A Proposal for the Establishment of a National Meteorological and Hydrological Service

A Report prepared for the Government of the Republic of Nauru

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Executive Summary

This report has been prepared at the request of the Government of Nauru to provide advice and instruction for the establishment of a National Meteorological and Hydrological Service (NMHS) in this country.

A National Meteorological and Hydrological Service is to be established in Nauru to provide scientific and technical advice to the government and people of Nauru. Nauru is the only independent country or self-governing territory within the membership of the South Pacific Regional Environment Programme (SPREP) not to have an established NMHS.

The need for an NMHS has been recognized both externally (Brook 1991) and internally (Nauru Govt. 1999). In November 1971 the Nauru Government passed an act of parliament, the Air Navigation Act of 1971, which provides the legal framework for the establishment of meteorological service in Nauru. At present the only meteorological activity on Nauru are part of three separate research projects, two sponsored by the US Government, and one by the Australian Government.

Nauru needs an NMHS for three essential reasons: to provide important information for the public safety of all Nauruans, satisfy the requirements for operation of air transport to and from Nauru, and provide useful information for economic development in Nauru. Initially the Nauru NMHS could be funded almost completely through external sources identified in the report. In the future (8-10 years) the Government of Nauru will assume financial responsibility for the NMHS. By this time the NMHS will have become a valuable national asset, and could potentially generate revenue through the sale of information and services. The potential for commercial activity is outlined in an annex to the report.

The Republic of Nauru Air Navigation Act of 1971 specifies that, by law, a meteorological service is necessary for aircraft operations in Nauru. This law was passed by the Nauru Government to ensure Nauru complies with International Civil Aviation Organization (ICAO) regulations concerning international civil aviation. The Air Navigation Act provides an adequate legal framework within which the Government of Nauru may take the steps necessary to establish an NMHS in Nauru.

The NMHS proposed for Nauru in this report will be capable of taking three hourly SYNOP reports, hourly METAR reports, twice-daily upper air soundings and any additional climate observations necessary, disseminating information important to day-to-day meteorological forecasting in real time to the Fiji Meteorological Service for onward transmission to operational forecast centers around the world, archiving relevant information for further use in Nauru into appropriate electronic and paper databases, and distributing locally meteorological information required for the effective management of the various private and public organizations in Nauru.

The proposed Nauru Meteorological Service will function at the most basic level, maintaining an observation programme sufficient for aviation purposes, providing information to Fiji for the preparation of the public weather forecast, and collecting necessary information for climate purposes. A meteorological service of this size and functionality would compare closely with meteorological services in countries of a similar geographical size (Niue) and population (Tuvalu).

Summary of Recommendations

1. General

1.1 It is recommended that the Government of Nauru authorize the Public Service Commission to establish a new government department for the purposes of monitoring the atmosphere and providing information on meteorology and climatology for industry, services and the public in Nauru.

1.2 It is recommended that, in keeping with the practice in the majority of meteorological services in the region and the nomenclature used by the World Meteorological Organization, the new meteorological service be named the Nauru Meteorological Service.

1.3 It is recommended that the Nauru Meteorological Service be established at the present site operated by the ARM project at Denigomodu.

1.3 It is recommended that the new Nauru Meteorological Service be established under the Ministry of Civil Aviation, and report to the Director of Civil Aviation

1.4 It is further recommended that the ministry responsible for civil aviation be provided with the human and financial resources to effectively support and administer this new department.

1.5 It is recommended that Nauru become a member of the World Meteorological Organization (WMO), the specialized United Nations agency responsible for coordinating international cooperation within the atmospheric sciences.

2. Human Resources

2.1 It is recommended that Mr. Nicholas Duburiya be appointed to the position of Officer in Charge of the Nauru Meteorological Service.

2.2 It is recommended that Ms. Janah Tom, Ms. Megan Aliklik, Mr. Henry Harris and Mr. Franklin Teimitsi be appointed as weather observers.

2.3 It is recommended that the Government of Nauru identify and appropriate person to be trained by the Bureau of Meteorology to maintain and repair equipment owned and

operated by the Nauru Meteorological Service. Particular emphasis should be placed on repair and maintenance of PC's, the hydrogen electrolyser, and Automatic Weather Station (AWS) equipment.

2.4 It is recommended that the Officer in Charge be appointed as the Permanent Representative (PR) of Nauru to WMO.

3. Equipment

3.1 It is recommended that the observer inspector from the Fiji Meteorological Service undertake a brief visit to Nauru to confirm that instrument types and locations meet the relevant WMO specifications, and that a copy of these specifications be provided to the OIC and kept on station.

3.2 It is recommended that a reference barometer be procured, and kept at the Denigomodu site, for the purpose of calibration of all operational barometers within Nauru.

3.3 It is recommended that the cost of consumable equipment be clearly identified so that provision in the annual budget for this equipment can be made.

3.4 It is recommended that a low-resolution weather satellite earth station (WEFAX) be installed in Nauru as an add-on to the existing EMWIN system. The QFAX system is recommended, to maintain compatibility with all other meteorological services in the region.

3.5 It is recommended that a basic Automatic Weather Station (AWS) be installed at the eastern end of the runway at the airport. The AWS should be capable of reading dry and wet bulb air temperature, wind speed and direction, and QNH air pressure. The AWS should have a real time display in the flight service office, and telephone dial up access from the Denigomodu site.

1. Introduction

This report has been prepared at the request of the Government of Nauru to provide advice and instruction for the establishment of a National Meteorological and Hydrological Service (NMHS) in this country.

