The Bureau of Meteorology continued to serve the Australian community to the best of its ability during 1999-2000 through the further development of its operational systems and scientific capabilities and through the provision of a wide range of meteorological and related services to virtually every sector of the community. It gave particular priority to service delivery and the success of the Bureau’s Web site, which is consistently rated in the top three Federal Government sites in Australia, is indicative of the general community regard for the quality and range of information available. The effectiveness of the Bureau’s communications and service delivery systems was formally recognised through the joint presentation of a Government Technology Productivity Silver Award to the Bureau’s Computer Message Switching System (CMSS) and to SILO, the Internet Web site established in 1997 to provide specialised meteorological information services to rural communities, decision makers, researchers and educationalists.

The Bureau made a major commitment to provision of weather information and forecasting services in support of the Sydney Olympic and Paralympic Games, and operational trials carried out in September 1999, during the Trial Games, and again in February 2000 allowed a full evaluation of the systems and services to be provided in September and October 2000. Forecasts along the route of the Olympic Torch Relay commenced when the Olympic Torch landed at Uluru on 8 June, and these proved to be of considerable assistance to organisers and the general public.

The importance of meteorological information to Australian Defence Force (ADF) operations was demonstrated during the operation of the International Force - East Timor (INTERFET), as acknowledged by the Air Component Commander of INTERFET. The development by the Bureau of an aviation weather service program for East Timor changed the fuel loading requirements of transport aircraft, thereby significantly increasing their load carrying capacity. The climatology of the region prepared for the ADF played a pivotal role in the early planning of the mission, and daily weather forecasts were an integral input to daily briefings and to the overall planning process.

The Bureau’s climate services to the rural community were expanded through the introduction of seasonal temperature outlooks. These products, developed by the Bureau of Meteorology Research Centre, complement the seasonal rainfall outlooks that the Bureau’s National Climate Centre has provided for more than a decade. The temperature outlooks are based on observed statistical relationships between temperature across Australia and the sea-surface temperature patterns in the Pacific and Indian Oceans.

An external review of the Bureau of Meteorology Research Centre (BMRC), which was completed by a review panel that included leading experts from Australia and overseas, reaffirmed the very high quality of the BMRC research program and emphasised its ongoing national and strategic importance.

This year’s World Meteorological Day celebrations on 23 March commemorated the 50th anniversary of the establishment of the World Meteorological Organization (WMO). To mark the occasion, celebrations were hosted by the Bureau of Meteorology on 21 March, centred around an address by former President of WMO and retired head of the Philippine Atmospheric, Geophysical and Astronomical Services Administration, Dr Roman Kintanar.

During 1999-2000, some of the major issues confronting the Bureau of Meteorology included follow-up action in respect of critical weather events experienced in 1998-99. The NSW Coroner’s Inquiry into the deaths of six people during
the 1998 Sydney to Hobart Yacht Race commenced in March 2000. Investigations by the Bureau into the meteorology of the Race and into additional aspects such as the use of computer models and the reliability of wind measurements on yachts were included in evidence to be considered by the Coroner. The Bureau will release a final report into the meteorology of the 1998 Race after the Coroner’s Inquiry, which will enable it to address any recommendations the Coroner might make which impact on the future provision of meteorological services.

The Bureau’s inability to predict the intensity of the Sydney hailstorm of 14 April 1999 and to issue a severe thunderstorm warning to the public have been the subject of thorough review. The reviews have addressed the Bureau’s use of scientific methods, technology and staff through the event, to identify ways of enhancing overall system performance. Actions have commenced in response to the recommendations of the reviews, in areas such as training, secure communications, specialist staffing and state-of-the-art technology installations.

The Bureau is a member of the Group 9 ‘Science Cluster’ for the Whole of Government IT Outsourcing Initiative and significant effort has been directed into determining the appropriate scope of the Group 9 Request for Tender (RFT). The geographically dispersed nature of the Group 9 cluster, combined with the considerable functional differences among Group members, is adding significantly to the complexity of coordination and the conceptual and operational challenges faced by the individual organisations. The process is continuing into 2000-2001.

Highlights

Despite the heavy workload and other pressures under which most areas of the Bureau continued to operate during 1999-2000, there were also many highlights. These included:

- Twenty-one automatic weather stations were installed across Australia to improve the efficiency and coverage in monitoring surface weather elements.
- Autosondes, automated upper air observing systems, were installed at Eucla (South Australia) and Charleville (Queensland), bringing the autosonde network to nine. Their installation facilitates enhanced quality control of upper air observations and ensures reliability and timeliness of data delivery in reduced staffing situations.
- The introduction of electronic field books at all contract observer sites across Australia was completed. This allows the direct electronic transfer of surface weather observations into the Bureau’s communications network and improves quality control and the efficiency of data handling.
- An automatic text to speech (TTS) system was implemented in the Queensland and South Australian Regional Offices. TTS allows for automatic generation of voice content for recorded telephone weather services and is expected to be implemented in all remaining Bureau Regional Offices by the end of 2000. It provides an improved, efficient infrastructure to support telephone weather services.
- The Australian Meteorological Data and Information Service System (AMDISS) progressed substantially with a comprehensive suite of information now available on the Bureau’s Web server (http://www.bom.gov.au). The average weekly hit rate for 1999-2000 was 2 million and reached 5.5 million per week in early April when cyclone Tessi and cyclone Vaughan threatened north Queensland. The Bureau Web site consistently rated in the top three Federal Government sites in Australia for the year.
- The Bureau’s Computer Message Switching System (CMSS) receives and forwards meteorological data (reports)
and processed products both domestically and internationally. In recognition of the increased productivity and improved services made possible through CMSS, the Technology in Government Committee awarded the Bureau a joint silver award in the 2000 Government Technology Productivity Awards. This was the fourth such award presented to the Bureau in the past 13 years.

- A supercomputer strategic plan for the joint Bureau/CSIRO High Performance Computing and Communications Centre (HPCCC) to scale operational and research systems through until 2003 was adopted in 1999. The strategy included the replacement of the current NEC SX-4 supercomputer with an SX-5 supercomputer by August 2000 and the addition of a second supercomputer by November 2000.

- Further progress towards improved productivity and higher-quality weather services was achieved through the operational implementation of the Australian Integrated Forecast System (AIFS) in Western Australia, South Australia and Tasmania/Antarctica. This completed a major upgrade of the Bureau’s regional specialised computing infrastructure commenced in 1996. In addition, a special version of AIFS was implemented at the Navy’s Fleet Weather and Oceanographic Centre (FWOC) and the Defence Meteorological Support Unit (DMSU), Darwin.

- The Bureau’s transition to the Year 2000 and over 29 February passed without impact on the Bureau’s operations and hence on the Bureau’s services to the community. This was the result of an extensive Year 2000 Compliance Project, initiated several years earlier, which ensured that all essential Information Technology (IT) and embedded systems, on which the Bureau is heavily dependent, performed correctly during these transitions.

- Enhancements to the Bureau’s Limited Area Prediction System (LAPS) implemented during the year included a doubling in the horizontal resolution, bringing the computational grid down to 37.5 km, and an extra 10 levels in the vertical and resulted in improved accuracy of the predictions particularly in the upper layers of the atmosphere.

