Federated States of Micronesia

Department of Transportation,
Communication and Infrastructure

Yap International Airport

FINAL Master Plan

JUNE 2012

YAP

LEO A DALY
PLANNING ARCHITECTURE ENGINEERING INTERIORS

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Acronyms

AC	Advisory Circulars
AFIS	Aeronautical/Aerodrome Flight Information Service
ACIP	Airport Capital Improvement Program
AGL	Above Ground Level
AIP	Airport Improvement Program
ALP	Airport Layout Plan
AMP	Airport Master Plan
AOA	Air Operations Area
ARC	Airport Reference Code
ARFF	Aircraft Rescue and Fire Fighting
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
CTAF	Common Traffic Advisory Frequency
DME	Distance Measuring Equipment
DPWT	Division of the State Department of Public Works and Transportation
DTWL	Dual Tandem Wheel Loading
DWL	Double Wheel Loading
EA	Environmental Assessment
EPA	Environmental Protection Agency
FAA	United States Federal Aviation Administration
FAR	Federal Aviation Regulations
FSM	Federated States of Micronesia
GSE	Ground Service Equipment
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rule
MIRL	Medium Intensity Runway Lights
MSL	Mean Sea Level
MTOW	Maximum Takeoff Design Weight
NAVAIDS	Navigational Aids
NDB	Non-directional Beacon
NOAA	National Oceanic and Atmospheric Association
NPIAS	National Plan of Integrated Airport Systems
OFA	Object Free Area
OSHA	Occupational Safety and Health Administration
PAPI	Precision Approach Path Indicator
PCC	Portland Cement Concrete
PMA	Pacific Missionary Aviation
PSC	Public Service Corporation
PVC	Poor Visibility and Ceiling
REILs	Runway End Identifier Lights
ROM	Rough Order of Magnitude
RPZ	Runway Protection Zone
RSA	Runway Safety Area
SWL	Single Wheel Loading
TSA	Transportation Security Administration (US Dept. of Homeland Security)
USDA	United States Department of Agriculture
USPS	United States Postal Service
VASI	Visual Approach Slope Indicator
VFR	Visual Flight Rule
VISAIDS	Visual Aids
VOR	Omnidirectional Range
WFO	Weather Forecast Office
YAP	Yap International Airport
YSPSC	Yap State Public Service Corporation

CHAPTER 1: INTRODUCTION

1.1 PURPOSE OF THE MASTER PLAN

The Federated States of Micronesia (FSM) retained LEO A DALY to develop the Yap International Airport Master Plan and to identify potential and evaluate necessary improvements to the existing airfield and terminal facilities. These facility improvements are in response to the projected growth of tourism affecting Yap and future associated growth in aviation activities.

The Master Plan establishes a developmental approach to respond to current conditions and includes appropriate conceptual plans to assist the Federated States of Micronesia (FSM) with implementing technically sound programs for the short and long term development of Yap International Airport. Principal concerns are to:

- Enhance the safety of aircraft operations
- Be reflective of community and regional goals, needs, and policies
- Ensure that future development is environmentally compatible
- Prioritize development and improvements that are consistent with the master plan
- Develop a plan that is responsive to air transportation needs and expectations
- Develop an orderly plan for use of the airport
- Coordinate this master plan with local, regional, state, and federal agencies objectives
- Develop active and productive public involvement throughout the planning process.

1.2 SCOPE OF THE MASTER PLAN

The airport master plan can be thought of as a flight map into the future. The FAA methodology is followed for the core elements of the master plan, as this has been a reliable method to identify existing and forecasted conditions and aids in identifying the various facility upgrades that will be needed to address the specific needs of the airport. In addition to a flight map, the master plan can be used successfully as a funding document. In other words, funding agencies, whether they are government, commercial, or private, typically require that the projects are evaluated and approved by an official, responsible authority. Thus, the master plan that is approved by the FAA can additionally serve the airport by providing formal justification to various funding agencies and facilitate the securing of funding for the important capital improvements recommended in the planning document.

1.3 SCOPE OF PROJECT WORK

The following tasks represent the core elements of the master plan. These are the typical elements called for in all FAA funded master plans and master plan updates.

1.3.1 Existing Conditions/Inventory

Collect and assess all relevant information, historical and current, to evaluate existing facilities and equipment and to form the factual baseline for an informed judgment about the airport and its environment.

1.3.2 Aviation Forecasts

Utilize the most current information available to develop a reasonable aviation forecast for a 20 year planning horizon with five and ten year milestones. Basis of forecasts will be customized to reflect the unique nature of Yap's projected growth rather than the population/business growth model applied to mainland US airports. FAA approval for this unique modeling/forecasting effort will be obtained.

1.3.3 Airport Operations

Aviation forecasts for Yap will consider numerous factors and will ultimately be expressed in passenger counts, Cargo volumes and aircraft operations that impact the airport. Once the forecasting methodology and anticipated rates of growth have been reviewed and approved by the Federated States of Micronesia and FAA, this data is converted into peak hour demand in order that FAA formulae can be used accurately for the purpose of determining capacity of airside, landside and terminal facilities. Converting forecast data into peak hour operations involves estimates of airline aircraft mix - both current and future. Discussions will be held with the various airlines to best estimate their future aircraft mix.

1.3.4 Demand/Capacity Analysis

This analysis is a key element of the master plan process. Essentially, existing and anticipated levels of activity (demand) will be assessed to determine the facility's ability to handle the demand (capacity). Three separate analyses will be done:

- Airside demand/capacity
- Landside/access demand/capacity

- Terminal facility demand/capacity

These analyses are useful tools that give an indication of which facilities will need upgrading to serve the projected level of activity, and when those facilities need to come on line.

FAA has mathematical models and formulae to guide the efforts for airside capacity and terminal capacity. The landside demand/capacity analysis is less well defined, but this will be supplemented with accepted standards for roadway/access capacity to provide an accurate overall picture of the airport's present and future needs.

1.3.5 Land Use Planning

Review of present airport land use, identification of airport property, and alternate development schemes for aviation related developments on and near airport property will be incorporated within this task. Conducting "think-tank" sessions with airport officials and stakeholders will be encouraged to maximize community participation and help to get the best conceptual ideas going forward.

1.3.6 Utilities

Existing utilities serving the airport will be inventoried and an overall utility plan will be developed for planning purposes. Fuel farms and fuel distribution networks to apron areas will also be included in this effort. Needs for future upgrades will be identified for all appropriate utilities.

1.3.7 Environmental

For the various land use ideas and for various facility upgrades, environmental impacts will be discussed and rough mitigation guidelines provided to ensure development is implemented in an environmentally responsible manner.

1.3.8 Capital Improvement Program/Facilities Requirement Plan

A Facilities Requirement Plan will be developed to provide a comprehensive implementation plan over the twenty-year planning horizon with five and ten years milestones. This plan will identify the recommended capital improvements and when they are anticipated. Rough Order of Magnitude (ROM) budget estimates will be provided for each capital improvement project.

1.3.9 Airport Layout Plan Drawing Set

The Airport Layout Plan (ALP) will be updated to illustrate existing and future developments. The new FAA criteria for ALPs will be followed and will include the various airspace drawings required per the FAA advisory circulars.

1.4 FEDERAL AND LOCAL APPROVAL

The preparation of this master plan is based upon guidelines established by the U.S. Department of Transportation, FAA Advisory Circular AC 150/5070, Airport Master Plans. Preparation of airport layout plans and identification of significant planning data are based on FAA Advisory Circular AC150/5360-9, Planning and Design of Airport Terminal Facilities at Non-hub Locations.

The work for this Master Plan is supported by AIP Grant Project No. 3-64-0000-01 and is sponsored by the Federated States of Micronesia in accordance with the terms and conditions of a Grant Agreement under the Airport and Airway Improvement Act as amended by the Airport and Airways Safety Expansion Act of 1987, and the regulations of the FAA.

CHAPTER 2: EXISTING CONDITIONS

2.1 GENERAL BACKGROUND

This planning project is for Yap International Airport (YAP). The airport is situated on the Island of Yap, which is the largest island in the State of Yap, Federated States of Micronesia.

Yap State is the western-most of the four states which comprise the Federated States of Micronesia (FSM). It is located in the North Pacific Ocean 370 miles (590 km) north of the equator located west of Guam. The FSM is a sovereign nation in free association with the United States. Its geographic coordinates are approximately 5 degrees north latitude and 163 degrees east longitude. With an area of 45.6 square miles, Yap is the second smallest state in the FSM (after Kosrae). Yap state is made up of 4 large islands, 7 small islands, and 134 atolls.