2. Nauru Geography and Environment

Nauru consists of a single raised coral atoll island, located about 40 km south of the equator near longitude 167E. A map of Nauru showing the district boundaries, prominent landmarks and places referred to in this report is shown as Figure 1. The total land area is just 22 square kilometers. Almost all the population, infrastructure and commercial facilities are located on the lower terrace ("Bottom side") within 100 metres of the coast. Most of the interior of the island ("Topside") is uninhabited following extensive phosphate mining. The mining of phosphate began in the late 1800's and continues to this day. It is the primary source of foreign income in Nauru.

While the land area is small, Nauru has a large maritime Exclusive Economic Zone (EEZ) of 320,000 square kilometers. The marine EEZ straddles the equator, and occupies waters which are the subject to intense scrutiny by climate scientists interested in the El Nino phenomenon. Commercial fishing of near-shore and pelagic fish within the EEZ is becoming an important source of income for Nauru.

Since gaining independence in 1968, Nauru has functioned as an independent sovereign nation of the Pacific islands. In 1999 Nauru became a member of the United Nations General Assembly. In addition Nauru is a member of the Commonwealth nations, and a member of the South Pacific Forum.

3. A History of Meteorological Activities in Nauru

3.1: Pre Independence Era

Prior to independence the government of Australia, with assistance from the governments of New Zealand and the United Kingdom, maintained a basic meteorological programme on Nauru under the aegis of the British Phosphate Company (BPC) and supported by the coastal radio station. Daily rainfall records have been kept at the BPC headquarters at Aiwo since June 1915. Rainfall information is important to the phosphate industry, as the phosphate mined on Nauru must be dry prior to export. Drying of the phosphate is a part of the mining process, and how much drying is required depends upon the wetness of the phosphate ore, which in turn is dependent upon rainfall. The Aiwo rainfall record is complete except for the period October 1941 to October 1945.

Meteorological observations were taken each day at the coastal radio station site at Meneng following the Second World War through to the late 1980's. These reports were transmitted to Australia on a regular basis. It is believed that this information is in archive at the Australian Bureau of Meteorology. Observations ceased with the opening of the

new telecommunications center at Yaren in March 1990. The Meneng Coastal Radio Station site has been abandoned, but the meteorological equipment (including a Kew Pattern Barometer) can still be seen at this site.

3.2: Post Independence Era

With independence in 1968 the responsibility of collecting and keeping meteorological information was passed to the Telecom department. A public weather information service was established at the Telecom office utilizing basic weather data collected at the telecom office and information provided by the Australian Bureau of Meteorology (Nauru Govt. 1999) From the early 1980's the Flight Service office of the Nauru Civil Aviation Authority assumed responsibility for weather information. During this period the Marine Department addressed the need for weather information separately for shipping services.

In November 1971 the Nauru Government passed an act of parliament, the Air Navigation Act of 1971, which provides the legal framework for the establishment of a NMHS in Nauru. This act remains in force to this day, and Part V, paragraph 19 of the act reads:

The [Civil Aviation] *Authority shall, subject to regulations made hereunder, establish, maintain and operate the following services and facilities for the safe operation of aircraft in, over and near Nauru.*

(a) an air traffic control service;
(b) a meteorological service;
(c) a search and rescue service
(d) a fire-fighting service; and
(e) such other services and facilities, if any, as the Cabinet may direct.

While no independent meteorological service was formed at the time, air traffic control center staff were trained to take meteorological measurements and transmit these to relevant authorities using the Aeronautical Fixed Telecommunications Network (AFTN). Since the late 1980's the increasing unreliability and subsequent phasing out of the AFTN meant that meteorological programme for aviation in Nauru could no longer be sustained. At present no information is available via the meteorological circuits for the preparation of aerodrome forecasts for Nauru.

During the late 1980's the US National Oceanographic and Atmospheric Administration (NOAA) research laboratory in Boulder Colorado commenced taking meteorological measurements as part of a global climate research project. Equipment to monitor surface and upper air meteorological variables was provided to Nauru. Initially this site was located "Topside" just above the airport terminal. Initially all the information gathered at this site was stored on electronic or magnetic data storage media and sent direct to the US. Little or no information was available locally for operational or research use within Nauru.

In 1991 the Government of Australia established a sea-level and climate monitoring station (known as SEAFRAME) at the main harbour at Aiwo. This equipment is part of a regional project to monitor changes in climate and sea level throughout the Pacific basin. While much of the information gathered is sent direct to Australia by satellite, it is possible to view weather and sea level information locally. Real-time display of information via a PC dedicated for this purpose is a part of each facility. In Nauru this equipment is located at the Nauru Fisheries and Marine Resources Authority at Aiwo. A second real-time display, presently out of service, is located at the Ministry of Island Development and Industry in Yaren.

During the late 1990's the US Department of Energy (USDOE) began a project to monitor cloud and solar radiation in the tropical western pacific. This project is known as the Atmospheric Radiation Measurement (ARM) project. As part of the ARM project a large suite of equipment (Atmospheric Radiation and Cloud Station, Site Two, or ARCS II) was established on Nauru to monitor a large number of meteorological variables. The site, which commenced observations in November 1998, is located on the west coast of the island adjacent to the Nauru hospital at Denigomodu.

The ARCS II equipment includes all the necessary instruments required to start a National Meteorological Service on Nauru. While the vast majority of the data collected at this site is sent to the US for research purposes, considerable effort has been placed on the use of information locally also. Under the auspices of ARM, the USDOE has undertaken a great deal of training and education to help Nauru benefit directly from the information available from the ARCS II site.