- A new version of the MESOLAPS model was developed with a horizontal resolution of 12.5 km over the entire Australian domain together with a special 5 km resolution version specifically for the Sydney region to assist weather forecasters provide services during the Sydney 2000 Olympic Games.

- The Bureau provided special forecasting support to the Dick Smith/John Wallington Trans-Tasman balloon flight from New Zealand to Australia and provided weather advice during the single-handed round-the-world voyage of the paraplegic sailor Vince Lauwers.

- In its role as a WMO Regional Specialized Meteorological Centre (RSMC) for Environmental Emergency Response (EER), the National Meteorological Operations Centre (NMOC) provided advice on the transport of radioactive material following the accident at the Tokaimura nuclear fuel fabrication facility in Japan in September. The RSMC also took part in a joint trial of the EER system with the Comprehensive Nuclear Test Ban Treaty Organisation from 3-5 May and a full global trial involving meteorological services, national atomic energy agencies and the International Atomic Energy Agency on 27 June.

- An independent external review of the Bureau of Meteorology Research Centre (BMRC) was completed during the year and found that the BMRC is held in universally high regard in respect of both the quality and impact of its science. Its world-class research was found to extend across the areas required to sup-
port a National Meteorological Service and its development of more advanced numerical weather and climate prediction models was acknowledged as a major contributor to the improvements achieved in forecast accuracy and reliability.

- The preparations for the Sydney Olympics were the focus for an international nowcasting (i.e. very short range forecasting) demonstration project under the auspices of the WMO World Weather Research Programme (WWRP). Successful trials of the demonstration, involving systems from the USA, Canada and the UK as well as from the BMRC, were held in September and February to ensure that products from the radar-based systems could be effectively fed into the Bureau's operational procedures for the generation of short-range forecasts and warnings.

- The Bureau continued to support the application of the small autonomous aircraft, the Aerosonde, to meteorological functions. The Aerosonde was initially developed in the Bureau of Meteorology Research Centre (BMRC) in collaboration with ES&S Pty Ltd and the US-based In Situ Group. A trial was held over the second quarter of 2000 in the Victorian Regional Office to test the utility of the Aerosonde in supplementing conventional observing systems for routine weather analysis and forecasting and the results are currently being analysed.

- During 1999, the suite of limited-area numerical models used for operational weather prediction was successfully transferred to the NEC SX-4 supercomputer. These models include a new version of the system used to predict the behaviour of tropical cyclones in the Australian region. It provided consistently accurate predictions during the 1999-2000 tropical cyclone season.

- In follow-up action on the recommendations of the Slatyer II report, the definition of a comprehensive Basic Product Set, encompassing those products to be provided free of charge to the public through the mass media and the Internet, was completed towards the end of the year with an implementation date set at 1 August 2000.

- A range of weather services was provided to the Sydney Organising Committee for the Olympic Games (SOCOG) during the Trial Games held in Sydney in September. This provided an opportunity for both the Bureau and SOCOG to evaluate systems and services in preparation for the Olympic and Paralympic Games to be held in September and October 2000. Forecasts along the route of the Olympic Torch Relay were commenced when the Olympic Torch landed at Uluru on 8 June and proved to be useful to organisers and the general public.

- The Bureau provided significant support for Australian Defence Force (ADF) operations in East Timor through the newly established Defence Meteorological Support Unit (DMSU) in Darwin. Comprehensive climatological advice and an aviation weather service program developed specifically for East Timor were important elements of ADF planning and operations respectively. These services have continued beyond the withdrawal of the International Force - East Timor (INTERFET) and are now provided to the United Nations Transitional Authority for East Timor (UNTAET). The quality of the forecast information provided by the Bureau and its direct contribution to the efficiency and effectiveness of aircraft operations into East Timor was acknowledged by the Air Component Commander of INTERFET.

- The Bureau’s Seasonal Climate Outlook was extended during the year with the introduction of seasonal maximum and minimum temperature outlooks. The first of these was issued in February.
2000 for the autumn. The temperature outlooks are expected to be generally more skilful than the corresponding rainfall outlooks, with useful skill expected over a larger area of Australia and greater skill in predicting peak values.

- To help meet the demand for weather and climate information both from within Australia and from the influx of visitors expected for the Olympic Games in Sydney, a special publication, Climate of Sydney: The Olympic City was made available to the Sydney Organising Committee for the Olympic Games (SOGOG), and to Olympic sporting managers, overseas countries and schools.

- The SILO project, a three-year joint undertaking between the Bureau of Meteorology and the Queensland Department of Natural Resources, and supported by external funding, was completed during the year. SILO was initially established as an Internet Web site in 1997 to provide a specialised meteorological information service for rural communities, decision makers, researchers and educationalists and the information available has since been substantially upgraded. SILO won a joint silver award at the ‘Technology in Government Awards 2000’, along with the Bureau’s CMSS project, and was also a semi-finalist in the Telstra Internet Awards 1999.

- Compilation of a national set of streamflow data to be used in developing techniques for forecasting seasonal streamflow based on the El Niño and Southern Oscillation phenomena was completed. The data were provided by State and Territory water agencies and will be included in an upgraded version of the decision support tool RainMan, developed for use by the agricultural industry.

- The development of a method for estimating Probable Maximum Precipitation (PMP) for the west-coast region of Tasmania was completed during the year. This project was undertaken in close collaboration with the Hydro-Electricity Corporation of Tasmania and to date has been applied to two catchments.

- A Memorandum of Understanding between the Bureau and the Islamic Republic of Iran Meteorological Organization (IRIMO) on cooperation in meteorology, and particularly in the areas of climate, weather forecasting, meteorological applications and new technologies, was signed at Geneva in May.

- The Bureau continued its support for the National Meteorological and Hydrological Services (NMHSs) in the South Pacific by providing the team leader and several officers to assist in the South Pacific Regional Environment Programme (SPREP) Pacific Meteorological Service Needs Analysis Project funded by the Australian Agency for International
Development. This included preparation of a report: Pacific Meteorological Services: Meeting the Challenges which recommended a comprehensive set of development projects aimed at upgrading weather and climate services in the Pacific Island Countries and Territories.

- This year’s World Meteorological Day on 23 March commemorated the 50th anniversary of the establishment of the World Meteorological Organization (WMO). The occasion was marked by a 21 March address by former President of WMO and retired head of the Philippine Atmospheric, Geophysical and Astronomical Services Administration, Dr Roman Kintanar and distribution of a media release, poster and booklets as well as display panels for Head Office and all Regional Offices.

- The Bureau of Meteorology Training Centre (BMTC) was designated by the WMO as a Centre of Excellence in Satellite Meteorology Training and hosted a meeting of the WMO Commission for Basic Systems Open Program Area Group (OPAG) Integrated Observing System Expert Team on Improving Satellite Systems Utilisation and Products.