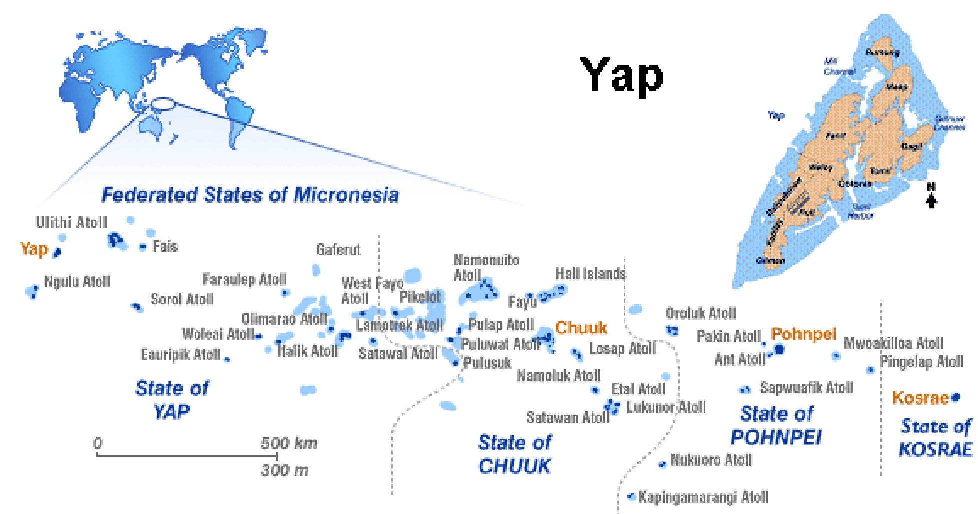


Figure 2-1. Map of the Federated States of Micronesia

Yap is famous for its ancient stone money. The large disc-shaped stones were brought to Yap by canoe from various other islands in the Micronesian region. Although they are no longer used as monetary forms today, they are still exchanged for traditional or ceremonial events. Yap has excellent diving conditions, and its waters are home to giant manta rays. The manta rays reside around Yap Island year-round, which gives tourists ample opportunities to see these amazing creatures.

Figure 2-2. Map of Yap's Main Islands

2.2 YAP INTERNATIONAL AIRPORT (YAP) – Existing Conditions

Yap International Airport (YAP) is the only international airport within the State of Yap. The airport is located on the southwestern portion of Yap Island. The airport is at an elevation of 91 feet mean sea level (MSL). The Airport Reference Point is Latitude N09°29.94', Longitude E138°04.95'. YAP is owned and operated by the Yap State Government as a Division of the State Department of Public Works and Transportation (DPWT). The Airport is operated in compliance with the International Civil Aviation Organization (ICAO), but follows the procedures in Federal Aviation Regulations (FAR) Part 139, Certification of Airports, to meet ICAO requirements.

2.2.1 Critical Design Aircraft

The critical design aircraft for YAP is the Boeing 737-800 series operated by Continental Airlines. The Boeing 737-800 series aircraft is the only scheduled aircraft that flies into YAP and with more than 250 arrivals and departures annually, meets the FAA criteria for critical design aircraft.

2.2.2 Airport Reference Code

The airport reference code (ARC) is a system established by the FAA to relate airport design criteria to the operational and physical characteristics of the aircraft currently operating and/or forecast to operate at the airport. The ARC has two components relating to the airport design aircraft. The first component, denoted by a letter, is the aircraft approach category and correlates to the aircraft approach speed (an operational characteristic). The second component, depicted by a Roman numeral, is the aircraft design group and relates to aircraft wingspan and tail height (physical characteristics). Generally, aircraft approach speed impacts the ARC for runways and runway facilities and aircraft wingspan or tail height impacts to taxiway and taxi lane separation criteria. The ARC for Yap International Airport is D-III. The Airport Reference code is discussed in greater detail in Chapter 6 Facility Requirements.

2.2.3 Runway

YAP consists of a single runway: 7-25, which is 6000 feet long by 150 feet wide. The runway is paved with asphalt, grooved, and currently in good condition. Roughly 95% of air carrier operations (landings and takeoffs) use the Runway 7 end. On runway 7-25, the surface is bituminous with a weight bearing capacity of 75,000 pounds for single wheel aircraft; 160,000 pounds for duel-wheel aircraft; and 230,000 pounds for dual tandem wheeled aircraft. The Yap International Airport has a flexible PCN value of 47/F/B/X/T and a rigid PCN value of 77/R/B/X/T. Turnarounds have been constructed on the north side at both ends of the runway.

2.2.4 Taxiway

There is a single stub taxiway that connects runway to the terminal apron. The taxiway is located approximately 2000 feet from the approach end of Runway 25 and proceeds to the south of the runway. The taxiway for YAP is 88 feet wide (44 feet from centerline to edge) with 25 foot shoulders.

2.2.5 Apron

The Yap International Airport terminal apron is located 4000 feet from the departure end of Runway 7 and extends to the south of the runway. The apron itself is 520 feet long by 300 feet wide and has two in-pavement fuel pits. The Portland cement concrete apron was completed in 2009. It can accommodate two Boeing 737 or 757 aircraft or aircraft of similar size.

2.2.6 Airport Lighting, Visual Navigation Aids

Runway 7-25 uses Medium Intensity Runway Lights (MIRL); the runway is labeled with non-precision markings and each end of the runway is equipped with runway end identifier lights (REILs). For approach purposes, the runway also has a Precision Approach Path Indicator

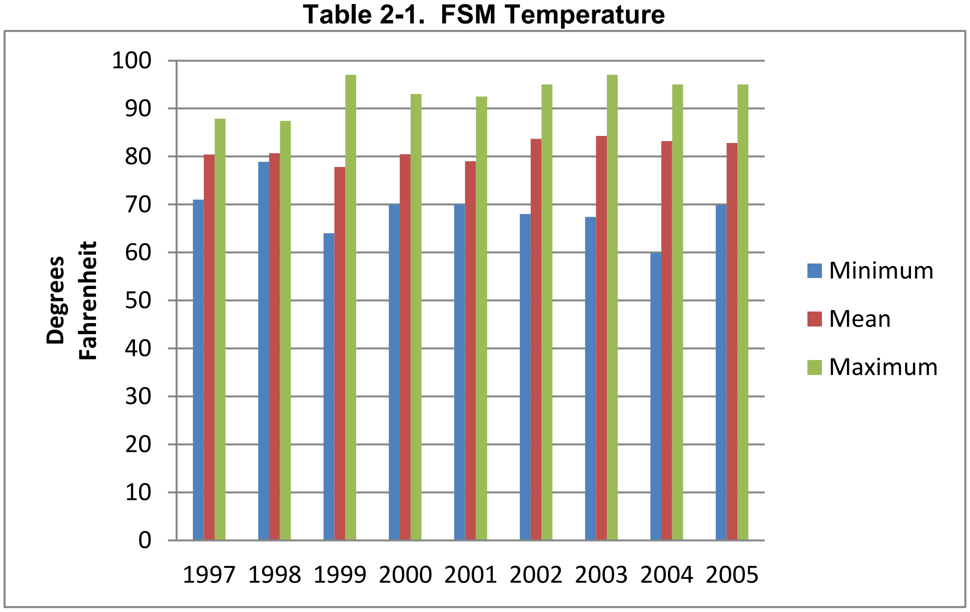
(PAPI) at each end. There is also a non-directional beacon (NDB) for navigational purposes located near the aircraft parking apron. As with all of the airports located in the FSM, Yap is an uncontrolled airport with no air traffic control tower. Runway lighting can be activated by the pilot via the CTAF frequency. The airport is furnished with a lighted rotating beacon that flashes green and white to indicate that YAP is a land based airport.

2.3 AIRPORT ENVIRONMENT

2.3.1 Climate and Wind Conditions

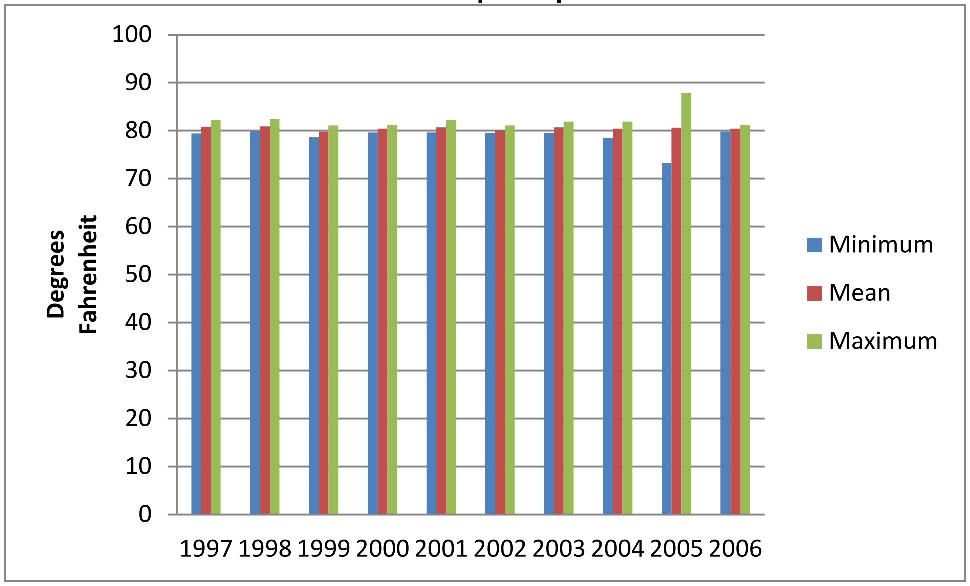
Yap, like all states in the Federated States of Micronesia, has a pleasant tropical climate. The year-round temperature ranges from the high 70's to high 80's (in degrees Fahrenheit) with the average temperature of 80 degrees. The humidity in Yap usually ranges between 65 and 100 percent. Rainfall in Yap is usually around 120 inches per year and occurs mostly during the summer. The winter and spring months in Yap are typically dry and can sometimes generate droughts. The northeastern trade winds typically flow over the islands during the dry season, although Yap's location makes it vulnerable to typhoons, which have struck in the past. The last major super typhoon, Sudal, devastated Yap in 2004.

