhD students, three MSc students, one Postgraduate Diploma student, and four undergraduate students contributing to research and project work across a range of topics. The provision of training in research continues to be a prime goal of the student program at Curtin, and the student complement suggests that much has been achieved.

Three projects relating to land use were being conducted. Work continued on the use of remote sensing to study the degradation of agricultural land, and on aerosol and moisture corrections to the remotely sensed normalised difference vegetation index (NDVI). A new project commenced on the application of satellite data to the monitoring of soil moisture and associated crop yield. The work involved Dr R G C Smith of CSIRO Division of Exploration Geoscience and Mr Tissa Weerasekera, a Curtin PhD student visiting from Sri Lanka.

A number of projects involved studies of the atmosphere and atmospheric corrections to surface observations. Work continued on the investigation of alternative approaches to stabilising atmospheric retrievals, recovery of trace gas profiles from high spectral resolution infrared sensors, the estimate of aerosol optical depths from NOAA AVHRR satellite data, on global atmospheric methane sensing, and on improvements to atmospheric ozone concentrations derived from the NOAA satellite.

Five projects relating to meteorology and climate change were being conducted. Work continued on the use of MSU microwave data in determining the intensity of WA tropical cyclones, on precipitation estimation from GMS infrared imagery and on the estimation of cloud parameters using CO2 sounding channels on the NOAA polar orbiting satellite. A new project commenced on the climatic impact of the Leeuwin current, involving Mr Brendan McAtee, a third year project student, and Mr Craig Low, a Postgraduate Diploma student. A new project commenced on remote sensing of land surface temperature, involving Drs Campbell and Prata from CSIRO as well as Mr Cecep Rustana, PhD student, and Mr Brian MacRitchie, a third year project student.

Work continued on the development of imaging processing software for application to astronomical images acquired by the Perth Observatory telescope's CCD camera. Major progress was made on the Perth Astronomy Research Group (PARG) project to automate the Perth Observatory Telescope and to equip it with a CCD camera. Plans are in place to have the official opening of this facility in early 1992.

The WARSIDEC initiative is actively supported by CURTIN. Curtin has reserved space in the building primarily for the accommodation of some 12 research students who will be involved in research work associated with WARSIDEC scientists. The WARSIDEC building is scheduled for occupancy in early 1993.

Description of Research Projects

A brief review of research being undertaken by Curtin staff and students in conjunction with research scientists from other agencies appears below.

Investigation of Least Squares Algorithms in Atmospheric Retrievals

Mr L E Gumley, Associate Professor M J Lynch, Mr B A White and Mr P van Delst.

The Estimation of Aerosol Optical Depths from AVHRR Data

Associate Professor M J Lynch, Mr L E Gumley and Mr H J Lynch.

Global Atmospheric Methane Sensing

Associate Professor M J Lynch, Mr J Li and Mr P F van Deist.

Indian Ocean Sea Surface Temperature

Associate Professor M J Lynch, Mr B McAtee and Mr C Low

The Evaluation of Ozone Products from the NOAA/HIRS 9.6mm Channel

Associate Professor M J Lynch, Dr B T P McGann and Mr S Bos.

Use of Remote Sensing to Study the Degradation of Agricultural Land

Associate Professor M J Lynch, Mr C Rustana, Dr N Campbell, Dr A J Prata and Mr B MacRitchie.

Aerosol and Moisture Corrections to the Remotely Sensed Normalised Difference Vegetation Index (NDVI)

Associate Professor M J Lynch, Dr R G C Smith and Mr P Mathaha.

The Estimation of Agricultural Crop Productivity Using Remote Sensing Techniques

Associate Professor M J Lynch, Dr R G C Smith and Mr T Weerasekera.

Use of MSU Microwave Data in Determining the Intensity of WA Tropical Cyclones

Associate Professor M J Lynch and Mr J L van Burgel.

The Retrieval of Atmospheric Trace Gas Profiles from High Spectral Resolution Infrared Data

Associate Professor M J Lynch, Mr P van Delst and Mr B A White.

Precipitation Estimation from GMS Imagery

Associate Professor M J Lynch, Mr D Foster, Dr W P Menzel and Dr B Goodman.