While each of these three individual activities relies on separate sources of funding, some effort has been made locally to draw together the benefits of these projects. The NOAA equipment is now located next to the ARCS II site at Denigomodu. The second real-time display from the SEAFRAME site will shortly be located at the ARCS II site. In this way, the embryo of a national meteorological service has been created. The equipment, resources, personnel and training provided by these three separate projects means the formation of a national meteorological service in Nauru is now possible with minimal expense and effort.

4. The Need for a Meteorological Service

Nauru is the only independent country or self-governing territory within the membership of the South Pacific Regional Environment Programme (SPREP not to have an established NMHS. A report prepared on behalf of the Pacific island countries by Australia in 1991 recommended that NMHS's be strengthened as the first and most important step toward countering the then new threat of Climate Change (Brook et al. 1991).

Since 1993 the Government of Nauru has been invited to attend meetings and training programmes aimed at developing meteorological services convened by SPREP, which has the mandate within the Pacific for addressing meteorological and climatological

issues. With the growth in importance of climate change as a national, regional and international issue the need for an NMHS has become greater than ever. The severe drought of 1998-99, the worst recorded in Nauru, which occurred during the International Decade for Natural Disaster Reduction, highlighted the need for weather information for the well being of the population. In a report published in 1999, the Government of Nauru considered the establishment of an NMHS to be a priority activity (Nauru Govt. 1999).

It is recommended that the government of Nauru establish a meteorological service as soon as practicable. Additionally, it is recommended that the new meteorological service be established under the Ministry of Civil Aviation.

In keeping with the practice in the majority of meteorological services in the region and the nomenclature used by the World Meteorological Organization, it is recommended that the new meteorological service be named the Nauru Meteorological Service. This report provides a clear guide to what the role of this service would be, how it would function, and what is required to carry out these functions.

There are three important reasons why Nauru should have a meteorological service. A meteorological service will provide important information for the public safety of all Nauruans, satisfy the requirements for operation of air transport to and from Nauru, and provide useful information for economic development in Nauru. Each of these three arguments is briefly described below.

4.1: Public Safety

The most important task of any meteorological service is to assist the national government to safeguard the life and property of its citizens from the impacts of extreme weather events. Many natural atmospheric phenomena can injure and kill, and damage and destroy private and public property. Flood, lightning, strong winds, and drought are extreme events known to occur in Nauru.

The National Meteorological Service will be expected to provide adequate warning to the public of Nauru whenever such events are expected. Standards for public weather warnings and assistance with agreed nomenclature and units can be obtained from the World Meteorological Organization (WMO). It is strongly recommended that Nauru join WMO once the NMS is operational (See Annex 4).

The important issue of human induced climate change threatens the very existence of all Nauruans. To address the complex environmental, social and economic problems that climate change poses for Nauru, the Pacific region, and indeed the entire world, it is important that climate data for Nauru is accessible, and that local expertise is available to analyze this data and advise the government and people of Nauru. The Meteorological Service will be able to serve this important function.

4.2: Legal and Institutional Issues

The Republic of Nauru Air Navigation Act of 1971 (hereafter referred to as the Act) specifies that, by law, a meteorological service is necessary for aircraft operations in Nauru. This law was passed by the Nauru Government to ensure Nauru complies with International Civil Aviation Organization (ICAO) regulations concerning international civil aviation. The Act specifically requires that the Nauru Civil Aviation Authority establish, maintain and operate a meteorological service. From 1971 to 2001, there has been no meteorological service in operation in Nauru, in clear breach of the Act.

According to ICAO regulations, each international airport must prepare and disseminate METeorological Aerodrome Reports (METAR's) every hour via the Aeronautical Fixed Telecommunications Network (AFTN). A METAR is a message containing information about the horizontal visibility, wind speed and direction, cloud type, cloud height, air pressure and present weather at the aerodrome. The responsibility for preparing and sending METAR's at Nauru is with the Flight Service unit. At present METAR's are not being prepared or disseminated from Nauru. The AFTN link to Nauru is not working, and has not been working for several years.

Under ICAO laws binding upon Nauru, it is a key requirement that a valid weather forecast be prepared for all airports where international flights operate. However WMO regulations specify that a Terminal Area Forecast (TAF) for any particular aerodrome can only be prepared if there are hourly METAR's available. It is for this reason the Fiji Meteorological Service in Nadi will not issue a TAF for Nauru, despite the fact that Nauru falls within the Nadi Flight Information Region (FIR), and therefore under the responsibility of the Fiji Meteorological Service.

In the absence of a TAF from Nadi, Air Nauru has made arrangements with the Papua New Guinea National Weather Service (PNG NWS) to provide a TAF in order to operate within ICAO regulations. This is despite the fact that no METAR's, or indeed any other meteorological information about Nauru, is available to PNGNWS forecasters. Such an arrangement is obviously far from optimum, and the service provided is second-class. In my opinion, and the opinion of flight operations at Air Nauru, that TAF's prepared by PNG NWS are of a poor quality. But most importantly, these arrangements certainly contravene the spirit, and probably the letter, of ICAO regulations. In the event of an accident where the weather was a contributing factor, Air Nauru could be found liable if the meteorological information provided does not meet ICAO law.

4.3: Meteorological Information for Economic Development

A third persuasive argument for the establishment of a meteorological service is the economic value of meteorological information. In many cases meteorological information can enhance business performance and profitability. Increasing profit and reducing costs in business means greater wealth, and hence better living standards, for all Nauruans.