Table 2-1. FSM Temperature



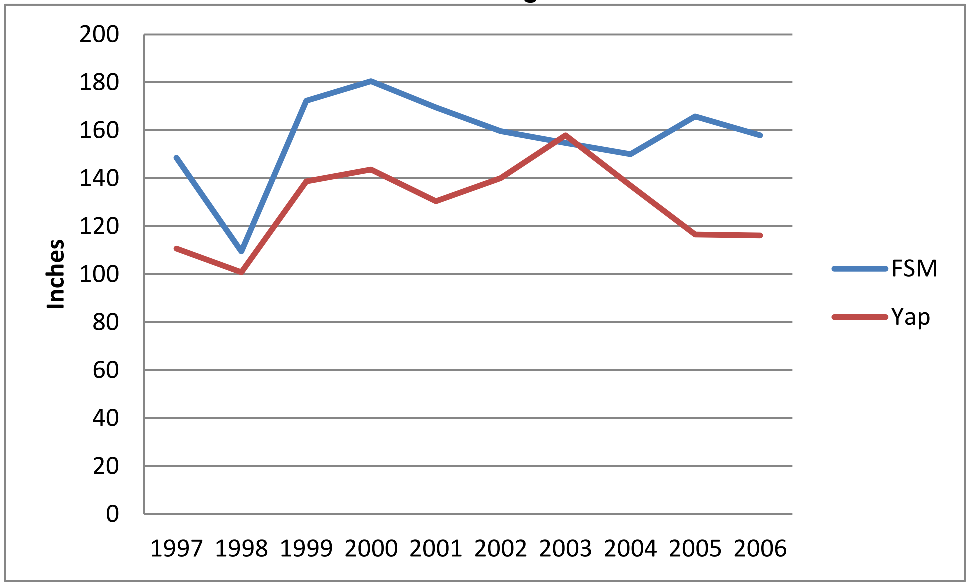
Source: FSM Office of Statistics

Table 2-2. Yap Temperature



Source: FSM Office of Statistics

Table 2-3. Average Rainfall



Source: FSM Office of Statistics

2.3.2 Land Formation and Topography

Of Yap's more than 130 islands and atolls, only around 19 are actually inhabited. Yap State is composed of 4 large islands, 7 small islands, and 134 atolls. The main Island of Yap is grouped together with 3 other main islands: Tomil/Gagil, Maap, and Rumung.

2.3.3 Land Ownership

Yap State has title to airport lands and a large area surrounding its currently developed airport facilities. Yap has chosen to adhere to traditional values and practices, particularly with respect to land, or land ownership issues. Almost all of the land and water in Yap is owned by individuals.

2.3.4 Socio-Economic Conditions

a) Population:

According to the 2000 FSM National Census Report, Yap housed only around 11,000 inhabitants, which is about 10 percent of the total population in the FSM. An estimated two-thirds of Yap's population is located on the main island of Yap and it's population has slowly, but steadily increased throughout the years. However, Yap's percentage of the total population of the FSM, has declined.

b) Local Economy:

Yap's local economy has not drastically changed throughout the years. Like all of the FSM states, Yap is heavily supported by the United States' Compact funds. Unlike the other three states, however, the Asian Development Bank indicates that Yap is the most capable of becoming economically stable in the future.

In regards to employment, the member of people in the labor force increased from about 55 percent in 1994 to approximately 72 percent in the year 2000. Yap is also noted as having the greatest population engaged in subsistence activities, which means that their job is to provide food for their family.

In order to become a self-sustaining economy, Yap is trying to increase its tourism resources. Yap has continued to be distinguished as one of the best diving locations in the world, mainly due to the attraction of their resident giant manta rays. The tourism industry is slowly growing, largely due to the tourist appeal for remoteness and the fact that the FSM is almost unknown throughout the world. Other than tourism, Yap is generating the most profits from exports of all the states in the FSM. In

2001, manufactured garments accounted for 82 percent of Yap's total exports. The garment industry reached a peak between 2003 and 2004 and essentially ceased to exist in 2004. Another notable export of Yap is betel nuts, which constituted 15 percent of all exports in 2001. This product has increased in demand and in 2007 the export value of betel nut was reported to be over 2.6 million dollars. This represented almost sixty percent of Yap's commodity exports that year.

2.4 EXISTING LAND USE

Most land on the islands is undeveloped. Agricultural activity takes up only a small portion of the available land in the central islands of the state. Taro and other food products are grown in cultured areas. Other non-feed agricultural products, such as betel nut, are harvested from the natural forests.

The airport has title to a large area surrounding the currently developed facilities. This area is provided to protect the arrival and departure surfaces and also provide for future expansion. There are known graves in some of these undeveloped areas that will have impact on future plans.

2.5 AIR CARRIERS

2.5.1 Aircraft Operations

a) Scheduled Air Carriers:

Continental Micronesia provides essential air service to Yap. Yap is serviced through either Guam or Palau. Previously, aircraft landed in Yap three times per week in each direction (total of six times per week), and Yap was being serviced by only a Boeing 737 series aircraft. Since October 2010, Continental has reduced service to Yap. Continental only flies to Yap international Airport on Wednesdays, Saturdays, and Sundays. Continental has now uses a 737-700 series aircraft on its Guam-Yap-Guam flight.

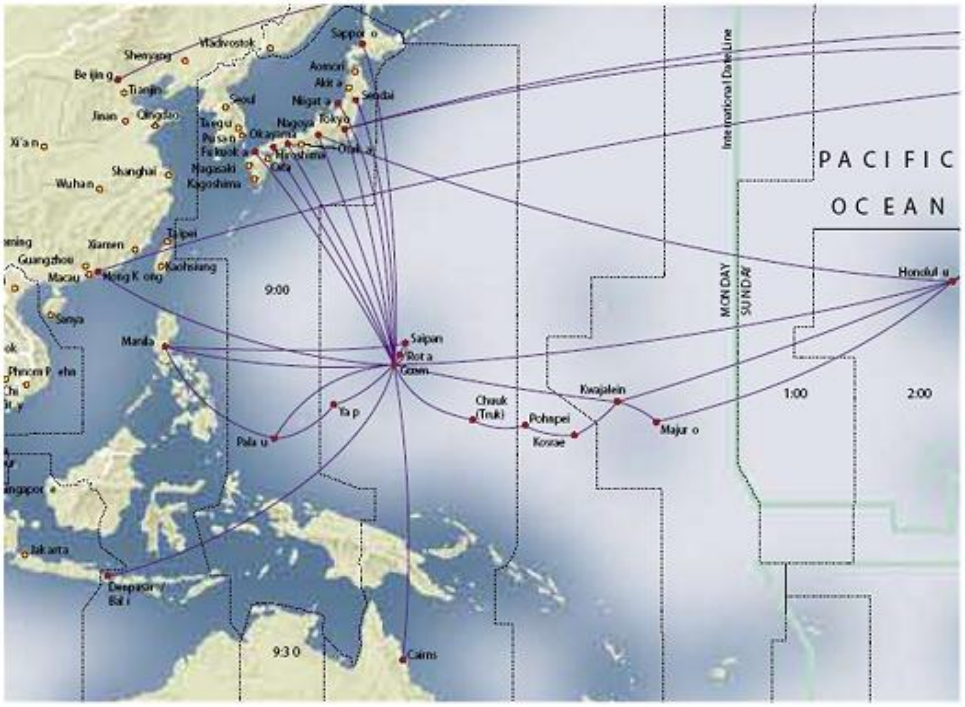


Figure 2-3. Continental Micronesia Route Map

Table 2-4. Continental Flight 956 Timetable (October 2010)

	Mon	*Tues*	*Weds*	*Thurs*	*Fri*	*Sat*	*Sun*
YAP			*A1:35 am*				*A3:50 am*
							D4:30 am

Table 2-5. Continental Flight 957 Timetable (Oct. 2010)

	Mon	Tues	Weds	Thurs	Fri	Sat	Sun
YAP						A12:10 am	
			D2:35 am			D12:50 am	

b) Commuter Airlines:

Inter-island service to other islands of Yap is provided by Pacific Missionary Aviation (PMA). PMA currently utilizes two Beechcraft Queen Air Excalibur aircraft that are based on the main island of Yap. PMA flies to Falalop islands in the Ulithi Atoll and Fais Island in the Ulithi Atoll and Falalop Island in the Woleai Atoll. Flights to Ulithi atoll tend to be planned, but are more due to the need and demand. They fly about once a month to Fais and only about a few times a year to Woleai atoll. In addition to Yap, PMA also services Palau, although only a few flights were made to Palau in the past year.