The Estimation of Cloud Parameters Using CO Sounding Channels on the NOAA Polar Orbiting Satellite

Dr W P Menzel, Associate Professor M J Lynch and Mr J Y Li.

Research Outputs for 1991

Lynch, M J, Gumley, L E and Sansalone, J 1991. The Determination of Atmospheric Aerosol Optical Depth from the NOAA/AVHRR Data. Contract Report No 1 to DSTO, Salisbury, S.A. 1991.

Gumley L E, White B A and Lynch M J, 1991. An Evaluation of Least Squares Algorithms Used in Atmospheric Retrievals. Proceedings of the 6th International TOVS Study Conference. Airlie, Virginia, May 22-24.

Li J Y and Lynch M J, 1991. A Review of the TOVS Ozone Products. Proceedings of the 6th International TOVS Study Conference. Airlie, Virginia, May 22-24.

van Delst P F W, Lynch M J and White B A 1991. Progress in the Recovery of the Trace Gas Concentration Profiles from High Spectral Resolution Data. Presented at the 6th International TOVS Study Conference, Airlie, Virginia, May 22-24.

Lynch, M J (Contributor), 1991. Remote Sensing for Global Change, Editor, G Harris. Report of Australian IGBP Workshop No. 8. Canberra, June, 1990.

Gumley L E and Lynch M J, 1991. Progress Report No.2: Retrieval of Aerosol Optical Depths from NOAA AVHRR Satellite Data. Contract Report to Surveillance Research Laboratory, Optoelectronics Division, DSTO, Salisbury. SPS 564/1991/AP8., December 1991.

Lynch M J (Contributor), 1991. Recent Australian Developments in Greenhouse Gases and Climate Forcing. IPCC Working Group 1 Update. July 1991.

Lynch M J and Foster D, 1991. Contributor, Atlas of Products from the Algorithm Intercomparison Project 1: Japan and Surrounding Oceanic Regions, June - August, 1989. (Editors, Lee T H, Janowiak J E and Arkin P A, University Corporation for Atmospheric Research, August, 1991).

Lynch M J, Foster D, Goodman B and Menzel P, 1991. Results of Processing the GMS Data Set for the 1st Algorithm Intercomparison Project. Presented at the Global Precipitation Climatology Project Workshop, Laurel, Maryland, May 22 - 24.

Lynch M J, Gumley L, Foster D and Lynch H J, 1991. Progress Report No. 3: Retrieval of Aerosol Optical Depths from NOAA AVHRR Satellite Data. Contract Report to Surveillance Research Laboratory, Optoelectronics Division, DSTO, Salisbury. SPS 564/1991/AP 8., December 1991.

Mathaha P M and Lynch M J, 1991. Atmospheric Correction of the Normalised Difference Vegetation Index (NDVI). Abstracts, AIP Postgraduate Research Conference, Jarrahdale, WA, August 5 - 7.

Rustana C E, Lynch M J, Prata and Campbell, N A, 1991. Study of Land Surface Temperature in W.A. Abstracts, AIP Postgraduate Research Conference, Jarrahdale, W.A., August 5 - 7.

van Burgel J L and Lynch M J, 1991. Investigation of the Vertical Structure and Intensity of W.A. Tropical Cyclones Using Radiosonde Composites and Measurements from the Microwave Sounding Unit on the NOAA Series of Satellites. Abstracts, AIP Postgraduate Research Conference, Jarrahdale, W.A., August 5 - 7.

Young S A, Cuffen D, Lynch M J and Davies, J E, 1991. Lidar-Derived Backscatter and Extinction of Maritime Aerosols. Proceedings 71st Amer Meteorol Society Annual Meeting, New Orleans, 13 - 18 January.

Vegetation Watch

A grant of \$460,000 over 3 years from 1991 to 1994 was received by Consortium members, CSIRO and RSAC from the Rural Industries Research and Development Corporation (RIRDC) to process in near real-time the WASTAC data to monitor green vegetation cover over the western half of Australia and to develop information products from this data to assist in the improved management of native vegetation. RIRDC provided a further grant of \$220,000 over 3 years to CSIRO and the Western Australian Department of Agriculture (WADA) to develop the use of these data in pastoral management.