Management and Organisation

Management Strategy

The Bureau’s overall strategy for management of the organisation and its outputs throughout 1999-2000 focussed particularly on:

- Management of the overall resource situation in the light of Government decisions in the 1999-2000 Budget context on continued support for the recommendations of the Slatyer I Report and on an ongoing level of funding for asset replacement;
- Management of staffing levels to ensure the optimum use of available salaries funding during 1999-2000 while moving towards a more balanced and efficient disposition of staff categories and numbers in the medium to long term;
- Development of a staffing strategy to ensure that the Bureau will be well placed in terms of qualified, experienced staff to maintain and enhance operations and services during the next five to 10 years which are expected to see a significant increase in the number of age retirements of senior staff across all major staff categories;
- Integrated management of the Bureau’s asset acquisition and replacement pro-
gram to ensure the integrity of the Bureau’s asset register and establish that asset values correctly reflect their full cost;

- Preparations for the introduction of the Goods and Services Tax (GST) from 1 July 2000 by ensuring that appropriate policies, processes and systems were put in place;

- Further development and refinement of the integrated modernisation plan titled Bureau of Meteorology Operations Beyond 2000 which was prepared in response to Recommendation 16 of the Slatyer I Report;

- Follow-up on other recommendations of the Slatyer I Report including implementation of the specific projects and initiatives that have been funded through the additional resources provided in the 1999-2000 Budget and refinement of the plans for the period 2000-2001 to 2002-2003;

- Finalisation of the Government response to the recommendations of the Slatyer II Report on Capturing Opportunities in the Provision of Meteorological Services and their implementation as key elements in the management of cost-recoverable services together with the terms of the resolution of the Federal Court matter between the Bureau and the Australian Competition and Consumer Commission;


- Updating progressively the systems and procedures used for the routine monitoring of performance against agreed service standards;

- Planning and implementation of upgraded financial management systems to accommodate the introduction of accrual accounting, the additional costing information necessary under the Government's competitive neutrality policy and the increased emphasis on revenue generation, including electronic commerce;

- Finalisation of a new Certified Agreement and Australian Workplace Agreements for Bureau staff and implementation of the associated savings measures;

- Completion of the sale of staff housing commenced in response to Government decisions in the 1996-1997 Budget;

- Implementation of the first phase of the centralisation of Management Services processing tasks and commencement of a review of the efficiency and effectiveness of the initial arrangements;

- Progressing the reorganisations of the Head Office Observations and Engineering Branch (OEB) and Central Operations and Systems Branch (COSB);

- Completion of the external review of the Bureau of Meteorology Research Centre and commencement of a minor evaluation of the International Activities Program under the Portfolio Program Evaluation Plan;

- Management of the Bureau’s Year 2000 compliance program to ensure that all critical systems were compliant and that operational difficulties during the 1999-2000 transition were minimised;

- Development of strategies and plans for responding to the Whole-of-Government approach to the outsourcing of IT systems in order to minimise the adverse impacts on Bureau operations and services;

- Implementation of agreed recommendations of the performance audit of the Bureau’s weather services conducted by the Australian National Audit Office (ANAO); and

- Implementation of the Bureau’s consolidated programs on:
  - Social Justice,
  - Corporate Information Technology,
  - Energy Management, and
  - Access and Equity.
Organisational Structure

The Bureau’s basic organisational and operational structure underwent some change during 1999-2000, with closure of the Edinburgh (South Australia) and Richmond (New South Wales) Defence Weather Services Offices, the withdrawal of Bureau staff from the Navy facility at Nowra (New South Wales) as from 31 December, and a realignment of the research group structure in the BMRC following an independent external review.

The planned restructuring of the Observations and Engineering Branch (OEB) and Central Operations and Systems Branch (COSB) was not, however, completed during 1999-2000. It was judged necessary to further consider the implications of the findings and recommendations of the 1999-2000 evaluation of the Analysis and Prediction Program and the external review of the BMRC, particularly in the area of satellite meteorology, together with the potential impact of the Whole-of-Government Information Technology (IT) Outsourcing Initiative before firming up on the new structure and responsibilities of the OEB, COSB and BMRC.

Output Structure

From the mid-1980s until 1998-99, the Bureau planned and reported against an output-based program structure derived directly from its goals and objectives. With the introduction of the Outcomes/Outputs framework in 1999-2000, the program structure has been replaced by an output structure based on the Bureau’s basic (output) objectives (Figure 5). There are strong similarities between the program and output structures, reflecting their common base in the Bureau’s basic objectives, and Appendix 4 provides a detailed mapping from the program framework used previously in the Bureau Annual Report and the Portfolio Budget Statements to the output structure adopted for 1999-2000. Organisational responsibilities for internal policy coordination in respect of the Bureau’s seven Major Outputs are as shown in Figure 8. The Major Output of Meteorological and Related Data and Products is concerned with the development, maintenance and operation of the basic national meteorological infrastructure and its output of a wide range of real-time operational and archival data and products. The remaining Major Outputs focus on the provision of a series of downstream outputs including new scientific knowledge and all the services of the Bureau.

Corporate Achievements

Significant progress was achieved on most of the major initiatives which the Bureau had identified as its corporate priorities for 1999-2000(cf pp 14-17). In summary:

Improved Service Charter

The Bureau’s Service Charter for the Community which was launched in June 1998 continued to guide the Bureau’s operations during the year. A Departmental audit of the Charter was undertaken during May with an emphasis on the extent to which appropriate mechanisms are in place for the effective measurement of performance against the Service Charter standards. In addition, the Department of Finance and Administration has been finalising revised guidelines for the development of service charters, including a greater emphasis on on-line service delivery, services for people with disabilities, and access
to services for remote users. The Bureau’s Charter is due for formal review during 2000-2001 and it is expected that it will be formally revised, based on the Department of Finance and Administration guidelines and the recommendations of the Departmental review, to include, for example, a greater degree of user consultation than was achievable when the Charter was first developed.

Restructuring of Aviation Weather Services

Some of the uncertainty over future charging arrangements for the provision of aviation weather services was resolved in December when the full bench of the High Court handed down its judgment in the Airservices Australia versus Monarch Airlines case. The decision upheld the validity of the previous charging arrangements for the provision of services to civil aviation and in particular network-based charging and application of the Ramsay pricing principle. While the successful resolution of the long-standing legal challenge helped to clarify the charging regime issue, the introduction of the outcomes and outputs based accrual budgeting framework had a significant impact on the calculation and presentation of future charges.

The Bureau participated in international consultations under the auspices of the World Meteorological Organization (WMO) and the International Civil Aviation Organization (ICAO) aimed at re-establishing the basic framework for recovery of the costs incurred by National Meteorological Services in providing essential meteorological services for civil aviation. Pressure on the Australian cost recovery arrangements continued, however, from the New Zealand based organisation, Metra, a subsidiary of the Meteorological Service of New Zealand Limited (MetService), which has sought approval from the Civil Aviation Safety Authority (CASA) to provide aviation related meteorological services in Australia in competition with the Bureau. In February, Metra lodged a complaint on this issue with the Competitive Neutrality Complaints Office. CASA, as part of its regulatory reform program, is undertaking a review of the relevant Civil Aviation Regulation - CAR 120.

Although a number of possible options for restructuring the aviation weather service were investigated during the year in consultation with the industry and staff, the volatility of the overall aviation scene suggests the need to avoid major restructuring until the larger situation becomes clearer.