Passenger counts vary depending on need and adjusted flight schedules. In both August and July 2008, PMA carried more than 165 passengers each month, but had forecasted those amounts to decrease significantly in the following months. Data on PMA operations is presented in Chapter 3.

c) Cargo Carriers:

Continental Micronesia is the main cargo carrier that services Yap. This service is provided by all Continental Micronesia flights to and from Yap. Asia Pacific Airlines occasionally provides air freight services to Yap with Boeing 727-200 aircraft. Asia Pacific service is more of an as-needed, on-demand basis and has not flown to Yap in a number of years. Its only recent service to FSM has been to Pohnpei.

Pacific Missionary Aviation also provides essential cargo service to the outer islands of Yap. Cargo consists of just about anything, although the most commonly transported items are food and betel nut. In August 2008, PMA carried 16,641 pounds of cargo to the surrounding islands of Yap.

d) General Aviation, Business Jets, etc.:

General Aviation activity rarely occurs at Yap International Airport and represents a fraction of the overall aviation activity. There are presently no single-engine aircraft based at the airport.

e) Other, Including Military Operations:

No other services, such as aircraft flight schools or helicopter sight-seeing services operate from Yap International Airport. Although there were previous military operations at the airport, there have been no military operations that utilized Yap International Airport in the past few years.

2.6 AVIATION RELATED FACILITIES

2.6.1 Passenger Terminal

The terminal building is adjacent to the south edge of the apron. The terminal building is a one-story structure approximately 11,050 square feet in area. It was completed in 1987. Major additions/alterations since completion include the expansion of the Departures Lounge and Immigration, and replacing the roof in 2005.

The small terminal currently has all of the necessities of a functioning airport. It is equipped with customs and immigration for international flights and has the required passenger and baggage screening areas. Additionally, the terminal has lobbies and waiting areas. Concessions and gift shops are available for travelers in an adjacent building.

2.6.2 Aircraft Rescue and Fire Fighting (ARFF) Facility

Construction of a new ARFF facility was completed in March 2010. The ARFF facility is a two-story structure approximately 9,852 square feet in area. The building contains three large bays for the airfield rescue equipment. Also included are crew accommodations, training rooms, support equipment, an airfield observation room, and Aeronautical/Aerodrome Flight Information Service (AFIS).

2.6.3 Fuel Farm

The aircraft are currently serviced by a fuel truck. There is a complete fueling tank farm including pumps and other equipment to permit the use of the new underground fuel lines in the apron. This system was originally installed and maintained by Mobile, but was abandoned about five years ago after the apron expansion damaged the in-pavement fuel lines. The fuel farm is now operated by FSM Petroleum Company. The fuel farm is protected by its own perimeter fence and has access on the public side for fuel delivery and access on the secure airfield side to permit the fuel truck to enter the airfield.

2.7 OTHER EXISTING BUILDINGS

There is a wooden building immediately west of the terminal building that contains a snack bar and gift shop. This facility is open at times of aircraft arrivals and departures. Just west of the wooden building is a small guard house building at the gated entrance to the apron. The guard house is not used at this time.

Across the entrance road are the electrical vault and support facilities for the airfield lighting system and the FAA equipment. An emergency generator is provided at this building. These components are entirely outside the secured air operations area of the airfield.

2.8 ACCESS AND PARKING

There is one airport access road that connects directly to the airport parking area. The road extends from the public road to the parking lot and terminal frontage road. There are parking spaces available in front of the terminal building. Beyond the terminal building, the road turns left to permit vehicles to enter the parking lot or right for access to the Pacific Missionary Aviation office and the secure access entrance to the airfield.

The existing vehicle parking facility is located to the south, which is directly across from the entrance of the terminal building. There are two rows of parking and also another road for pick-ups and drop-offs in front of the terminal building. The parking lot is presently bituminous surfaced and is in good condition. The lot consists of two lanes. The lane closest to the terminal has parking on both sides and has space for over 60 vehicles parked on the left and right of the center lane. This lane ends at the exit road from the terminal where vehicles turn left and either exit the airport, park in the third parking lane or return to the terminal frontage road. There are curbs and parking stops in fair condition. There is a new Portland Cement Concrete access road from the public roadway to the new ARFF building. This road was constructed in 2010 and is in excellent condition. It is located near the middle after runway where the ARFF is sited.

2.9 SECURITY FENCE

An 8-foot high security fence with barbed wire surrounds the entire airfield. This fence was constructed in 2006. The fence is a standard fence without animal intrusion paving at the base of the fence. There is also a fence around the fuel farm and a fence around the ARFF building. The only other fencing is a gate at the road entrance from the airport access road adjacent to the terminal.

2.10 EXISTING UTILITIES

Water, power, and telephone are provided to the airport from the respective island utility agency distribution systems. These utility lines are routed both overhead (power only) and underground.

2.10.1 Water Supply

Yap does not have extensive public water systems. About 75 percent of the population of Yap has piped water available to them. Portable water is available in the Main Islands, except for Maap and Rumung.

The airfield is connected to both Colonia and Southern Yap Water Systems. The water is supplied from a main in the public road and is distributed to the terminal and apron facilities. There is also a waterline from the apron area to a water tank on the hill to the northwest of the apron. This second line is reported to be closed at this time.

2.10.2 Sewer System

The Airport is connected to Colonia Waste Water Collection and Treatment Plant. Sanitary sewer lines are located in the entrance road. This sanitary sewer is connected via the island sanitary system located in public roadways.

2.10.3 Electrical Power

Electricity is generated in Yap by the Yap State Public Service Corporation (YSPSC), which distributes power on the main islands and also on Falalop in Woleai, Falalop in Ulithi, and Mogmog in Ulithi. The State of Yap does not have any hydro-electric facilities. There also is not any data on solar power being used in Yap. Electric power is 110-220 volt, 60 cycles, with the use of standard flat, two-pronged plugs. The overhead primary power lines are tapped from the utility agency’s overhead distribution lines routed on the public roadway, extended up the slope closer to the airport parking lot, then transitioned to underground at a riser pole below the airfield Generator/Power Vault.

2.10.4 Communications

FSM Telecommunications Corporation is the only telecommunication company that services all of the states of the FSM with telephone, internet, and cable TV. FSM Telecom utilizes earth stations on each of the main islands to service all of the subscribers. The telephone and cell phone services at Yap International Airport are moderately reliable.

2.10.5 Roadways

There is a linear paved road from the south end of the main island of Yap to near the north end of the island. A paved branch extends from this road to the Gagil/Tomil island area. These roads were constructed around 1980 and are reaching the end of their service life. A separate road exits from the north-south road just north of the airport access road and extends along the west side of the island. It reconnects to the north-south road near the north end of Yap Island. This road was just completed by the Japanese Government a few years ago and is in very good condition.

CHAPTER 3: AVIATION FORECASTS

3.1 INTRODUCTION

This chapter describes the objectives, methodology, and preliminary findings of future aviation demand at the Yap International Airport.

3.2 OBJECTIVES

The Master Plan sets forth the short, intermediate and long-range (5-, 10-, and 20-year) development plans for Yap International Airport. A primary objective of the Master Plan is to identify the present and future need for a full range of facilities to serve anticipated air carrier, commuter and general aviation demand. To achieve this objective, it is important to identify the magnitude of potential future aircraft operations. Aggregated demand of all types of aviation activity, including aircraft mix, passengers, cargo, and type of flight operations are of specific interest in this study.

This forecast identifies the various drivers of Yap's economy and evaluates the potential for major economic growth. Typically, for any small or medium size airport, the significant variables in the determination of demand are population, employment and income of the community being served. However, in a unique economy such as Yap's, the traditional determinants of demand may be of lesser significance in comparison to tourism, government sponsored trips and international actions impacting airport operations.

A reasonable forecast of aviation activity is essential in determining future aviation facilities needs. Forecasts of commercial airline passengers are the basis for sizing and phasing of airside, landside and terminal facilities. The adequacy of existing airfield facilities is assessed using the number and types of current and projected aircraft activity. The adequacy of both air and landside facilities is influenced by the estimated level of activities at peak arrival and departure periods. For example, this level of detail is helpful specifically when evaluating the size of terminal hold-rooms needed to meet future demand.