With this grant John Adams was appointed as data analyst with a dedicated SUN-Sparc2 workstation and three 1.1 gigabyte disks to process the data from the afternoon overpass of NOAA-11 on a routine basis. DISIMP software and a specific set of utilities developed by CSIRO Division of Atmospheric Research to process the NOAA data were acquired. With this software data from channels 1 and 2 of AVHRR are radiometrically and atmospherically corrected to estimate reflectance of solar irradiance in the red (RED) and near infrared (NIR) wavebands. The presence of green vegetation depresses RED reflectance due to absorption by chlorophyll and enhances NIR reflectance due to multiple scattering by leaf tissue. RED and NIR are combined to compute the Normalized Difference Vegetation Index ($NDVI = (NIR-RED)/(NIR+RED)$), as a measure of green vegetation cover. To produce a cloud free image, successive overpasses are combined over a 15 to 16 day period and a MAXIMUM VALUE NDVI COMPOSITE image produced. This compositing requires the accurate geometric correction of the data so that the latitude and longitude of each pixel can be located with 1 km accuracy. Specific software to automatically register the data with 1 km accuracy was developed under contract by CSIRO Division of Atmospheric Research.

To aid in the analysis of the contemporary data a historical Global Area Coverage (GAC) set of monthly NDVI from 1981 to 1991 was acquired from NASA. These data are currently being analysed and related to monthly rainfall by Mike Roderick of WADA.

Composite images of the NDVI for the western half of Australia will be available from the beginning of 1992 for evaluation by potential clients in the private and public sectors. Feedback from these potential clients will be used to customise the information products for future commercial development. Use of the NDVI product by the pastoral industry to better manage grazing under conditions of rainfall variability is being developed with the WA Department of Agriculture (WADA), who are incorporating the NDVI into their Geographic Information System so that conditions for different geographic areas and specific pastoral properties can be determined. Other potential uses of the NDVI yet to be developed are for crop yield forecasting, management of wild life in remote areas, estimation of fuel load for bush fire management, locust control and drought assessment.

Collaborating Agencies:

Remote Sensing Applications Centre, WA Department of Land Administration
Rangelands Management and Land Information Systems Branches, WA Department of Agriculture
CSIRO WA Remote Sensing Group
CSIRO Division of Atmospheric Research, Melbourne.

Personnel:

Dr Richard Smith (CSIRO and RSAC), Principal Investigator
John Adams (RSAC), Data Analyst (RIRDC appointment)
Ron Craig (RSAC), Senior Systems Analyst
Mike Roderick (WADA), Geographic Information System analyst
Don Burnside (WADA), Rangeland Management
RIRDC Appointee (WADA), Applications of NDVI to rangeland management
Peter Hick (CSIRO), Extension of NDVI to vegetation management
Mac Dilley (CSIRO Division of Atmospheric Research), Software Consultant.

Land Surface Albedo and Temperature Change

WASTAC NOAA-AVHRR data is being used in a collaborative study with Murdoch and Flinders Universities to study the impact of land surface conditions on climate change. One climate change of significance in south western Australia is the 30% decline in annual rainfall over the last 60 years. Whether any of this decline is due to the clearing of over 13 m ha of native perennial vegetation and replacement by winter growing annual species used for agriculture, is being investigated. Changes in land surface albedo and surface temperature of agricultural and native vegetation on either side of the rabbit proof fence were measured from NOAA-AVHRR data at monthly intervals from April 1990 to April 1991. It was found that the clearing of native mallee vegetation for agriculture in the 300mm rainfall zone had increased surface albedo from 14% to 25%, year round and surface temperature by 1-5° C during the summer.