Consolidation of National Plans for GCOS/GOOS

Decisions of the fourth and fifth sessions of the Conference of the Parties (COP4 and COP5) to the UN Framework Convention on Climate Change (FCCC), calling on Parties to address deficiencies and gaps in global climate monitoring systems, have provided a new impetus and urgency for the implementation of both the Global Climate Observing System (GCOS) and relevant aspects of the Global Ocean Observing System (GOOS). The Bureau has taken a key role in Australia’s response to these decisions. Key elements of the decisions and of Australia’s response relate to:

• improvements in monitoring systems, including meeting the requirements appropriate to designated GCOS baseline stations in the GCOS Upper Air Network (GUAN) and the GCOS Surface Network (GSN) – during the year, all 16 designated Australian GUAN stations were made compliant with the requirement for soundings to attain heights of 5 hpa or higher. In doing so, Australia became the first country to fully meet this requirement.
The Bureau also worked collaboratively with CSIRO and the Australian Institute of Marine Science (AIMS) to further develop plans for climate components of an Australian Ocean Observing System, within the context of the Oceans Policy and the Marine Science and Technology Plan, and contributed to the deployment of Argo ocean profiling floats in the Australian region;

- reporting on the status of climate monitoring commitments as part of periodic national communications to the UNFCCC – the Bureau worked within the UNFCCC process, through co-chairing an informal group on research and systematic observation and through the secondment of a Bureau officer to the GCOS Secretariat in Geneva, to develop guidelines for national reports on climate monitoring systems which were adopted through Decision 5/CP.5 of COP5 in Bonn (November 1999). Subsequently the Bureau accepted responsibility to coordinate preparation of the relevant elements of Australia’s third national communication, to be submitted by November 2001;

- establishment of an intergovernmental mechanism for GCOS to advise on priorities for action in meeting UNFCCC climate monitoring requirements – following an informal meeting hosted by the Meteorological Service of Canada in February, attended by the Director of Meteorology, the concept of developing an informal network of National GCOS Coordinators as a defacto intergovernmental mechanism was proposed, pending the resolution of issues towards more formal actions. Plans were advanced for the first informal meeting of national GCOS coordinators in Melbourne in August 2000, with the principal item of discussion being the development of a standard (more detailed) format for national reports on climate monitoring. In addition to Australia, six countries and the GCOS Secretariat agreed to participate in the informal meeting; and

- support for a series of regional implementation workshops to assist developing countries in improving climate monitoring systems – the first such workshop was scheduled for the Pacific region (Samoa) in August 2000 and the Bureau contributed substantially to the preparations for the workshop, including through the drafting of a key discussion paper on the development of an action plan for the region.

Follow-up to the Evaluation of the Analysis and Prediction Program

A major evaluation of the Analysis and Prediction Program (now part of the Meteorological and Related Data and Products Major Output) was completed in October as part of the Department of the Environment and Heritage Program Evaluation Plan. Its aims were to review the effectiveness of the program, compare its performance with comparable overseas programs, review the technical supporting infrastructure and assess its capacity to respond to emerging trends and user requirements.

The evaluation proceeded under the guidance of a Steering Committee comprising the Bureau’s Deputy Director (Research and Systems), Assistant Director (Central Operations and Systems), Regional Director Northern Territory and Superintendent National Meteorological Operations Centre together with a member of the Program Evaluation and Audit Unit of the Department of the Environment and Heritage. External advice was provided by Mr Hubert Allard, former Head of the Canadian Meteorological Centre.

Overall the Evaluation Team endorsed
the major thrust of the program and in particular noted the widespread view that the quality of the output from the Analysis and Prediction Program has significantly improved during the last five years. The review identified some new directions and changes of emphasis, particularly within the National Meteorological Operations Centre (NMOC). Follow-up action on the Bureau Executive’s decisions on the recommendations of the Evaluation commenced with the establishment of a small project team to coordinate the implementation of the key recommendations.

Upgrade of the Data Management Function

The planned upgrade in the Bureau’s data management function included the development of a new organisational focus within the Central Operations and Systems Branch (COSB). Whilst the broad structure of the COSB reorganisation was agreed and approved, the uncertainty surrounding the scope of the Whole of Government IT Outsourcing Initiative delayed its implementation.

Australian Integrated Forecast System and Forecast Process Streamlining

The implementation of an improved computing infrastructure in the Bureau’s Regional Forecasting Centres to support the provision of weather services to the Australian community was completed in 1999. The centrepiece of this program has been the Australian Integrated Forecast System (AIFS). During the year, AIFS was installed in Western Australia, South Australia and Tasmania/Antarctica. In addition, a version of AIFS was installed at the Royal Australian Fleet Weather and Oceanographic Centre, Sydney and at the Defence Meteorological Support Unit in Darwin. AIFS is now operational in 27 Bureau Offices and at several overseas locations. AIFS has made possible significant efficiency gains by increasing the volume of products originating from Regional Offices and decreasing system costs.

The next phase of the AIFS development will build on the new infrastructure to streamline the forecast process and enhance the quality of outputs. The Forecast Streamlining and Enhancement Project (FSEP) is driven by the need for improved services and more efficient operations. Developments in meteorology and information technology are providing opportunities for a greater degree of automation in some forecasting tasks, as well as offering decision support and data visualisation tools for forecasters. The project focus is initially on weather forecast services, but it is intended that the Bureau climate and hydrological services will also be addressed. This work will also build on the continuing strategic research in BMRC on the use of numerical weather prediction models.

An FSEP Workshop was held in June and made useful progress in:
  • achieving wide awareness and discussion of the FSEP concept and plans developed to date;
  • further defining and clarifying project modules in FSEP and their relative priorities;
  • refining the virtual project team approach and, in particular, securing Regional involvement; and
  • considering means of documenting and analysing aspects of the forecast process.

Public Access Systems

In preparation for the introduction of e-commerce and full operational implemen-
tation of Web-based service systems, a new payment system was piloted by the Bureau in late 1999, allowing testing of all aspects of the e-commerce process. The pilot worked well from a technical perspective but several non-technical issues such as staff resources, accounting support and uncertainties in product pricing are yet to be resolved.

Improvements were made to the Web feedback system to facilitate performance monitoring and work is continuing on a Services Management System. The objective of this project is to provide a national database to support improved management of Bureau products, clients and services. Potential users of this system include all Bureau Regional and Head Office service outlets. The system will have interfaces to the new Financial Management System and to the new HelpDesk System. It will provide reporting on product usage (free and cost-recovered), service activity levels and client service access patterns through a management information system and also support subscription processing and quoting systems.

Work has continued on improving recorded telephone access systems and services. The Bureau’s text-to-speech system was installed in Queensland and South Australia to provide the basis for the Regions’ telephone recorded services and to prove the system prior to the planned tender for operation of the Bureau’s 1300 and 1900 recorded telephone weather services in 2000-2001. Transfer of fourteen 1900 services from Optus to Telstra numbers was successfully implemented on 2 June following Optus’ withdrawal from 1900 services.

Charges for data access were revised and promulgated in conjunction with the implementation of the Goods and Services Tax (GST). Further work on the charging policies and guidelines will continue following the implementation of the Basic Product Set from 1 August 2000.