Forecasts of air cargo and mail are necessary to determine the aircraft requirements to accommodate this need and the building space to meet this need. Included in these requirements are specific handling requirements such as secure space for inbound and outbound cargo and properly conditioned rooms to safely store the cargo until departure or distribution throughout the islands.

For the airfield, forecasts of the aircraft most likely to serve the passenger and cargo needs are critical to determining aircraft facility dimensions. Safety area dimensions will be impacted by aircraft larger than the Boeing 737-800. Larger aircraft or destination airports further away than Guam will require longer runways.

The validity of any forecast may be affected by numerous variables and is dependent upon the uncertainty of future events. As such, the potential of demand forecasts is dependent on some known and some unforeseeable factors, and these forecasts become more speculative as one looks further into the future. It may be reasonable to predict as much as three to five years out with a relatively high level of confidence, but with less confidence for projections beyond five years, particularly in an air travel and tourism industry that can be characterized as having dynamic fluctuations.

The research that has been done to develop this aviation forecast for Yap International Airport tends to emphasize the relative stability of Yap's tourism industry. The various long-term trends in the region support the premise that Yap's tourism industry will stay constant or increase lightly. As a result, two growth cases to discuss are evaluated in this report: a most likely "base case" and a high "optimized case." A third case, the low growth case, or "constrained case" relates to low to negative outcomes going forward. While these negative outcomes are not anticipated, they are plausible and must be discussed in this section.

3.3 METHODOLOGY

Forecasting for a typical system or master plan for a small or medium size airport is based on economic growth factors, population growth, income, employment, domestic and business oriented enplanements and international travel. However, these forecasting tools, including those published in the applicable FAA Advisory Circulars; do not apply all that well to the FSM.

The Federated States of Micronesia has a unique passenger and travel profile. The factors that affect the FSM economic growth are based more on travel and tourism. Therefore, the economic forecast and growth trends for the Master Plan are weighted more toward tourism, travel, and the world events and natural disasters that drive these factors.

3.4 SOCIO-ECONOMIC REVIEW

The propensity to travel, by air or any transportation mode, generally correlates closely with three statistically significant variables – population, employment, and income. An evaluation of the forecasted population and income of Yap's residents can help establish trends useful in forecasting commercial and general aviation activity.

3.4.1 Local Demographic Characteristics

Yap State residents are generally divided into two groups, residents of the four main islands, described as "Yap Proper" and outer island residents. In 2000 the total population of Yap State was 11,241 persons of which 7,391 lived on Yap Proper and 3,850 lived on the neighboring islands. (Source: Yap Branch Statistics Office, Division of Statistics, 2007 Annual Statistical Handbook, Yap State, Table 2.1). The outer island population is significant as it will have an impact on inter-island travel, although only a small part of such travel may be by air.

Expatriate workers and their families make up only a small fraction of the resident population. The peak number of expatriate workers occurred in FY2002 when 792 workers were on island. Most of these worked in the garment industry. The garment industry effectively ceased operations in 2005-2006 and by FY2006 there were only 224 expatriate workers on the island. (Source: Yap Branch Statistics Office, Division of Statistics, *2007 Annual Statistical Handbook, Yap State*, Table 4.2.)

a) Population

The population of Yap has increased steadily throughout the years, but its percentage of the total population of the Federated States of Micronesia has decreased. The percentage decrease has slowed over the past 20 years, reducing by only a fraction of a percent of Yap's total population. Yap currently claims 10.5 percent of the total FSM population. Table 3-1 shows the historic and a projected population estimate for the four states in the Federated States of Micronesia.

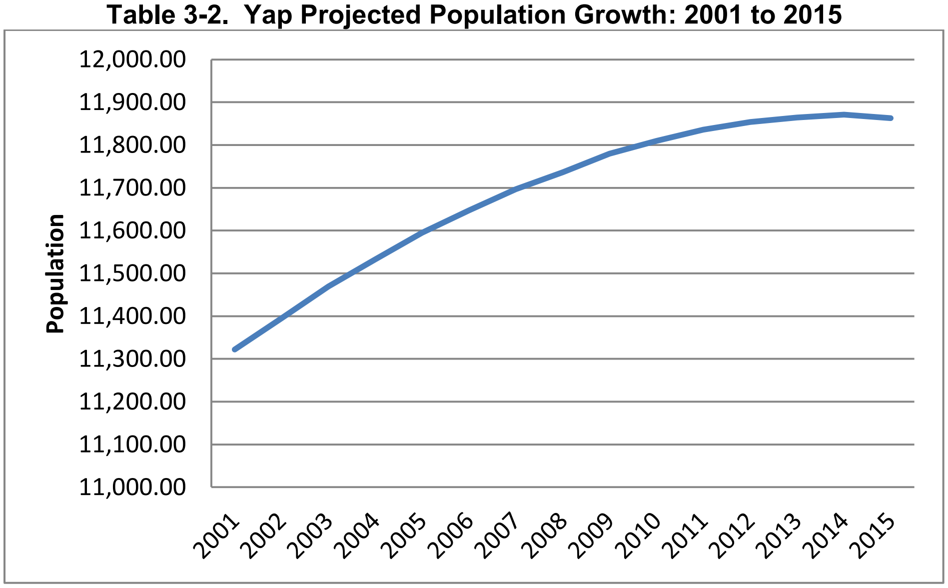
Table 3-1. Population Distribution: 1930 to 2008 Federated States of Micronesia

State	1930	1958	1967	1973	1980	1989	1994	2000	2009 projected
Total	29,727	39,284	50,172	62,731	73,159	95,551	105,506	107,008	108,100
Yap	6,486	5,540	6,761	7,870	8,099	10,431	11,178	11,241	11,700
Chuuk	15,200	20,124	25,107	31,609	37,488	47,616	53,319	53,595	53,300
Pohnpei	7,051	11,253	15,044	19,263	22,081	30,669	33,692	34,486	34,900
Kosrae	990	2,367	3,260	3,989	5,491	6,835	7,317	7,686	8,200

Source: FSM Office of Statistics

Over the years, Yap's population has been growing at a rate of approximately 1.01 percent. More recently, the rate of growth has reduced to 1.00 percent. The 2008 projected population growth shows a continued slight increase of approximately 1.04 percent for the year. Yap continues to have the second least population of all the states in the FSM (after Kosrae). In the year 2015, the FSM Office of Statistics is projecting that Yap's population will start to decrease slowly after reaching a peak at just short of 12,000 people. This is shown in Table 3-1 and Table 3-2. However, the 2007 Yap Statistical Yearbook indicates that population projection estimates showed the total population increasing to about 15,000 persons by year 2020. (Source: Yap Branch Statistics Office, Division of Statistics, *2007 Annual Statistical Handbook, Yap State*, Page 8, last paragraph.) The percentage change between these numbers is significant and does impact the assumptions applied to population projections used herein.

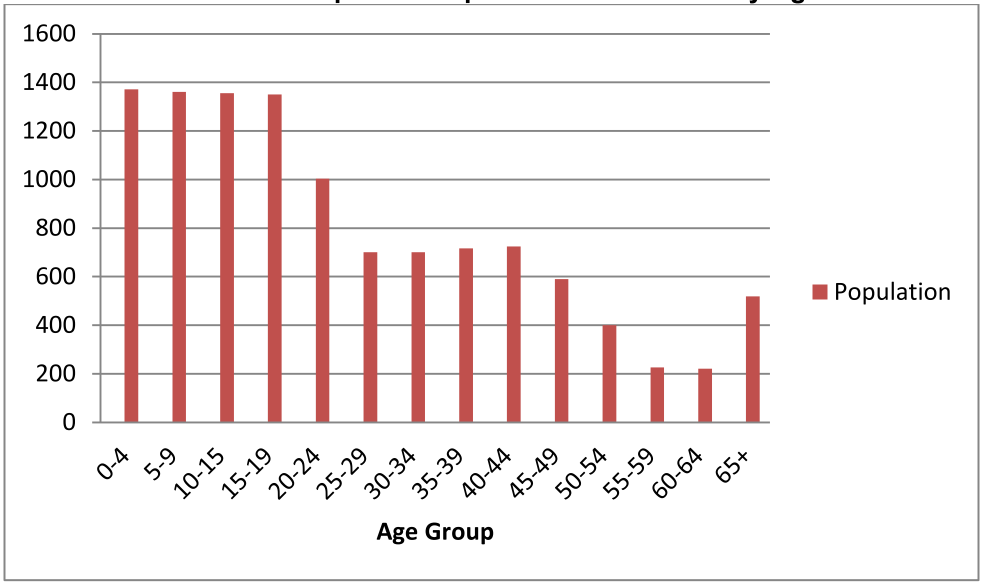
Table 3-2. Yap Projected Population Growth: 2001 to 2015



Source: FSM Office of Statistics

The projected population flattening and declining is attributed to young adults and persons of middle age leaving for education and work opportunities. Historic and current statistical handbooks for Yap show a clear pattern of "missing persons". Specifically in the young adult through middle age groups of persons, there are fewer persons in each age group than in the similar age groups older and younger. The distribution of Yap population by age group is shown in Table 3-3.