As an example, consider the operations of the Victor Eoaeo II, the long-line fishing vessel operated by the Nauru Fisheries and Marine Resources Authority. For each fishing voyage the vessel requires fuel and oil for the motors, food for the crew, and ice and bait

for the fish. In addition, for each voyage there is salary costs for the crew, and depreciation in the value of the vessel and it's equipment. It is expected that each voyage the net value of the fish will exceed these costs, thus making this a profitable and hence sustainable business.

For each voyage where poor weather means the catch is reduced, or possibly even non-existent, the costs are still incurred. However it is possible, with accurate weather forecasts, to cancel voyages when the weather is forecast to be bad. In this way running costs can be reduced.

Additionally, good information about winds, and hence currents, can be used by experienced fishermen to find the best fishing grounds. In this way, weather information can also increase revenue by increasing the yield of each voyage. Meteorological information is important for the fishing industry.

There are many examples where weather information can help reduce costs and increase yields. With more accurate and reliable weather forecasts Air Nauru can reduce fuel costs. Climate information provided by the meteorological service is important to the Nauru Phosphate Corporation for the drying of phosphate prior to shipping, and the operation of the desalination plant.

5. Requirements of the Meteorological Service

The new meteorological service will be able to provide the following services to the Nauru government and the international community:

- Take three hourly SYNOP reports, hourly METAR reports, twice-daily upper air soundings and any additional climate observations necessary.

- Disseminate information important to day-to-day meteorological forecasting in real time to the Fiji Meteorological Service for onward transmission to operational forecast centers around the world.

- Archive relevant information for further use in Nauru into appropriate electronic and paper databases.

- Distribute locally meteorological information required for the effective management of the various private and public organizations in Nauru

In order to achieve these objectives, the following essential ingredients are required to establish, maintain and operate a meteorological service in Nauru:

- A trained and skilled team of staff to undertake the tasks required, including a on-going training programme to meet the expected growth of the organization;

- ❖ Equipment with which the staff can carry out their required tasks, and the human and financial resources to maintain and repair this equipment; and

- ❖ A legal and institutional framework within which to operate.

Through the assistance of the Governments of Australia and the United States, Nauru is fortunate that the first two of the above requirements are, for the most part, already available. This means that it is possible to avoid most of the time consuming and costly work necessary to build a meteorological service from scratch.

It is important that the government of Nauru is committed to providing the necessary on-going support for the meteorological service to ensure its long-term success. Initially there will be costs associated with salary for staff, consumable items, and equipment maintenance and repair. There is scope in the medium to long term for income generation within the service through the sale of information and/or services to the private sector.

The third ingredient is where the Nauru Government establishes the service required under the Act of 1971. A new government department will have to be established which, in keeping with the Act, will come under the Ministry of Civil Aviation. Arrangements for this can be made through the normal Public Service Commission process.

5.1: Staff Resources

Nauru has been fortunate to benefit from training and skill development programmes through several regional projects including the SPREP PICCAP project, the USDOE ARM project and the Australian SEAFRAME project. More recently, training for meteorological observers was provided by the Fiji Meteorological Service through financial assistance from WMO. There are presently sufficient skilled people in Nauru to begin a basic meteorological service.

To operate a basic meteorological service capable of performing the duties outlined above, the following positions will be required:

Officer in Charge: This person will be responsible for the day-to-day running of the department, and will report to the Director of the Civil Aviation Authority. The job description for the OIC position is contained in Annex A, while the duties are defined in Annex B. This person should initially be filled by someone with qualifications and experience equivalent to WMO class III level. In the future this position could be upgraded to WMO class II or even WMO class I level.

Weather Observers: Four weather observer positions are required. With four people it is possible to operate a roster sufficient for 20 hours coverage seven days a week 52 weeks a year. All weather observers should be trained to WMO class IV level. The job description for the weather observer position is contained in Annex A. The work schedule and duties are shown in Annex B.

With these 5 staff the Nauru Meteorological Service could function at the most basic level, maintaining an observation programme sufficient for aviation purposes, providing information to Fiji for the preparation of the public weather forecast, and collecting necessary information for climate purposes. A meteorological service of this size and functionality would compare closely with meteorological services in countries of a similar geographical size (Niue) and population (Tuvalu).

It is recommended that Mr. Nicholas Duburiya be appointed to the position of Officer in Charge. While Mr. Duburiya has not completed the WMO Class III course, he has sufficient experience and training in the ARM project to undertake this responsibility. Ms. Janah Tom, Ms. Megan Aliklik, Mr. Henry Harris and Mr. Franklin Teimitsi will initially fill the positions of weather observers. Ms. Aliklik to WMO Class IV level, while the other three weather observers have completed a three-week intensive course in weather observations conducted by Mr. John Vaivao of the Fiji Meteorological Service.

Support services necessary for the successful functioning of the meteorological service will be required. Assistance with equipment maintenance, and computer support is available through the ARM project. The Australian Bureau of Meteorology has been contracted to provide routine maintenance and repair support for the ARM project for the duration of this project.

At some point in the future however Nauru will have to undertake this responsibility. It is recommended that the Government of Nauru identify and appropriate person to be trained by the Bureau of Meteorology to maintain and repair equipment that will remain with the NMS once the ARM project is completed. Particular emphasis should be placed on repair and maintenance of PC's the hydrogen electrolyser, and the Automatic Weather Station (AWS) equipment.

5.2: Equipment

5.2.1: Denigomodu Site

Under the aegis of the ARM project a suite of sophisticated meteorological equipment has been installed at Denigomodu. Most of the basic instruments required for observation of weather at the surface have been installed at this site. This includes a Stevenson screen with dry bulb, wet bulb and max-min thermometers, an anemometer with analogue and digital read-out, a barometer, and a five-inch diameter rain gauge.