The temperature difference was associated with year round evapotranspiration by native species but negligible evapotranspiration by agricultural species during the summer. The lower albedo and higher annual evapotranspiration of the native vegetation indicated that it is absorbing more solar energy than the agricultural system. It is proposed that native mallee vegetation partitions a greater proportion of this energy into sensible heat which results in greater convective activity over native vegetation and the evolution of a higher planetary boundary layer during the day. Evidence to support this enhanced convection came from studies with a mesoscale boundary layer climate model and afternoon NOAA-AVHRR image on 23 September 1991 in which convective cumulus clouds are evident over the areas of native vegetation but not neighbouring areas of agriculture. In this image the much darker colour compared with agricultural areas is due to its lower albedo. It is speculated from these data that the more extensive mixing of air over the native vegetation was sufficient for the air to reach the condensation level and form the convective clouds whereas over the agricultural area despite supplying more moisture, insufficient mixing occurred to allow condensation.

The results of this study are being presented at the World Space Congress in Washington, DC in September 1992 as a paper entitled:

CHANGE IN LAND SURFACE ALBEDO AND TEMPERATURE IN SOUTH WESTERN AUSTRALIA
FOLLOWING THE REPLACEMENT OF NATIVE PERENNIAL VEGETATION BY AGRICULTURE:
SATELLITE OBSERVATIONS

R.C.G. Smith⁽¹⁾, Huang Xinmei⁽²⁾, T.J. Lyons⁽²⁾, J.M. Hacker⁽³⁾ and P.T. Hick⁽¹⁾

- 1 CSIRO.
- 2 Department of Atmospheric Science, Murdoch University.
- 3 Department of Atmospheric and Marine Science, Flinders University.

(See NOAA-AVHRR image on page 8).

Curtin University of Technology School of Surveying and Land Information

EDUCATION

1 Graduate Diploma in Remote Sensing and Land Information Management

This course supersedes the Postgraduate Diploma in Remote Sensing, and is designed to provide for graduates in surveying, cartography, planning, computing, environmental science and related fields who seek high level training in remote sensing and land data management principles and application. The course is designed for professional updating at an advanced level for practitioners working in a relevant field. Integration of remote sensing and land information management is seen as a positive step towards the efficient development of both of these areas.

2 Professional Development Course.

During August 1991 the School ran a successful professional development course "Remote Sensing for Environmental Management", for 15 participants. Drawn from both government and private industry, the participants completed theory and practical sessions in digital data acquisition and image processing.

RESEARCH GRANTS

Dr Graham Lodwick and Mr Graeme Wright obtained a joint CSIRO/Curtin research grant for \$12,500 for Enhanced Regolith Interpretation Using Satellite Imagery and DEM Data.

RESEARCH PROJECTS

Cooperative Research Centre for Monitoring Renewable Resources.

This involved the development of a comprehensive proposal under the ARC Cooperative Research Centre Program. The School was involved with CSIRO, Government and Industry partners in developing a research program that would create a world class centre for the application of remote sensing to sustainable management of natural resources in Australia.

Use of Satellite Derived Vegetation Data for Updating GIS Databases.

This research is investigating the relationship between NDVI responses and ground phenomena to develop interpretation methods. In particular, it is proposed to investigate the relationships between periods of seasonal vegetation growth using a water balance model and NOAA AVHRR data.

Monitoring Bush Fires in the Kimberley Region using NOAA AVHRR Imagery.

The aim of this project is to utilize NOAA AVHRR data to trace the movement of uncontrolled fire burns throughout the seasons. This project is establishing a database for monitoring the fire burns throughout the Kimberley region as an aid for both government instrumentalities and land owners.

Enhanced Regolith Interpretation using Satellite Imagery and DEM Data.

This project is being carried out by the School jointly with CSIRO and aims to develop a rigorous methodology for the integration of satellite imagery (Landsat TM data) and a Digital Elevation Model (DEM) for mapping the regolith in the Yilgarn of W.A.

Monitoring Groundwater Use on Perth Coastal Plain

This research involves the use of Thematic Mapper Satellite remote sensing data to monitor irrigation practices on the Swan Coastal Plain, W.A. This is useful in order that conservation and management of valuable ground water resources can be undertaken effectively.

Remote Sensing Applications Centre, Department of Land Administration

Remote Sensing Applications Centre's role is the archive management and distribution of data, applications development, provision of computing facilities and analysis support of applications for State Government and industry clients.