Table 3-3. Yap State Population Distribution by Age



Source: Yap Branch Statistics Office, Division of Statistics,
2007 Annual Statistical Yearbook, Yap State, Table 2.5.

b) Employment

Yap's contribution to the FSM labor force has decreased from slightly over 14 percent in 1994 to over 13 percent in 2000. The total number of people included in the labor force, however, is the highest of any of the states in the FSM. This percentage increased from just over 55 percent in 1994 to slightly more than 72 percent of the residents of Yap in 2000.

Data on Yap State employment in recent years is provided in Table 3-4. Employment reached a peak in FY2005 with a high of 3,641 private and government employees. This peak dropped afterwards when the garment factories closed and government employment numbers exceeded private employment. The peak in government employees in 2005 followed by a decline in 2006 is due to federal funding for the recovery efforts of Typhoon Sudal.

Table 3-4. Total Employment by Sectors: FY 2002 to FY 2006

Sectors	2002	2003	2004	2005	2006
Overall Total	3,067	3,594	3,225	3,641	3,383
Government Total	1,123	1,307	1,285	2,326	1,915
State	897	983	1,020	2,085	1,685
Other State Government Agency	36	42	77	75	74
Federal Program	119	116	116	102	92
National	71	166	72	64	64
Private Sector Total	1,944	2,287	1,940	1,315	1,468

Source: Yap Branch Statistics Office, Division of Statistics, 2007 Annual Statistical Yearbook, Yap State, Section 4 and Table 4.1.

c) Income

Out of all the states in the Federated States of Micronesia, Yap has the smallest spread of income. The highest percentage of wage earners in 2000 earned between $2,000 and $3,000 annually. Yap has the least percentage of all the states earning less than $1,000 per year. Even though income is more distributed in Yap, 60 percent claimed earnings of less than $4,000 for the year 2000. Over 62 percent of all employees earned in the range of $3,000-$3,999 dollars per annum in the years between FY 2002 and FY 2006. This information is reported in the 2007 Annual Statistical Yearbook, Yap State, Page 12. The relatively large number of low to mid-income wage earners indicates that the resident population of Yap will not be able to contribute to any major growth in air traffic. A factor that may eventually affect this observation is that the Yap legislature is considering passing a higher minimum wage law. (Verbal report to writer in July 2009.) However, this increase will most likely only permit workers to keep up with inflation, so the overall ability of residents to make trips may not change significantly.

3.4.2 Foreign Tourism

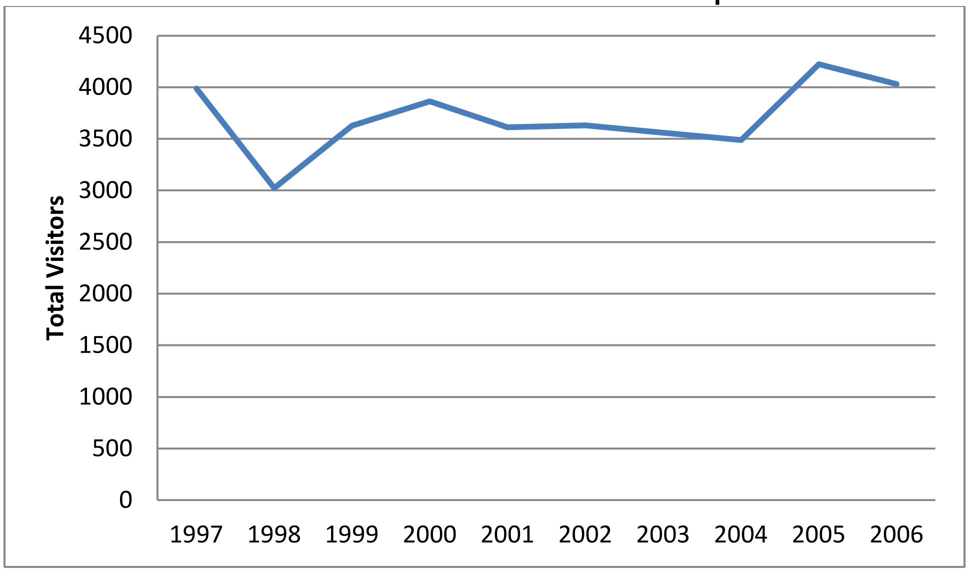
Between the years 1997 and 2008, Yap has averaged approximately 3,805 tourists and visitors per year. The majority of foreigners (non-Pacific Islanders) visiting Yap have come from the United States, Japan, and Europe. The combination of the U.S., Japan, and Europe has accounted for around 83% of the total travelers to Yap throughout the years. Visitor counts to Yap have historically fluctuated, but have ultimately shown an increasing trend.

Table 3-5. Tourism and Visitors to Yap by Region of Citizenship: 1997 to 2008

Tourism & Visitors	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Asia	170	68	99	140	149	244	266	211	239	147	77	96
Australia	73	32	43	46	61	42	99	114	110	76	127	221
Canada	93	71	63	73	56	60	63	75	64	67	141	142
Europe	378	407	553	646	604	694	624	597	1135	1157	1025	1285
Japan	877	690	791	802	606	612	599	481	654	563	564	512
New Zealand	21	14	33	13	12	25	15	21	19	19	19	106
Pacific Islands	373	169	176	162	135	130	113	178	155	124	128	172
Philippines	81	58	51	59	60	80	98	121	112	64	55	84
USA	1,899	1,494	1,779	1,878	1,901	1,710	1,666	1,655	1,709	1,754	1,630	2,114
Other	22	20	38	45	27	32	15	35	26	59	45	52
Total	3,987	3,023	3,626	3,864	3,611	3,629	3,558	3,488	4,223	4,030	3,811	4,784

Source: Yap Branch Statistics Office, Division of Statistics, DRAFT 2008 Annual Statistical Yearbook, Yap State, Table 5.16.

Table 3-6. Tourism and Visitors to Yap



Source: FSM Office of Statistics, 2008

3.5 HISTORICAL AIRPORT ACTIVITY

The Federated States of Micronesia are serviced by one major carrier: Continental Micronesia. Continental operates Boeing 737-800 series aircraft to each of the four states of the FSM. Continental services Micronesia through major hubs at Honolulu and Guam. Yap is located southwest of Guam and is an intermediate stopover on the Continental route between the Guam hub and Palau. Unless Yap traffic increases dramatically, it is probable that Yap will continue to be serviced as a stopover along the Palau route.

3.5.1 Passenger Data

Passenger arrivals and departures on foreign aircraft and vessels are shown in Table 3-7. The Continental airline office at Yap provided data for 2008. In that year they reported 8,769 passenger arrivals and 8,160 passenger departures. The ship data are included as this clearly shows the dependence of Yap on service by aircraft. Departures normally approximate arrivals on these islands. The data in this table indicates that arrivals by airplane are higher than departures for most of the years covered.

Table 3-7. Passenger Arrivals and Departures on Foreign Aircraft and Vessels: 2000 to 2008

Year	Arrivals			Departures			Arrivals minus Departures		
	Ship	Airplane	Total	Ship	Airplane	Total	Ship	Airplane	Total
Total									
2000	88	8,934	9,022						
2001	86	9,610	9,696						
2002	401	8,574	8,975						
2003	88	8,312	8,400						
2004	140	8,603	8,743	17	9,282	9,299	123	-679	-556
2005	405	8,487	8,892	412	8,383	8,795	-7	104	97
2006	551	7,857	8,408	363	7,713	8,076	188	144	332
2007	232	8,074	8,306	0	7,460	7,460	232	614	846
2008		8,769			8,160			609	
Foreigners									
2000	88	5,924	6,012						
2001	86	5,799	5,885						
2002	401	6,217	6,618						
2003	88	5,661	5,749						
2004	132	4,858	4,990	17	5,714	5,731	115	-856	-741
2005	405	5,111	5,516	412	4,935	5,347	-7	176	169
2006	551	4,771	5,322	363	4,483	4,846	188	288	476
2007	232	4,863	5,095	0	4,399	4,399	232	464	696
2008									
FSM Citizens									
2000	0	3,010	3,010						
2001	0	3,811	3,811						
2002	0	2,357	2,357						
2003	0	2,651	2,651						
2004	8	3,745	3,753	0	3,568	3,568	8	177	185
2005	0	3,376	3,376	0	3,448	3,448	0	-72	-72
2006	0	3,086	3,086	0	3,230	3,230	0	-144	-144
2007	0	3,211	3,211	0	3,061	3,061	0	150	150
2008									

Source: 2001 through 2003 data from Yap Branch Statistics Office, Division of Statistics, 2005 Annual Statistical Yearbook, Yap State, Table 8.8. This yearbook does not have a departure table.
Source: 2004 through 2007 data from Yap Branch Statistics Office, Division of Statistics, DRAFT 2008 Annual Statistical Yearbook, Yap State, Table 8.8 and 8.9.
Source: 2008 data from Continental Micronesia office at the Yap International Airport, July 23, 2009.