The instrument enclosure is adequately grassed and large enough to ensure good exposure for temperature measurements. The thermometer screen has been set onto a concrete base; it should be located directly above the ground. The anemometer has at the correct height although the cliffs located about 150 metres east of the site mean wind speed and direction measurements for wind from the easterly quadrant will be affected. A modern digital barometer is used to measure air pressure,

The equipment in place at Denigomodu complies with WMO specifications for instrument type and purpose. However it is recommended that the observer inspector from Fiji undertake a brief visit to confirm that this is indeed the case. A copy of the relevant WMO specifications should be provided to the OIC and kept on station.

There is no reference barometer with which to calibrate the operational barometers in use at Denigomodu and the Airport. It is recommended that a reference barometer be procured, and kept at the Denigomodu site, for the purpose of calibration within Nauru.

Under the ARM project all the necessary consumable items required by a meteorological service including radiosondes, balloons, hydrogen/helium, paper charts, printer cartridges and ribbons, and stationery are provided by the US government. At some point in the future the government of Nauru will have to assume these costs. It is recommended that the cost of this equipment be clearly identified well before responsibility is passed to the Nauru government so that provision in the annual budget for this equipment can be made.

The Emergency Managers Weather Information Network (EMWIN) system presently in use at Denigomodu provides valuable information for use by staff presently working there. EMWIN is an inward broadcast by satellite that provides forecast and warning information, weather maps, and satellite pictures of cloud over the Pacific region. However it will be necessary to upgrade the cloud satellite imagery by installing a low-resolution receiving system (WEFAX). The system used throughout the region is known as QFAX. It is possible to install QFAX as a simple add-on to the existing EMWIN system for approximately $A1,000. It is recommended that funds be located to complete this upgrade as soon as possible.

An upper air programme comprising two flights per day using GPS radiosondes and PC CORA receiving system is currently operating. The information from the balloon flights is presently used for research purposes only by the ARM project and NOAA. ARM project. Once established the meteorological service will be responsible for ensuring the upper air information is sent to Nadi for onward distribution to operational forecast centers. A small hydrogen generator of the electrolyser type is used. A supply of helium kept for use when the hydrogen generator is not operational.

5.2.2: Nauru Airport, Yaren

Flight Service staff at the airport have access to measure wind speed and direction, air temperature relative humidity, and air pressure. There is no instrument screen for the thermometers, and the display for wind speed and direction does not meet WMO standards. As has been mentioned, METAR reports are not sent from Nauru. The instruments at the airport are used only whenever an aircraft is taking off or landing.

To ensure that accurate weather information is available at the airport at all times, it is recommended that a basic Automatic Weather Station (AWS) be installed at the eastern end of the runway at the airport. The AWS should be capable of reading dry and wet bulb

air temperature, wind speed and direction, and QNH air pressure. The AWS should have a real time display in the flight service office, and telephone dial up access from the Denigomodu site. The weather observer would then use temperature, wind and pressure (QNH) information from the AWS at Yaren, and cloud, visibility and present weather information at Denigomodu, to compile hourly METAR messages for dissemination to Fiji.

5.2.3: Communications

Communication of meteorological information collected in Nauru to those who require this information in real time is possible using established communications systems. It is recommended that standard email services used in Nauru be the primary method of distributing surface and upper air information to the regional and international meteorological community. Information can be sent to the Fiji Meteorological Service in Nadi by email where the messages are automatically switched to Melbourne and onward to anyone requiring this information.

Email is a reliable and inexpensive means of communication, and is used for meteorological purposes in Niue, Tuvalu, Kiribati, Tonga, Samoa, and the Cook Islands. Alternate means of communication are fax and telephone. Using the existing systems means that it is not necessary to operate additional communication networks solely for this purpose, particularly as the volume of messages likely to be sent does not warrant such a system.

5.3: Legal and Institutional Arrangements

To establish a meteorological service in Nauru will require the government to agree to the establishment of the positions required. At present the 1971 Air Navigation Act provides sufficient legislative basis for the establishment of these positions. It is recommended that the Government of Nauru authorize the Public Service Commission to establish a new government department to be known as the Nauru Meteorological Service, and create the positions required. It will be necessary to complete this task before any of the additional recommendations contained in this report can be addressed.

In view of the importance of the Act in the establishment of this new department, it is recommended that the Nauru Meteorological Service be incorporated in the cabinet ministry responsible for civil aviation matters. It is further recommended that the ministry responsible for civil aviation be provided with the human and financial resources to effectively administer this new department.

It is strongly recommended that Nauru join the World Meteorological Organization (WMO). Meteorology is a truly global science, and the atmosphere does not recognize political boundaries. Membership of WMO is essential to ensure that Nauru benefits from the international programmes aimed at advancing scientific knowledge of the atmosphere and improving national, regional and international development through the use of weather information. A detailed step-by-step guide to joining WMO is included in this

report as Annex D. In the event that Nauru does join WMO at some time in the future, it is recommended that the Officer in Charge be appointed as the Permanent Representative (PR) of Nauru to WMO.

6. Functions of the Meteorological Service

The meteorological service will be located at the present site operated by ARM at Denigomodu. The existing facilities and infrastructure will be sufficient for the commencement of the meteorological service, however additional buildings will be required sometime in the near future. The

7. Summary

A meteorological service such as that proposed will provide a valuable and necessary service for the people of Nauru. Apart from helping to safeguard the life and property of all Nauruans from extreme weather events, and ensuring the efficient and safe operation of air services in Nauru, it will provide information important for the social and economic development of Nauru.