Major applications utilising NOAA data during the year and supported by the centre were:

Smoke Plume Assessment

A joint Environmental Protection Authority (EPA) and Conservation and Land Management (CALM) environmental monitoring project to assess the extent and direction of smoke pollution in the metropolitan and near metropolitan area caused by controlled fuel load reduction fires in state forests.

(See remotely sensed image on page 9).

Perth Metropolitan Coastal Water Studies

A collaborative project between Remote Sensing Applications Centre, Western Australian Water Authority and Environmental Protection Authority to aid the study of ocean water quality along the metropolitan coastline and Cockburn Sound. A series of NOAA and Thematic Mapper satellite Sea Surface Temperature images have been produced to assist in the optimum positioning of ocean vessels measuring temperature and water quality as well as provide supporting data for benthic bathymetry and biological community studies.

Bushfire Monitoring

A service to assist in the identification and extent of bushfires within the state is continuing. The benefits derived from the satellite data maps are the detection of fire position which can be then mapped and maintained in a data base to be used as a management tool.

Oil Spill Detection

Following the oil spill from the Greek tanker "Kirki" a sea surface temperature image was produced using NOAA data. It was apparent from the image, that the south flowing warm waters of the Leeuwin Current with an associated offshore eddy was probably responsible for the quick dispersion of oil away from the coast. Imagery assisted the subsequent monitoring programme.

The centre continues to provide facilities, management and expertise in the development of the NDVI vegetation watch project in collaboration with the CSIRO and Western Australian Department of Agriculture.

(See remotely sensed image on page 10).

ASSETS REGISTER

The asset register listed in the attached appendices details equipment currently held by WASTAC. The listings compiled at the Curtin University reflect current changes in the fixed asset requirements. The changes take into the account the depreciated value of items and show present book values.

**WESTERN AUSTRALIAN SATELLITE TECHNOLOGY
APPLICATIONS CONSORTIUM**

BALANCE SHEET @ 31 DECEMBER 1991

Accumulated Funds:

	1991	1990
Opening Balance @ 1 January, 1991	129,088.39	119,178.61
Plus: This years surplus	65,244.13	9,909.78
	<u>194,332.52</u>	<u>129,088.39</u>
Represented by:		
Cash at Hand	79,606.09	87,846.17
Accounts Receivable	3,550.00	0.00
Computer Equipment (at cost)	95,279.00	24,869.00
less: Depreciation Provision	18,053.30	518.09
Book Value	77,225.70	24,350.91
Other Equipment (at cost)	41,765.00	20,365.00
less: Depreciation Provision	7,814.27	3,473.69
Book Value	33,950.73	16,891.31
	<u>194,332.52</u>	<u>129,088.39</u>

**WESTERN AUSTRALIAN SATELLITE TECHNOLOGY
APPLICATIONS CONSORTIUM**

Income and Expenditure Statement for the year 1991

Income:

	1991	1990
WASTAC Contributors	40,000.00	30,000.00
Newmont Australia Ltd	0.00	1,070.00
CSIRO Marine Lab.	6,550.00	0.00
Earth Resource Mapping	0.00	400.00
Geoimage P/L	0.00	250.00
CSIRO - Oceanography	320.00	400.00
Perilya Mines	0.00	200.00
Dominion Mining	0.00	400.00
SA Ctr for Remote Sensing	400.00	0.00
Dept. of Geology - Melbourne Uni	0.00	400.00
Dept. of Physics - Curtin	2,000.00	0.00
Defence Sci. & Tech. Organisation	0.00	2,500.00
Purchase Credit	0.00	225.00
Interest Earned	7,661.23	15,734.57
	56,931.23	51,579.57

Expenditure

Data Transmission Datel Line	1,866.50	2,317.79
Travel	0.00	1,766.91
Consumables	13,665.97	19,114.40
Photocopying	303.00	0.00
Printing	1,650.00	0.00
Maintenance of Equipment	1,883.84	2,243.16
Publications	115.00	0.00
Essc Consulting Fee	0.00	1875.00
Essc Other Expenses	0.00	908.75
Minor Equipment	1,518.00	0.00
	21,002.31	28,226.01

Depreciation Expense

Computer Equipment	17,535.21	
Other Equipment	4,340.58	
	21,875.79	
		42,878.10
		14,053.13
		23,353.56