Relationship with Private Sector Providers

The Bureau’s long-standing policy is to support the development of a professionally competent private sector in meteorology in Australia and this has been encouraged in a number of ways. The Bureau actively seeks to undertake collaborative projects where its expertise can make a contribution and, from time to time, employs members of the private meteorological sector to provide advice and undertake services. During the year, the Bureau collaborated on projects with private sector companies such as Weather 21, Almos Australia, Environmental Systems & Services, Lawson & Treloar and Vaisala Australia. The Bureau also seeks to encourage development of the sector through its policy of providing access to a large part of its database either free of charge or at the cost of providing access. All major service providers have data access agreements with the Bureau.

As a follow-up to the Slatyer II report, the Bureau sought to enhance its ongoing consultative process with private sector providers with the aim of facilitating the sharing of information about the Bureau’s services and plans, and gathering feedback on issues of particular concern. Meetings were held with a large number of providers in June 1999 and with individual providers on a number of occasions through the year. The definition of the Bureau’s Basic Product Set was completed and subsequently promulgated to the private meteorological sector.

Support for the Year 2000 Olympics

The Bureau successfully provided weather services support for the September 1999 Olympics Trial Games, as part of its preparations for the main Olympic Games of
September 2000. During the Trial Games, the Bureau located a team of meteorologists at the main sailing venue at Rushcutter’s Bay and sailing competitors and race organisers were provided with hourly wind forecasts for the event areas of Sydney Harbour and offshore. This service enhanced competitor safety and provided all competitors with high quality weather information for application to race strategies.

The trial provided the opportunity to test systems and to train staff. Two meteorologists from the Hellenic Meteorological Service were invited to attend as part of the preparation for the 2004 Olympic Games to be held in Athens.

Since many visitors to the Games were expected to be unfamiliar with Sydney’s weather, an Olympics Home Page was created on the Bureau’s Web site to provide access to a range of weather information. In October 1999, the Bureau published Climate of Sydney: The Olympic City, a 50 page book that provides an overview of Sydney’s climate during the Olympic and Paralympic Games months of September and October. Forecasts were provided for the Olympic Torch Relay which commenced from Uluru on 8 June.

Upgrade of Marine Weather Services

A demonstration version of the new Australian Marine Forecasting System (AMFS), to be used in the preparation of marine forecasts, was completed during the year and is now available for trialing and evaluation by Bureau forecasters during 2000-2001. Work also commenced on developing the capability for automatic derivation of forecasts. A program of extensive internal and external consultation will commence in 2000-2001.

A two-month trial to evaluate the feasibility and benefits of centralised preparation of high seas forecasts commenced in June. This was a first step towards probable eventual application of the AMFS to produce such forecasts more efficiently using flexible output formats to better meet the needs of merchant shipping and other long-distance marine users.

Preparation of a strategic plan for the Bureau’s marine meteorological and oceanographic observing program was commenced with completion planned for late 2000. This will include significant asset replacement expenditure, commencing in 2000-01, to sustain the Bureau’s marine meteorological and oceanographic observing capability, including the coastal wave buoy network, coastal automatic weather stations and moored weather buoys.

Considerable effort was directed to resolving the future of Bureau marine radio services. A tender for the provision of HF radio services to the Bureau, including voice and radio facsimile services, was reissued in May and will be finalised in early 2000-2001. The tender will secure marine HF radio services for the next two to five years. The Bureau also commenced working with Telstra to develop marine services targeted to users of Wireless Application Protocol (WAP)-enabled devices such as new generation mobile phones. Uptake of WAP devices by mariners is expected to be very rapid over the next few years. The Marine Page on the Bureau’s Web site, which was established at the end of 1998, has been very successful with hits of around 15,000 per month in the warmer months of the past year.

The 1998 Sydney-Hobart Yacht Race demonstrated the difficulty in successfully communicating the details of marine forecasts and warnings to users, even those expected to have well-developed specialist knowledge or training. This is being addressed, in part, through improved marine publications and work commenced on the new Tasmanian edition of Wind Waves Weather and the revision of other marine pamphlets and brochures.
Air Quality Monitoring and Forecasting

The Bureau of Meteorology Research Centre (BMRC) continued to collaborate with CSIRO and the Environmental Protection Authorities (EPAs) of Victoria and New South Wales on the development of an air quality prediction system for Melbourne and Sydney. The system will be demonstrated for a four-month period from August 2000, when it will provide each EPA with detailed predictions on the distributions of key air pollutants up to 36 hours ahead.

To support the overall system, the BMRC numerical weather prediction model is run with a resolution of 5 km around Melbourne and Sydney. Development in BMRC over the past year has focussed on improving the prediction of weather near the surface, especially the passage of wind changes associated with fronts and sea breezes. This has involved detailed comparisons between model predictions and observations of parameters such as surface wind and temperature from automatic weather stations.

The BMRC is also supporting implementation of the Ambient Air Quality National Environment Protection Measure (NEPM), enacted in 1998. Through the NEPM Peer Review Committee, collaboration continues among all jurisdictions to ensure that the NEPM is implemented in a scientifically sound manner. A key objective of the process is to ensure the routine collection of nationally consistent air quality information in major airsheds.

Climate Monitoring and Prediction Services

Improved climate prediction is increasing the scope for proactive adaptation and risk management in climate sensitive activities, such as water management and primary production. Following the transfer of research on sea surface temperature (SST)-based rainfall outlooks into operations in 1998, the Bureau’s Seasonal Climate Outlook (SCO) was further upgraded in February with the introduction of national air temperature outlooks, based on research conducted in the Bureau of Meteorology Research Centre (BMRC). Summaries of the seasonal climate outlooks for rainfall and temperature were routinely provided to the public via the Bureau’s Web site and through the media and regularly featured in radio and newspaper as well as free-to-air and cable TV reports. More detailed information, including information from the BMRC coupled ocean-atmosphere models, was provided to registered users on a cost-recovery basis. Work by the Northern Territory Regional Office in cooperation with the US National Oceanic and Atmospheric Administration/Atlantic Oceanographic and Meteorological Laboratory, Hurricane Research Division, resulted in the production and dissemination of predictions of tropical cyclone genesis potential for monsoon seasons.

Several high-quality datasets developed by Bureau of Meteorology and University of Melbourne researchers for monitoring long-term trends in Australian climate are now regularly updated by the Bureau. The annual mean temperature dataset revealed that the 1990s was the warmest decade in the high-quality record, since 1910, promoting public awareness of climate variability and climate change issues through extensive media interest. A high-quality dataset of corrected daily temperature data was used in a major study of changes in the frequency of extreme temperature events in Australia for input to the Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report on the science of climate change. The high-quality climate datasets also provided valuable input to many of the indicators used in National State of the Environment (SOE) reporting. Rainfall and temperature varia-
tions on decade to decade and longer time-
scales during the 20th century, and their
impacts in terms of drought and flood,
were documented.

In addition, promising work was com-
pleted on digitising data directly from
scanned images of autographic rainfall
charts.