The recommendations proposed can be acted upon immediately, and the Government of Nauru is strongly encouraged to make every effort to ensure the meteorological service could be operational before the end of 2001. It is recommended that the Government of Nauru nominate a suitable person to attend the SPREP Regional Meeting of Meteorological Service Directors to be held in Vanuatu in September 2001.

With the establishment of a new meteorological service, it will be necessary to incorporate the future growth and development of the meteorological service within the current and future long-term plans for Nauru. A forward plan outlining the possible future development of the meteorological service through to the end of the current decade is attached as Annex E.

An indicative budget for the Nauru Meteorological Service for 2002 is included as Annex F. This budget has been prepared based on assumptions regarding salary levels and use of consumable items.

The successful completion of the recommendations enclosed will provide Nauru with a basic but effective meteorological service capable of meeting the essential needs of the nation. The observational programme that will commence will be important for the region. In view of the importance of global computer forecast models, and given the sparse network of observing sites in the Pacific ocean region, the surface and upper atmosphere weather observations from Nauru will be of value to the entire global community. The Nauru Meteorological Service will be a source of pride for Nauru and a valuable national asset.

Annex A1: Job Description: Officer in Charge

POSITION DESCRIPTION

Position Title: Officer in Charge

Reports to: Director of Civil Aviation

Current Incumbent: _____

Primary Purpose of the Position:

To provide the necessary technical and administrative skills to manage the efficient running of the Nauru Meteorological Service.

To prepare and disseminate valuable weather observations and information acquired at the Nauru Meteorological Service in accordance in accordance with the objectives of the World Weather Watch Programme of the World Meteorological Organization.

To prepare and disseminate valuable weather observations and information acquired at the Nauru Meteorological Service in accordance in accordance with the objectives of the US Department of Energy (USDOE) Atmospheric Radiation Measurement programme.

To adhere to the standards, regulations and procedures for collecting weather information as defined by WMO, USDOE and the International Civil Aviation Organization (ICAO).

To monitor the use and maintenance of instruments used for the collection of weather information, and ensure the equipment is operational at all times.

To respond to the needs of the government and public of Nauru by providing timely and accurate reports of relevant weather information as required.

At the discretion of the Director of Civil Aviation, serve as Permanent Representative of Nauru to the World Meteorological organization.

To perform any additional duties as required by the Director of Civil Aviation from time to time.

Role of the Position:

The Officer in Charge is responsible for the day-to-day management of the Nauru Meteorological Service. The information collected by the meteorological service is of critical importance nationally, regionally, and internationally. To ensure accurate and

useful forecasts the information collected by the meteorological service must be of a consistently high quality.

This position is requires a high level of scientific and technical skills along with good management and administrative skills. The incumbent must be capable of dealing with senior level officials, and replying to instructions from upper levels of government in a timely manner and in a way consistent with the broader functions of the Nauru government.

Authority Levels

The Officer in Charge is responsible for the welfare and safety of four subordinate officers. The OIC is responsible for ensuring the work place is maintained to appropriate health and safety standards, and that all work is carried out in accordance within all relevant technical and administrative regulations.

Within the scope of relevant Public Service regulations, the OIC is able to direct, instruct, and authorize staff to perform their tasks as required. He will also ensure that subordinate staff comply with Public Service regulations and guidelines, and will advise the Director of Civil Aviation of breaches to the said regulations as appropriate. Where necessary, with the consent of the Director of Civil Aviation, he will write to inform subordinates of disciplinary action arising from any breach of these regulations.

Reporting

The Officer in Charge reports directly to the Director of Civil Aviation. The reports provided will include, *inter alia*, quarterly reports of the status of the meteorological service, an annual report to be included in that of the Ministry, and annual reports of staff performance as per public service guidelines.

Knowledge/Experience/Skills

The weather observer should:

i.) Have a high degree of knowledge of WMO and ICAO weather reporting regulations, practices and procedures and ARM procedures and requirements.

ii.) Possess the scientific administrative and supervisory skills required to perform the tasks required.

iii.) Possess the required literacy and computer skills necessary to undertake all of the tasks required.

iv.) Be capable of performing consistently high quality work with minimal supervision.

Minimum Qualification Requirement

A pass in Form 6 or Form 7 in mathematics and physics at the Nauru High School or similar institution and a minimum of five years experience as a weather observer with the Nauru Meteorological Service.

Annex A2: Position Description: Weather Observers

POSITION DESCRIPTION

Position Title: Weather Observer

Reports to: Officer in Charge

Current Incumbent: _____

Primary Purpose of the Position:

To prepare and disseminate valuable weather observations and information acquired at the Nauru Meteorological Service in accordance in accordance with the objectives of the World Weather Watch Programme of the World Meteorological Organization.

To prepare and disseminate valuable weather observations and information acquired at the Nauru Meteorological Service in accordance in accordance with the objectives of the US Department of Energy (USDOE) Atmospheric Radiation Measurement programme.

To adhere to the standards, regulations and procedures for collecting weather information as defined by WMO, USDOE and the International Civil Aviation Organization (ICAO).

To prepare balloon trains for the upper air soundings, and release and monitor the balloon train as required.

To monitor and maintain instruments used for the collection of weather information, and advise the Officer in Charge (OIC) of faults and/or malfunctions in equipment.

To mow and clear the instrument enclosure of long grass on a regular and timely basis.

To assist the OIC as directed from time to time.

Role of the Position:

The weather observer provides the necessary technical skills to collect and disseminate weather information. The information collected by the weather observer is of critical importance for meteorological forecasting nationally, regionally, and internationally. To ensure accurate and useful forecasts the information collected by the weather observer must be of a consistently high quality.