Table 3-8 provides an interesting insight into the historic distribution of passenger arrivals. Over the past several years, foreigners have made up approximately 60 percent of the arrivals. This ratio has not changed significantly over time.

Table 3-8. Annual Percent of Total Arrivals by Foreigners and FSM Citizens

Year	Foreigners	FSM Citizens
2000	66.31%	33.69%
2001	60.34%	39.66%
2002	72.51%	27.49%
2003	68.11%	31.89%
2004	56.47%	43.53%
2005	60.22%	39.78%
2006	60.72%	39.28%
2007	60.23%	39.77%

Source: 2001 through 2003 data from Yap Branch Statistics Office, Division of Statistics, 2005 Annual Statistical Yearbook, Yap State, Table 8.8.
Source: 2004 through 2007 data from Yap Branch Statistics Office, Division of Statistics, DRAFT 2008 Annual Statistical Yearbook, Yap State, Table 8.8 and 8.9.

Another interesting relationship is the posited number of trips per Yap resident made each year. Table 3-1 indicates that in 2000 the population of Yap was 11,241 persons. Table 3-7 indicates that in the year 2000 there were 3010 arrivals of FSM citizens. From this, it may be deduced that 27 percent of the population made one trip that year. This rationale seems unreasonable on the surface. However, FSM citizens include all FSM citizens, regardless of their state of residence. The FSM citizens making the trips include government workers from Yap returning from business trips, FSM Government employees going to Yap for business purposes, local business persons making trips and Yap citizens living abroad who make home visits.

The Continental Airlines arrival and departure data in Table 3-9 shows similar but also different information. Notes accompanying the original tables in the Statistical Handbooks identify the source as Continental Air Micronesia and contain the following note; "*Arrivals and departure combine both FSM citizens and Non-FSM citizens. This table excludes aircraft crews onboard. All flights are internationally bound and do not include domestic flights (e.g. PMA).*" Although there are differences between the data in the tables, it is noted that arrival and departure passenger movements are reasonably close. The State is not gaining or losing significant permanent population through immigration or emigration.

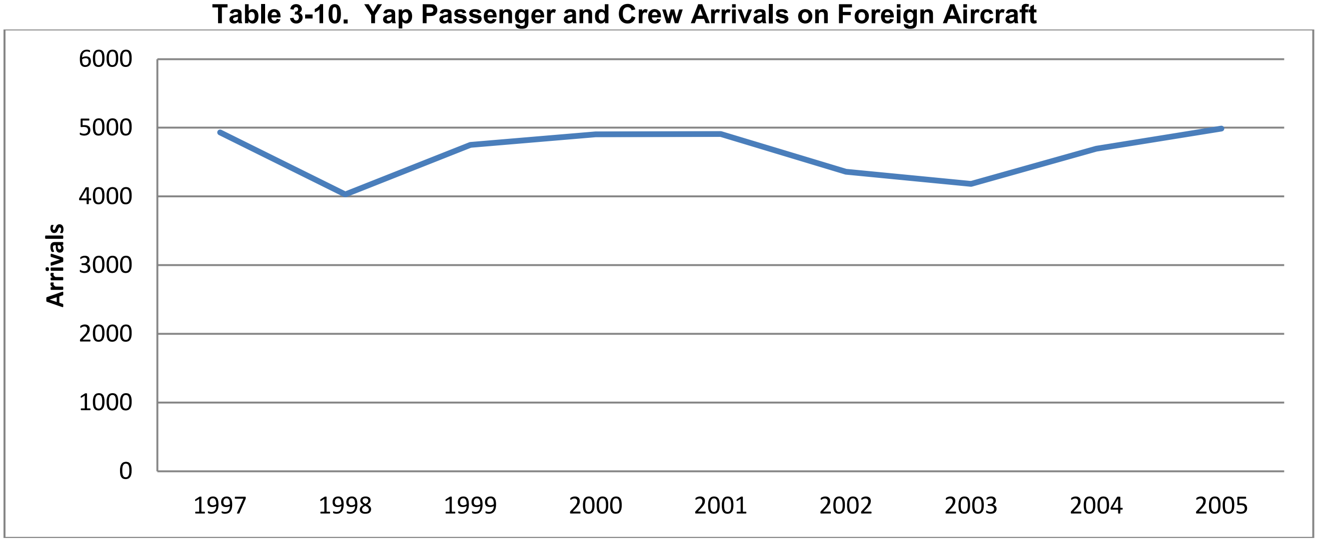
Table 3-9. Number of Persons Arriving and Departing by Air: 2000 to 2008

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008
Arrival	8,934	9,610	8,426	7,026	7,962	9,417	7,868		8,769
Departure	8,809	9,300	8,434	8,315	8,313	8,897	8,384		8,160
Difference	125	310	-8	-1289	-351	520	-516		609
Flights	249	266	212	274	310	313	237		
Average Arrivals Per Flight	35.9	36.1	39.7	25.6	25.7	30.1	33.2		
Average Departures Per Flight	35.4	35	39.8	30.3	26.8	28.4	35.4		

Note. A flight is one arrival plus one departure
Source of 2000 thru 2004 data: Yap Branch Statistics Office, 2005 Annual Statistical Handbook, Yap State, Table 8.9. Number of Persons Arriving and Departing by Air, and Flights: 2001 to 2004.
Source of 2005 and 2006 data: Yap Branch Statistics Office, 2007 Annual Statistical Handbook, Yap State, Table 8.9. Number of Persons Arriving and Departing by Air, and Flights: 2002 to 2006.
Source of 2008 data: Continental Airlines, Yap Airport Office.

The passengers and crew arriving on foreign aircraft to Yap has averaged 8501 passengers/crew per year over a nine year time span. (Not including 2008.) The peak of these arrivals was in the year 2005. The highest peak previous to 2005 was reported to have been in 1997, with a significant decrease occurring in 1998. The arrivals began to increase again after that year, but showed another decrease after the September 11th attacks in 2001. The least amount of passengers was reported to have arrived in the initial drop off in 1998.

Table 3-10. Yap Passenger and Crew Arrivals on Foreign Aircraft



Source: FSM Office of Statistics

A separate set of data was obtained from the Yap Visitor Bureau. These visitor arrival counts are shown in Table 3-11. These numbers are generally accurate representations of tourist or business type visitors who rent hotel rooms, dine out, and participate in typical tourist type activities.

Table 3-11. Yap Visitor Arrivals

	2005	2006	2007	2008	2009
January	239	311	436	358	411
February	400	422	556	479	543
March	326	739	531	140	470
April	222	337	466	400	393
May	214	225	389	514	272
June	228	309	362	453	
July	187	358	414	434	
August	190	360	378	457	
September	138	196	310	324	
October	187	330	529	398	
November	352	279	453	386	
December	400	350	316	318	
TOTAL	3,083	4,216	5,140	4,661	2,089

Source: Yap Visitor Bureau, latest visitor arrival data, printout of their data on July 21, 2009

The data provided in the tables above is of considerable value, but is not always consistent gathered. It was made clear in various conversations while on Yap those definitions for data gathering vary with time and individuals. For example, the Yap Visitor Bureau may consider a person a visitor when they stay in a hotel even if the person has been entered in the immigration data as a visitor on temporary employment.

a) Air Carrier Passenger Data

Air carrier passenger movements are contained in Table 3-11 above. There has been, only this one international air carrier serving Yap for many years. A new airline, Palau Micronesia Airline (PM Air), may have provided brief service, but cancelled operations prior to having any significant effect on service to the airport.

b) Inter-island (PMA)

Yap State is unique in Micronesia in having a first class inter-island air operation by Pacific Missionary Air. The underlying objective of this charitable organization is to provide service to the outer island residents. When necessary this organization provides emergency medical evacuation and free or low price medical and other transportation. When funds are available the government will pay for some of these costs. Foreign donations are relied upon to keep the aircraft in safe condition and to cover the costs of the medical services. However the realities of limited donations preclude providing more services except at prices that recover the costs.

During a recent fiscal year, PMA made 6 Medical Evacuation trips and 4 Medical drops. (Source: PMA data received in July 2009.) They also carried medical supplies and food for free when the State Field trip ship was unable to make a trip to the outer islands for several months.

The passenger movements by Pacific Missionary Air for one year are in Table 3-12. Some of these movements are on unscheduled flights and others are on charter flights.