Management of the Climate Record

The Bureau’s material (paper) archives rele-
vant to the national climate record are held
by National Archives Australia (NAA),
with archival material dating back to the
1800s. The Bureau has conducted two
reviews of these holdings to identify non-
essential records and material that can be
converted to modern digital records or
imagery. Approximately 25 per cent of the
archived volume was removed in 1999-2000
and further reduction is being considered.
Planning commenced to establish suitable
archives for electronic images and to ensure
effective preservation of important scientif-
ic records with easier access for Bureau
staff and the wider community.

The CLIMARC project is aimed at com-
puterising pre-1957 hourly and daily mete-
orological observations from 50 stations
throughout Australia by June 2002. With
funding support from a number of external
agencies, the project continued in 1999-2000
and by 30 June the records from 14 stations
had been processed.

The quality of climate data was further
improved during 1999-2000 through:
• re-calculation of a number of derived
datasets;
• enhancement of existing quality control
software;
• development of the Quality Monitoring
System and near implementation of the
RainQC software;
• development of a suite of new data
entry computer based forms;
• further strengthening of liaison on data
quality issues within the Bureau; and
• development of specifications for
improving the software in automatic
weather stations.

Reformulation of the Charging Manual

The Slatyer I report produced a number of
findings related to specialised services and
associated charges, and the follow-up
Slatyer II study included several recom-
mendations related to access to Bureau
products, the Bureau’s general charging
policy and the manner in which the Bureau
delivers its commercial services. Following
finalisation of the Government’s response
to the study during 1999-2000, several
planned follow-up activities were pro-
gressed, including definition of the generic
elements of a Basic Product Set and the
revision of the Bureau’s charging manual.

Prior to the introduction of the New Tax
System, charges for all Bureau products
and services were reviewed to take account
of non-GST changes, thus ensuring Bureau
prices did not rise more than was necessary
with the introduction of the Goods and
Services Tax.

Reformulation of the charging manual
is expected to be completed late in 2000.

Interrelation with the Environment and
Antarctic Outcomes of the Portfolio

During 1999-2000, the Bureau continued to
develop its collaboration with the function-
al groups of the Department responsible for
the various Environment Outcomes in
order to ensure effective contribution to the
full range of Environment objectives in
which the Bureau has shared interests or
responsibilities. Two staff members of the Policy and Secretariat Section were co-located with the Department in Canberra.

The Bureau worked closely on greenhouse matters with the Australian Greenhouse Office (AGO) which is an Executive Agency located within the Environment Portfolio with responsibility for coordination of domestic climate change policy and the delivery of greenhouse response programs. The Bureau has significant shared interests (e.g. the National Greenhouse Strategy and ongoing evaluation of climate change science) with the AGO.

In addition to interaction with the AGO, the Bureau continued to foster and, where necessary, develop links in areas of common interest with Environment Australia Groups and the Australian Antarctic Division. Priority activities during 1999-2000 included:

• liaison and cooperation on water resources issues including the National Land and Water Audit and other issues related to fresh water, drought and desertification;
• cooperation on Australian input to the Third Assessment Report of the Intergovernmental Panel on Climate Change;
• contribution to the ongoing program of the UN Framework Convention on Climate Change Subsidiary Body on Scientific and Technological Advice (SBSTA) and preparation for the sessions of the Conference of the Parties including monitoring progress of the review of the adequacy of global monitoring networks for climate change purposes;
• contribution to State of the Environment (reporting and atmospheric indicators), the National Pollution Inventory, the National Environment Protection Measures (NEPM) for ambient air quality and the proposed NEPM for marine and estuarine water;
• in close collaboration with staff of the Environmental Resources Information Network (ERIN), contribution to the work of the Commonwealth Spatial Data Committee and its Coordinating Sub-committee and participation in the Fundamental Data Working Group;
• participation in interdepartmental activities related to the Valdivia Group, a coalition of temperate-latitude southern hemisphere countries which aims to enhance cooperation on environment and associated scientific issues of common concern;
• cooperation on Global Learning and Observations to Benefit the Environment (GLOBE) activities, through providing advice to schools on observational techniques, exposure of instruments and the use of atmospheric data;
• ongoing contribution on science-related matters to major international environmental conferences and convention meetings such as the sessions of the Commission for Sustainable Development and the Desertification Convention;
• following the disbanding of the Science Group within Environment Australia, coordination of Departmental input to the Prime Minister’s Science, Engineering and Innovation Council and representation of the Department on the Coordinating Committee on Science and Technology; and
• ongoing contribution to follow up action on the national oceans policy including support to the National Oceans Office in the implementation of Australia’s Oceans Policy, and involvement in the implementation by Australia of the UNEP Global Action Plan for the Ocean, including support for international collaboration on the Global Ocean Observing System (GOOS).
Upgrading Meteorological Services in the South Pacific

The Bureau made a significant contribution to the upgrading of meteorological services in the South Pacific by providing the services of a team leader and several Bureau officers in an AusAID-funded South Pacific Regional Environment Programme (SPREP) ‘Needs Analysis’ Project, including the preparation of the report entitled Pacific Meteorological Services: Meeting the Challenges which recommended a comprehensive set of development projects aimed at upgrading weather and climate services in the Pacific Island Countries and Territories. These activities were aimed primarily at augmenting the quality of meteorological (including climatological) and related environmental data in these countries; improving the capabilities of the National Meteorological and Hydrological Services (NMHSs) to undertake research, provide services and monitor climate; improving regional telecommunication links, and enhancing data input into regional and global numerical weather prediction models run by the NMOC in Melbourne in support of weather services for Australia, and of its role as a designated World Meteorological Centre (WMC) under the WMO World Weather Watch.

In addition, during the year:

- a Bureau officer assisted in the preparation of the Vanuatu Meteorological Service Strategic Development Plan (2000-2009);
- two officers of the Bureau worked with SPREP and WMO in the preparation of the Strategic Action Plan for the Development of Meteorology in the Pacific Region (2000-2009);
- a Fiji Meteorological Service meteorologist visited the Bureau for training on meteorological visualisation software, and to gather information for national disaster awareness purposes in Fiji;
- the Bureau provided a digital barometer to the Niue Meteorological Service;
- the Bureau provided seven Stevenson Screens to the Solomon Islands Meteorological Service;
- the Bureau contributed to the SPREP effort to meet the critical needs of Meteorological Services of SPREP member countries;
- an officer from the Tuvalu Meteorological Service was placed on a training attachment at the Bureau’s Northern Territory Regional Office; and
- the Bureau assisted with the organisation of, and the attendance at, a WMO Global Climate Observing System (GCOS) workshop in the Pacific.

The Bureau made further contributions through the WMO Voluntary Cooperation Programme (VCP) to complete replacement of the Omega-based upper air observing systems and to provide radiosondes to the Papua New Guinea National Weather Service.

Major Issues

In addition to the progress during the year on its specific Corporate Priorities, summarised above, the Bureau faced a number of difficult and complex policy, management and operational issues, which required significant corporate attention and follow-up during 1999-2000.

Follow-up to the Sydney Hailstorm

Recent figures from the Insurance Council of Australia confirm that the severe hailstorm which devastated parts of Sydney on 14 April 1999 was the costliest natural disaster on record for Australia, in terms of insured damage, with a total payout of $1.7 billion, which is $0.6 billion higher than that for the Newcastle earthquake (in 1999 dollars). Roof damage was so extensive
that some of the repairs were still not completed at the end of June 2000.