This position is demanding and challenging, requiring dedication to the task. As the job of gathering information must continue day and night, shift work is required. There are opportunities for further training, which could lead to further promotion.

Authority Levels

There are no subordinates to this position, and as such there is no authority over other staff. However, outside normal working hours the weather observer is responsible for the security and continued operation of the meteorological service, usually without any additional support. This requires a mature and responsible person who is dedicated to the task and capable of adhering to established rules and procedures.

Reporting

The weather observer reports directly to the Officer in Charge. Outside of normal hours when the OIC is not on duty, the weather observer will use his/her discretion to contact the OIC at home during emergencies or matters requiring urgent attention.

Knowledge/Experience/Skills

The weather observer should:

i.) Have a good working knowledge of WMO and ICAO weather reporting regulations, practices and procedures.

ii.) Have a very good working knowledge of ARM procedures and requirements.

iii.) Possess the required literacy and computer skills necessary to undertake all of the tasks required of them.

iv.) Be capable of performing consistently high quality work, often unsupervised, in a shift work environment.

Minimum Qualification Requirement

A pass in Form 6 or Form 7 in mathematics and physics at the Nauru High School or similar institution. Or experience in a related field for a minimum of 3 years with demonstrated ability to conduct the tasks required.

Annex B: Staffing Requirements

Four Weather Observer positions are required, as per the roster shown below. The Officer in Charge will provide leave relief when staff are on leave or engaged in training.

Weather Observers Roster:

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
Pers.1	A	A	B	B	C	C	Off	Off	A	A	B	B	C	C
Pers.2	Off	Off	A	A	B	B	C	C	Off	Off	A	A	B	B
Pers.3	C	C	Off	Off	A	A	B	B	C	C	Off	Off	A	A
Pers.4	B	B	C	C	Off	Off	A	A	B	B	C	C	Off	Off

Shift A: 0530 – 1300 (30 minutes meal break, total shift time 7 hours)
Shift B: 1000 – 1800 (60 minutes meal break, total shift time 7 hours)
Shift C: 1730 – 0100 (30 minutes meal break, total shift time 7 hours)

Duties Shift A:

1. Collect and disseminate METAR messages from 1800UT – 2200UT inclusive.
2. Collect and disseminate SYNOP messages at 1800UT and 2100UT.
3. Collect climate data (max and min temps., soil temps., 24 hour rainfall, sunshine) at 0900 local time (2100UT)
4. Conduct 0000UT upper air sounding, balloon release at 2330UT.

Duties Shift B:

1. Answer public enquiries as required.
2. Collect and disseminate METAR messages from 2300UT to 0500UT inclusive
3. Collect and disseminate SYNOP messages at 0000UT and 0300UT.
4. Routine maintenance and yard work as required (mow lawns, clean instruments, check hydrogen electrolyser, etc.)
5. Assist OIC with data acquisition and archive for ARM project.

Duties Shift C:

1. Collect and disseminate METAR messages from 0600UT – 2200UT inclusive.
2. Collect and disseminate SYNOP messages at 0600UT and 0900UT.
3. Conduct 1200UT upper air sounding, balloon release at 1130UT.

Duties Officer in Charge:

1. Perform duties for ARM project as required.
2. Supervise weather observers to ensure that their work is as required.
3. Report to the Director of Civil Aviation on matters relevant to the meteorological service.
4. Serve as the Permanent Representative of Nauru to WMO.

Annex C: List of people visited in Nauru

Discussions regarding the establishment of a meteorological service in Nauru were conducted with the following people during the period 27-29 June 2001 in Nauru:

NAURU GOVERNMENT

Mr. Joseph Cain,	Secretary, Ministry of Industry and Economic Development
Mr. Tyrone Deiye,	Director of Projects, Department of Economic Development
Mr. Michael Dekarube,	Director, Nauru Television
Mr. Peter Jacob,	Acting CEO, Nauru Fisheries and Marine Resources Authority
Mr. Jim Robinson,	Science Curriculum Supervisor, Nauru High School
Mrs. Ruby Willis,	Secretary, Ministry of Education

AIR NAURU

Mr. Michael Aroi,	Acting CEO, Air Nauru
Mr. Gordon Breitag,	Acting Flight Operations Manager, Air Nauru

NAURU PHOSPHATE CORPORATION

Capt. Sekove Cama,	Harbour Master
Mr. Frank Davey,	Analytic Chemist, Nauru Phosphate Corporation
Mr. J. Lesi Olsson,	Personnel Manager, Nauru Phosphate Corporation

US DOE ARM PROJECT

Mr. Nicholas Duburiya,	Officer in Charge
Mr. Andrew Kaierua,	Administration Manager

Annex D: Membership of World Meteorological Organization

The World Meteorological Organization is a specialized agency of the United Nations, and is responsible for coordinating international programmes aimed at the development of the science of meteorology in its member countries. Over 180 countries are members of WMO, including 11 Pacific island countries and territories (Papua New Guinea, Solomon Islands, Vanuatu, Fiji, Tonga, Cook Islands, Samoa, Niue, New Caledonia, French Polynesia, and the Federated States of Micronesia).

The WMO was established in 1950, replacing the International Meteorological Organization (IMO), which was one of the first international scientific bodies formed in the early 1880's. The Government of the United States of America is the repository for the treaty establishing the WMO. The WMO secretariat is located in Geneva and the current Secretary General is Professor G.O.P. Obasi from Nigeria. The supreme body of the WMO is the World Meteorological Congress, which is held every four years. The next session, the 14th, is scheduled for 2003. All member countries are represented at the Congress, which elects office bearers, agrees on technical and scientific programmes for the next four years, and endorses the various long-term plans.