Plus:

Extraordinary Gain/(loss)		
Recognition of Assets Purchased prior to 1991	51,191.00	(13,443.78)
	65,244.13	9,909.78

WA SATELLITE TECHNOLOGY AND APPLICATIONS CONSORTIUM

FINANCIAL STATEMENTS: YEAR ENDED 31 DECEMBER 1991

AUDITOR'S REPORT

I have audited the attached financial statements and in my opinion they fairly represent the transactions of the Consortium during the 1991 calendar year, together with the balance of retained funds as at 31 December 1991. The statement is based on proper accounts and records.

P J Perriam
Manager Internal Audit
CURTIN UNIVERSITY OF TECHNOLOGY

27 May 1992

WASTAC BUDGET 1992

Estimated expenditure financial year January 1992 - December 1992.

		PER ANNUM \$	
		1992	1991
1	Telecom rental	2,500	2,000
2	Exabyte tapes		
	\$30 tape		
	15 passes per tape		
	Maximum 12 passes/day 50		
	weeks/year		
	4200 passes/year	9,500	8,500
3	Tape drive maintenance	-	2,500
4	System maintenance (new based on 10% of equipment costs (\$75,000))	7500	5000
5	Telecommunications - licence of facility	500	500
6	Photographic/Ink jet quicklook costs		
	7000 prints (4 passes/day)		
	at 50 cents each		
	5 copies	5,000	3,500
7	Consultants-Archive/product generation assistance	4,000	5,000
8	Sundries, consumables	4,000	5,000
9	Travelling - airfares	5,000	5,000
10	Provision for major equipment	9,000	8,000
TOTAL		\$44,500	\$47,500