Following the hailstorm when no public warnings were issued by the Bureau, a number of internal and external reviews of the Bureau's Severe Weather Warning Services were conducted. As a part of these review activities, the performance audit conducted by the Australian National Audit Office (ANAO) during 1998-99 was extended to assess the allocation of severe weather resources against the management of known and likely severe weather risks, especially for Sydney.

The audit report was tabled in the Parliament on 22 December 1999. Its conclusion focussed on three areas: quality of services, cost of services and severe weather services. The overall tenor of the reviews was that the Bureau's severe weather activities are well managed with high commitment from staff providing the severe weather services. The ANAO recognised that there were opportunities for improvement and made three specific recommendations relating to the Severe Weather Warning Services. The Bureau agreed, or agreed with qualification, to these, and to some 30 recommendations of the other reviews. The recommendations of the reviews have implications far beyond the provision of warning services for severe thunderstorms in Sydney. Follow-up actions commenced in the Bureau in relation to weather forecaster competencies and training, organisational procedures, thunderstorm forecasting in general, research and development and communications systems.

**Coronial Inquests**

The Bureau was heavily involved in two Coronial Inquests this year: the Inquest into the deaths of six competitors during the 1998 Sydney-Hobart Yacht Race and the Inquest into the deaths of five volunteer firefighters in a bushfire at Linton, Victoria on 2 December 1998.

The Bureau's involvement in the Sydney-Hobart Inquest concentrated upon informing the Coroner on:

- the meteorology of the storm which devastated the fleet;
- the services the Bureau provided to the Race fleet, including the forewarning of the storm and communication of that warning to the fleet; and
- the meaning of the terminology used in marine weather internationally and the extent to which the Bureau does, and should in the future, work with the sailing community to promote an understanding of that terminology.

The Bureau was represented at the Inquiry by senior legal counsel, and evidence was given in court by senior managers and staff directly involved in providing the pre-race briefings and the forecast service during the race. In addition, the Bureau made three major written submissions and provided many documents to police investigating the event.

While the findings of the Coroner have yet to be handed down, essential facts presented at the Inquest relating to the Bureau's services suggested that:

- the issuance of a storm warning less than two hours after commencement of the Race, and 20 hours or more before the leading yachts encountered storm force winds was, by any standards, a remarkably early and reliable forecast;
- the conditions experienced by the competitors, or as well as they can be determined given the paucity of observational data from the actual Race course, were reflected in the Bureau's forecasts and warnings;
- services provided by the Bureau to the Cruising Yacht Club of Australia (CYCA) fulfilled completely, and in many instances went beyond, the terms of the agreement between the Bureau and the CYCA; and
- many competitors did not fully understand the terminology used by the Bureau in its forecasts and warnings,
and further work needs to be done by the Bureau in educating the marine community in this regard.

The Bureau now awaits the report and recommendations of the Coroner to determine how best to ensure that its marine weather services are used as effectively as possible in the future.

The Bureau also expects to be required to give evidence at the Inquest into the Linton bushfire later this year. Proceedings to date have largely focussed on information gathering by the Coroner’s Office, in which process the Bureau has assisted through the provision of meteorological data and information and details of the Bureau services provided to the fire fighting agencies.

**Telephone Weather Services**

For many years the Australian public were able to access the Bureau’s current weather information such as capital city forecasts, local boating weather and warnings for major centres on the Dial-it 11xx services at the cost of a local call. Due to the national rationalisation of telephone numbering and changes within Telstra, most of the Dial-it 11xx series of public information numbers ceased in 1998.

Although the popular 1196 forecast service was retained for all State and Territory capitals, Rockhampton, Cairns and Townsville, the Bureau was forced to redesign the provision of all other recorded weather information. The Bureau contracted an independent service provider, Information Dialling Services Pty Ltd (IDS) in Sydney, to provide a premium rate Weathercall 1900 series weather information service. The opportunity was also taken to expand the range of forecasts and information provided on the 1900 services. The operating costs of the 1900 services are charged directly to the Bureau, and are recovered by user charges of 75 cents per minute. This change to a Weathercall 1900 premium rate service resulted in some community concern about the higher cost of accessing weather information, particularly boating weather forecasts and warnings. In Queensland and New South Wales the State departments of transport subsidised 1300 services making the Bureau’s marine forecasts and warnings available throughout those States for the cost of a local call.

Following a Commonwealth Government decision in late 1998, a 1300 service for Tropical Cyclone Warnings was made available in Queensland, the Northern Territory and Western Australia. This service provides tropical cyclone warnings for the cost of a local call anywhere within the State/Territory to which the warnings apply. Consideration was given to extending this service to other warning types but an extension is contingent upon the implementation of new technologies such as text-to-speech converters which would make the recording workloads manageable. The Bureau also discussed with providers the re-development of the 1196 service to take advantage of emerging technologies. However work did not progress to the point where the cost of implementing full national coverage was determined.

The area of telephone access to weather data and information is one of rapidly evolving technologies and markets. The Bureau continued to work with information service providers this year to ensure that advantage is taken of these new technologies to deliver the Bureau’s public good services to as wide an audience as possible in the most timely and cost effective manner.

**IT Outsourcing**

The Bureau is part of Group 9, the so-called Science Cluster with CSIRO, Australian Nuclear Science and Technology Organisation (ANSTO), Australian Institute of Marine Science (AIMS), Australian Antarctic Division (AAD) and Australian Geological Survey Organisation (AGSO). The outsourcing of
Bureau Information Technology (IT) was initially considered in 1998, and the process reactivated in March 2000.

The science agencies in the Group have worked with the Office of Asset Sales and IT Outsourcing (OASITO) with the objective of:

• identifying the scope for achieving budget realisable savings from shared outsourcing arrangements in the situation where the agencies have little in common in terms of either the scope or concept of operation of their IT infrastructure; and

• maintaining the efficiency, effectiveness and integrity of their operational systems.

For the Bureau, the very large resource demands of the market testing process and the envisaged subsequent contract management emerged as a significant challenge, given the efficiency of the Bureau’s present integrated mode of operation.

OASITO recognised that the scientific and research nature of the Group 9 agencies presents some unique challenges that may require modification to the outsourcing model used by the Initiative to date. A Scoping Study was commenced in May 2000 to identify and examine the IT equipment and systems which may require special treatment in Request For Tender documentation and the envisaged subsequent contract. The Bureau continued to work with OASITO to try to ensure that the long term quality and integrity of the Bureau’s operations and services to the community are protected, that the very large resource demands of the market testing process and any subsequent contract management can be met, and that any Bureau staff who may be adversely affected by the Initiative are treated equitably and fairly.