The President of the WMO Executive Council, the body responsible for managing WMO affairs between sessions of Congress, is Dr. John Zillman, Director of the Australian Bureau of Meteorology. Dr. Zillman has been very active in promoting the interests of the Pacific island members during his term as President, during which time WMO established a sub-regional office for the Pacific in Apia, Samoa. Mr. Rajendra Prasad, the Director of the Fiji Meteorological Service, is also a member of the Executive Council, which comprises 36 people elected based on their personal qualifications.

WMO divides the world into six Regional Associations, of which Nauru is located in Regional Association Five (RA-V) called the South-West Pacific. As well as the island countries and territories of Oceania mentioned above, RA-V also includes Australia, New Zealand, Indonesia, Malaysia, Singapore and the Philippines. The full details of WMO and its scientific and technical programmes can be found at the WMO web site **www.wmo.ch**.

The benefits which Nauru would enjoy if it became a member of WMO include:

- Access to scientific and technical publications prepared by WMO.
- Opportunities for training and fellowships through the WMO Training Programme.
- Financial and technical assistance for equipment through the Voluntary Cooperation Programme.
- Participation in the scientific and technical committees, such as the Tropical Cyclone Committee for the South-West Pacific.

As Nauru is now a member of the United Nations General Assembly, it is simple and straightforward process for Nauru to join WMO. For assistance with application for membership you can write to:

Mr. Eisa H. AL-MAJED
Regional Director for Asia and the South-West Pacific
World Meteorological Organization
7 bis, Avenue de la Paix
Case Postale 2300
CH 1211 Geneva 2
Switzerland

Tel: (+ 41 22) 730 85 10
Fax: (+41 22) 730 81 18

The steps involved are described below:

1. The Minister for Foreign affairs in Nauru writes a letter to the Secretary of State of the Government of the United States of America, stating that Nauru wishes to accede to the Convention Establishing WMO. A copy of this letter should be sent to the Secretary General of WMO as a courtesy.

2. The United States government will advise all member countries that Nauru wishes to join, and if there are no objections from members, they will then send a letter of reply to Nauru confirming their accession to the treaty.

3. The United States Government will write to the Secretary General of WMO to advise him that Nauru has been accepted as a Party the Convention Establishing WMO.

4. The Secretary General will write to the Minister of Foreign Affairs in Nauru to welcome them as a new member. He will advise the Nauru Government of their contribution to the core budget, and request them to nominate a Permanent Representative (PR) to WMO. The PR will become the focal point for all correspondence between WMO and Nauru.

5. The Government of Nauru will reply with a nomination for PR, and in due course send its membership dues to WMO.

The annual membership for Nauru will be assessed in a similar manner to that for assessing membership to the UN General Assembly, taking into account its size, GDP and other such factors. At present the annual fee for membership is SFR15,000 per annum. Membership fees are re-assessed at each session of the World Meteorological Congress.

Annex E: Forward Plan 2002 - 2006

Forward Plan for the Development of the Nauru Meteorological Service

The framework of a 5 year Forward Plan shown hereunder is based on the assumption that the Nauru Meteorological Service is established by 31 December 2001 in accordance with the recommendations enclosed in this report. The detail required for a comprehensive long-term plan will require further input from national government agencies, businesses, and the public.

By 1 January 2002 the Nauru Meteorological Service will be established. In addition to duties under the ARM project, the meteorological service will provide basic meteorological observations for regional distribution to forecast centers, collect climate data for local archival, and disseminate information to the public, and marine and aviation services, for the protection of life and property.

2002 – 2006

During the period 2002-2006 the primary objective of the Nauru Meteorological Service will be to establish and consolidate its position as the authoritative national centre for meteorological information and advice in Nauru. To achieve this objective, it will be necessary to ensure the following tasks are completed by 31 December 2006:

i.) Membership of Nauru Meteorological Service with WMO finalized. This is an important task, as the technical and financial assistance of WMO will be valuable in attaining the remaining tasks.

ii.) All weather observer staff completed minimum WMO Class IV training. This training is available through the Fiji Meteorological Service in Nadi, Fiji.

iii.) Officer in Charge completed WMO Class III training. This training is available in Australia or New Zealand, who may assist with sponsorship for this training.

iv.) Identify Form 7 graduate to commence B.Sc. course for future training to WMO Class I level (Meteorologist). A student completing Form 7 with appropriate subjects in 2001 could commence a B.Sc. course in 2002, and complete the course by 2005. By 2006 this person would be suitable for WMO Class 1 training in Australia or New Zealand.

v.) Commence issuance of regular (twice daily) weather bulletins for the public based on information provided by the Fiji Meteorological Service and other regional meteorological services.

vi.) When requested, provide advice, information and climatological data to the government concerning climate change and its impacts on the social, economic and environmental sectors in Nauru.

The

BUDGET FOR THE NAURU METEOROLOGICAL SERVICE 2002			
Expenditure	**Purpose**	**Budget**	**Source**
Salaries	Staff salaries for NMS employees		ARM / Govt. of Nauru
Communication Expenses	Domestic and international communications for the collection and dissemination of meteorological information		ARM / Govt. of Nauru
Consumable Items	Radiosondes, balloons, gas for radiosondes, stationery, charts, printer ribbons, printer paper, etc.		ARM
Transport	Fuel, maintenance and repairs necessary for the department vehicle.		ARM
Maintenance	Maintenance and repairs of buildings, instrument enclosure and stands, instruments, garden equipment, and		ARM
Capital Works	New buildings and infrastructure.		Govt. of Nauru