LIST OF ASSETS REGISTERED FOR COST CENTRE 1198

COST CENTRE: 1198 DEPARTMENT: 1010 01

Asset	Description	Serial	Purchased	Cost	Accum-Res	YTD-Depr	Cat	Auth	Qty	Bldg	Room
1358700	Satellite Station Tracking	00	87/07	140,000.00	67,070.74	4,007.10	EQPT	000000	1	204	ROF
1358800	System Satellite Tracking Station		87/07	110,000.00	82,718.18	3,172.30	COMP	000000	1	204	500
1948500	Power Conditioner	7/83/132	89/06	2,000.00	654.32	73.94	EQPT	000000	1	204	500
2009000	MA 23 CC	8910	89/08	20,365.00	6,354.89	769.79	EQPT	017235	1	204	500
2478800	2.3GB 8MM Exabyte	802548	90/12	6,272.00	2,145.79	479.79	COMP	038600	1	CITY	
2494500	PS2 25MHZ 4/320MBHD & Monitor VGA	90-3300463	90/12	16,686.00	5,708.66	1,276.44	COMP	038539	1	CITY	
2494501	Memory Expansion Board 4MB		90/12	1,911.00	653.80	145.19	COMP	038539	1	CITY	
2494503	PS/2 Dual Asynch Adaptor	81CA8133512	91/05	233.50	59.19	20.27	COMP	9	1	CITY	
2494504	PS/2 Dual Asynch Adaptor	81CA8130879	91/05	233.50	59.19	20.27	COMP	9	1	CITY	
2494505	5.25 External Diskette Adaptor	4578161	91/05	204.00	51.71	17.71	COMP	9	1	CITY	
2494506	PS/2 CARD TO OPTION SCSI		91/05	142.00	36.00	12.33	COMP	9	1	CITY	
2494507	OS/2 EXTENDED EDITION V1.2		91/05	700.00	177.43	60.76	COMP	9	1	CITY	
2494508	320MB HD DRIVE		91/05	4,739.00	1,201.20	411.37	COMP	9	1	CITY	
2494509	MATHS CO-PROCESSOR INTEL 25MHZ	L0141474	91/05	726.00	184.02	63.02	COMP	0	1	CITY	
2494510	4-16MB MEMORY BOARD 4MB	008C10287	91/05	1,501.00	380.47	130.30	COMP	0	1	CITY	
2494511	ETHERLINK MC CARD		91/05	590.00	149.55	51.22	COMP	0	1	CITY	
2494512	MONITOR DISPLAY CABLE		91/05	120.00	30.42	10.42	COMP	0	1	CITY	
2494513	MS MACRO ASSEMBLER V5.1	5RA TJ8	91/05	174.00	44.10	15.10	COMP	5	1	CITY	
2494514	MICROSOFT C COMPILER V6	ETBLWT	91/05	448.00	113.56	38.89	COMP	5	1	CITY	
2494515	MICROSOFT OS/2 PM TOOLKIT	142-098AV121	91/05	488.00	123.69	42.36	COMP	5	1	CITY	
2494516	FORTAN V2.0		91/05	754.00	191.12	65.45	COMP	1	1	CITY	
2494517	LOCAL AREA NETWORK TECH MANUAL		91/05	70.00	17.75	6.08	COMP	1	1	CITY	
2494518	PS/2 MOUSE	1333658	91/05	109.00	27.63	9.46	COMP	9	1	CITY	
2552600	SGSI HOST ADAPTOR 598A	61314	91/03	1,900.00	286.57	88.65	EQPT	1	1	CITY	
2552700	TAPE DRIVE 2 GBYTE X801A	1002745	91/03	6,840.00	1,989.06	564.06	COMP	1	1	CITY	
2553700	RECEIVER NOAA I/F FORMAT	1004	91/03	19,500.00	2,941.08	909.83	EQPT	8	1	CITY	
2553701	ACQNR		91/03	3,800.00	1,105.04	313.37	COMP	8	1	CITY	
2587000	PAINTJET XL C1602A	3005A36167	91/05	2,425.00	614.67	210.50	COMP	3	1	CITY	
2587001	PS/2 20MHZ 2/320MBHD VGA	3400482	91/05	8,846.00	2,242.21	767.88	COMP	9	1	CITY	
2587002	MOUSE	6450350	91/05	109.00	27.63	9.46	COMP	9	1	CITY	
2587003	DUAL ASYNCH ADAPTOR		91/05	233.50	59.19	20.27	COMP	9	1	CITY	
2587004	DUAL ASYNCH ADAPTOR		91/05	233.50	59.19	20.27	COMP	9	1	CITY	
2587005	OS/2 EXTENDED EDITION V1.2		91/05	700.00	177.43	60.76	COMP	9	1	CITY	
2587006	2MB MAIN MEMORY EXPANSION		91/05	953.00	241.56	82.72	COMP	9	1	CITY	
2587007	MATHS CO-PROC INTEL 20MHZ		91/05	570.00	144.48	49.48	COMP	0	1	CITY	
2587008	2-8MB MEMORY EXPANSION	6450605	91/05	1,450.00	367.54	125.87	COMP	0	1	CITY	
2587009	2MB MEMORY MODULE		91/05	475.00	120.40	41.23	COMP	0	1	CITY	
2587010	2MB MEMORY MODULE		91/05	475.00	120.40	41.23	COMP	0	1	CITY	
2587011	2MB MEMORY MODULE		91/05	475.00	120.40	41.23	COMP	0	1	CITY	
2587012	ETHERLINK MC CARD		91/05	590.00	149.55	51.22	COMP	0	1	CITY	
2587013	FUTURE DOMAIN		91/05	450.00	114.06	39.06	COMP	0	1	CITY	
2587014	MONITOR DISPLAY CABLE		91/05	120.00	30.42	10.42	COMP	1	1	CITY	
2587100	ULTRA 1000 20"	1098A0175	91/05	2,870.00	727.46	249.13	COMP	0	1	CITY	
2587200	ULTRA 1000 20"	1098A0182	91/05	2,870.00	727.46	249.13	COMP	0	1	CITY	
2587300	5.25 DISKETTE	0064128	91/05	501.00	126.99	43.49	COMP	9	1	CITY	
2629700	CARTRIDGE SYSTEM 2.5 G BYTE 8MM EXA	801491	91/07	4,950.00	1,069.92	451.17	COMP	7	1	WASTAC	
COST BASIS				369,802.00	181,716.12	15,341.00					
ACCUMULATED RESERVE											
YTD DEPRECIATION											