### Resource Use

The Bureau’s expenditure, receipts and average staff usage for 1999-2000 are summarised relative to those of previous years in Figures 14 and 15. Figure 14 shows, in cash terms, for comparison with the historical record, the Section 31 receipts (total $26.435m, including $1.895m for aviation weather services and $0.650m for defence weather services) and Meteorological Services Recoverable (total $15.154m, including $11.179m for aviation weather services and $2.806m for defence weather services). The 1999-2000 expenses and revenue in accrual terms are summarised in Table 2 compared with reconstructed accrual estimates for 1998-99 and with the 1999-2000 Budget (Appropriation Bill 1) and Budget plus Additional Estimates (Appropriation Bills 1 and 3, plus additional revenue received from the sale of goods and services) appropriations. The expenses and revenue associated with each of the Bureau’s Major Outputs for 1999-2000 are summarised in Table 3 and are provided in more detail in Tables 4, 9, 12, 16, 19, 22 and 25. These are not audited accounts but are included in order to provide a general indication of the usage of Bureau resources by output. Because of the highly integrated nature of Bureau operations, there is considerable subjectivity in the attribution of staff and resource usage across outputs, especially so in the accounting of cross-cutting and corporate activities which, for reasons of overall cost efficiency, are managed or coordinated centrally. An analysis of the Bureau’s overall staff profile is given in Appendix 9 and an estimated breakdown of the cross-cutting and corporate overhead component of expenses and staff usage is given in Appendix 10.
Figure 14. Bureau of Meteorology expenditure from 1976-77 to 1999-2000 ($million), in cash terms. Expenditure since 1986-87 includes a number of items (totalling approximately $37 million in 1999-2000) which were not met from Bureau appropriations in earlier years. The decrease in meteorological services recoverable from 1992-93 was a result of the reduction of the incremental resources directed to the provision of meteorological services to civil and defence aviation. The decrease has been offset since 1996-97 by increased revenue from other services and by other income through Section 31 arrangements.

Figure 15. Appropriation funded Bureau staffing (Average Staffing Level (ASL) excluding Section 31 funded staff and corrected for changes of function prior to 1985) from 1976-77 to 1999-2000. From 1987-88 to 1990-91 the decrease in ASL due to the efficiency dividend and other factors was partially offset by additional staff provided for re-equipment and upgrading of severe weather and flood warning services. These were integrated into ongoing operations from 1991-92.
Table 2. Bureau of Meteorology expenses, revenue and staff level for 1999-2000 compared with reconstructed estimates for 1998-99 and the Budget (Appropriation Bill 1) and Budget plus Additional Estimates appropriations (Appropriation Bills 1 and 3, plus additional revenue received from the sale of goods and services) for 1999-2000.

<table>
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<tr>
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<tbody>
<tr>
<td><strong>FINANCIAL</strong></td>
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<td><strong>EXPENSES</strong></td>
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<tr>
<td>Employee Expenses (Appropriation)</td>
<td>92,130</td>
<td>92,424</td>
<td>91,053</td>
<td>94,454</td>
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<td>Employee Expenses (Section 31)</td>
<td>2,664</td>
<td>2,972</td>
<td>4,343</td>
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<td>Supply of Goods and Services (Appropriation)</td>
<td>27,833</td>
<td>31,697</td>
<td>33,133</td>
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<td>Supply of Goods and Services (Section 31)</td>
<td>9,782</td>
<td>9,944</td>
<td>13,385</td>
<td>11,993</td>
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<td>Operating Lease Rentals</td>
<td>12,457</td>
<td>11,620</td>
<td>11,741</td>
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<td>Depreciation</td>
<td>37,561</td>
<td>28,813</td>
<td>28,813</td>
<td>31,484</td>
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<td>Other Goods and Services Expenses (WMO Contribution)</td>
<td>1,094</td>
<td>996</td>
<td>996</td>
<td>901</td>
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<td>Capital Use Charge</td>
<td>14,425</td>
<td>14,425</td>
<td>14,425</td>
<td>12,325</td>
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<td><strong>TOTAL PRICE OF OUTPUT</strong></td>
<td>197,946</td>
<td>192,891</td>
<td>197,890</td>
<td>202,878</td>
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<tr>
<td><strong>REVENUE</strong></td>
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<tr>
<td>Appropriations</td>
<td>185,500</td>
<td>179,975</td>
<td>180,096</td>
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<td>Sale of Goods and Services</td>
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<td>12,916</td>
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<td>Miscellaneous - other</td>
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<td>0</td>
<td>66</td>
<td>66</td>
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<tr>
<td><strong>TOTAL REVENUE</strong></td>
<td>197,946</td>
<td>192,891</td>
<td>197,890</td>
<td>197,890</td>
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<td><strong>STAFFING</strong></td>
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<td>Staff Years (actual)</td>
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<tr>
<td>- Funded from Employee Expenses (Appropriation)</td>
<td>1,339.7</td>
<td>1,274.0</td>
<td>1,274.0</td>
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<td>- Funded from Supplier Expenses (Appropriation)</td>
<td>12.0</td>
<td>10.0</td>
<td>19.5</td>
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<tr>
<td>- Funded from Section 31 Receipts (Appropriation)</td>
<td>43.7</td>
<td>45.0</td>
<td>56.2</td>
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<tr>
<td>- Funded from Capitalised Salaries (Asset Replacement)</td>
<td>0.0</td>
<td>66.0</td>
<td>66.0</td>
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<td><strong>TOTAL</strong></td>
<td>1,395.4</td>
<td>1,395.0</td>
<td>1,415.7</td>
<td>1,413.7</td>
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Table 3. Bureau of Meteorology expenses and revenue ($'000) and staff level for 1999-2000 by Major Output and Output Group.

<table>
<thead>
<tr>
<th>Major Output or Output Group</th>
<th>Average Staffing Level</th>
<th>Employee Expenses</th>
<th>Supplier Expenses</th>
<th>Other Expenses</th>
<th>Total Expenses</th>
<th>Appropriations</th>
<th>Other Revenue</th>
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<td>Meteorological and Related Data and Products</td>
<td>771.7</td>
<td>49,521</td>
<td>30,451</td>
<td>47,220</td>
<td>127,192</td>
<td>120,685</td>
<td>2,144</td>
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<td>Output Group 2.1</td>
<td>771.7</td>
<td>49,521</td>
<td>30,451</td>
<td>47,220</td>
<td>127,192</td>
<td>120,685</td>
<td>2,144</td>
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<td>Meteorological and Related Research</td>
<td>80.9</td>
<td>6,193</td>
<td>2,956</td>
<td>1,072</td>
<td>10,220</td>
<td>7,768</td>
<td>2,170</td>
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<td>Output Group 2.2</td>
<td>80.9</td>
<td>6,193</td>
<td>2,956</td>
<td>1,072</td>
<td>10,220</td>
<td>7,768</td>
<td>2,170</td>
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<tr>
<td>Weather Services</td>
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<td>5,002</td>
<td>3,216</td>
<td>35,513</td>
<td>31,421</td>
<td>3,995</td>
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<td>Climate Services</td>
<td>127.2</td>
<td>7,705</td>
<td>1,343</td>
<td>1,522</td>
<td>10,570</td>
<td>9,471</td>
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<td>Consultative Services</td>
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<td>721</td>
<td>10,827</td>
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<td>Hydrological Services</td>
<td>61.5</td>
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<td>874</td>
<td>6,129</td>
<td>5,544</td>
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<td>Output Group 2.3</td>
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<td>International Meteorological Activities</td>
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<td>TOTAL</td>
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