Table 3-12. PMA Inter-island Passenger Arrivals and Departures - July 2008 through June 2009.

	July	August	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	TOTAL
Departures	53	45	8	22	19	72	43	53	24	35	96	143	613
Arrivals	113	113	38	53	36	52	94	61	56	56	89	160	921
A&D Total	166	158	46	75	55	124	137	114	80	91	185	303	1,534

Source: Data provided by Pacific Missionary Air on July 23, 2009

c) Other

No Charter flights are reported to have provided international service to Yap. As noted above, Palau Air may have provided service during its brief existence. Military aircraft have made trips to Yap in the past, but none have made visits in the past few years. Occasional private or special flights land at Yap either as stopovers or rest stops or on occasion to visit the island. None of these operations has had an impact on the airport.

3.5.2 Cargo Data

Outbound international airfreight has generally exceeded inbound airfreight. Tables 3-13 and 3-14 provide the latest data on airfreight activity at the airport. The data in Table 3-13 will be used at this time.

The largest single export product is betel nut. The amount of cargo exported is limited by the capacity of the aircraft. This point was emphasized during a discussion on Yap in July 2009. The individual informed us that betel nut is so valuable that young men are provided with first class tickets to Guam so that they can check in the full, heavier baggage allowance and maximum carryon luggage full of betel nut. The return trip is in coach.

Other discussions on Yap indicated that the airfreight volume in no way represents the potential airfreight volume if adequate capacity were available. Regulations provide that the carrier must first accommodate passengers and their baggage. The next item to be placed on the aircraft is the mail. Any cargo capacity above that is available for airfreight. The demand for this capacity, which includes both the Palau and Yap demand, is larger than the available capacity. Businesses on Yap limit imports of airfreight items because of these restrictions. Customers are not willing to pay for airfreight when there is limited assurance that the freight will get there much faster by air than by ship. Likewise shippers do not attempt to ship freight out by air because of the lack of assurance as to whether the items will be shipped on the next flight. Perishable items are at risk of not arriving in satisfactory condition.

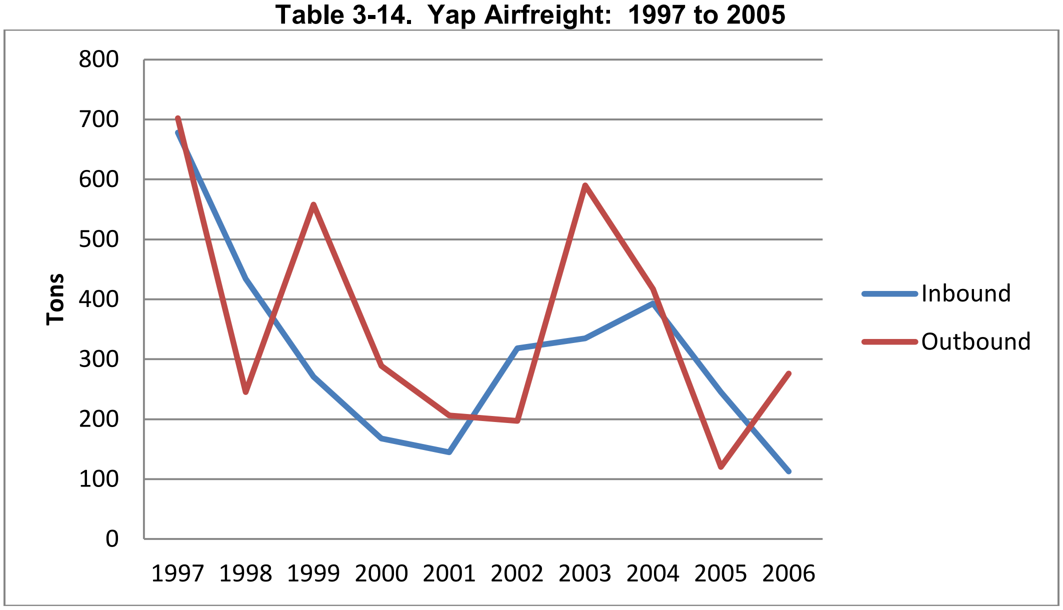
Although an independent cargo carrier could resolve this condition, the unfilled volume at this time has not warranted such separate service. Therefore, it is generally felt that there is some unfilled airfreight demand, but that the amount is not so great as to warrant an additional air carrier or independent flights.

Table 3-13. Inbound and Outbound Airfreight by Tonnage: 2000 to 2008

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008
Inbound	168	145	318	167	196	245	113	88	99
Outbound	289	206	197	295	209	125	276	229	270
Difference – Inbound minus outbound	-121	-61	121	-128	-13	120	-163	-141	-171

Sources: 1. Inbound and outbound Airfreight by Tonnage: 2004 through 2008, Latest Data from Yap Branch Statistics Office, Draft 2008 Statistical report, Table 8.10
2. Inbound and outbound Airfreight by Tonnage: 2000 through 2003, 2005 Annual Statistical Yearbook, Table 8.10. Yap State

Table 3-14. Yap Airfreight: 1997 to 2005



Source: FSM Office of Statistics

The following table contains data obtained a few years ago from Continental Airlines. Continental Airlines also provided a report on their cargo operations in 2008. During that year they reported 291.13 tons of outbound cargo and 114.08 tons of inbound cargo. Table 3-15 summarizes this data.

Table 3-15. Inbound and Outbound Airfreight by Tonnage (000) 1997 to 2006

YEAR	Inbound	Outbound	Difference
1997	678	702	-24
1998	434	245	189
1999	271	558	-287
2000	168	289	-121
2001	145	206	-61
*2002	378	197	181
*2003	335	590	-255
*2004	393	471	-78
*2005	245	120	125
2006	113	276	-163
2007	88	229	-141
2008	114	291	-177

Source: Continental Micronesia Office
*Note 2002 to 2005 do not include airmail

The two tables containing airfreight data are similar in some years and different in others. It is not totally clear why these differences exist. One reason is a note in some background data that mail was not included in the statistics for some years. It is also possible that in some years inter-island cargo was included and in other years it was not included. An attempt will be made to resolve this difference and provide an explanation in the next report. At this time, the two tables will remain in the report since there is no justification to eliminate or select either one.

Some additional data on air cargo was obtained from the FSM Customs & Tax Administration on July 27, 2009. However the information includes both mail and freight that arrived at the airport. The transmittal indicates that the large freight volume in 2004 was influenced by the figures for April and May 2004. These numbers are significantly higher as they were the months following Typhoon Sudal when goods related to the relief efforts were coming in by air.

Table 3-16. Air Cargo Received at Yap International Airport

	2004	2005	2006	2007	2008
Mail	6,118	8,800	6,923	6,443	6,824
Freight	13,842	7,873	8,760	6,612	7,625

Source: FSM Customs & Tax Administration, July 27, 2009

a) Air Carrier Freight

The airfreight data from 1997 to 2008 (Table 3-15) shows that the average amount of airfreight brought into Yap was approximately 280 tons per year. The most inbound airfreight was recorded at 245 tons in 2005, while the least amount was 88 tons in 2007. Outbound airfreight has varied over the years but has shown some increase in the past few years. The average outbound freight over the span was approximately 348 tons per year. This means that the average outbound airfreight has been exceeding the inbound airfreight. Yap tends to have more exportable items than any of the other states in the FSM.

b) Inter-island (PMA) Air Freight

Inter-island Air Freight is shipped on the Pacific Missionary Air aircraft. Space and weight are limited on this aircraft. Data on operations during a recent one-year period are shown in Table 3-17. The outbound cargo to the outer islands is significantly larger than the inbound cargo. Some of this cargo is emergency medical supplies, which in some cases must be air dropped to the island when the airstrip is unusable or there is no airstrip available.

Table 3-17. Inter-island Air Cargo: July 2008 through June 2009

	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	TOTAL
Outbound	10,984	11,773	1,384	4,770	2,826	8,444	4,235	9,499	2,845	9,121	14,323	9,796	90,000*
Inbound	3,509	3,708	1,580	1,923	1,398	1,967	2,854	2,513	1,383	2,601	3,562	4,540	31,538*
Total	14,493	15,481	2,964	6,693	4,224	10,411	7,089	12,012	4,228	11,722	17,885	14,336	12,1538*

*Weight shown is in pounds.
Source: Data provided by Pacific Missionary Air on July 23, 2009

c) Other Cargo

Freighter aircraft have not made trips to Yap since 2004. No other cargo has been brought to or from the island by air since that time according to persons interviewed.

d) Mail

Data about inbound and outbound international mail shipped on the Air Carrier aircraft is presented in Table 3-17. Discussions to date indicate that the airmail data may have been combined with airfreight in some years and separated out in other years and this may have affected the values in the different data tables. Mail shipped by contract on Continental Air Micronesia and Pacific Missionary Air takes priority behind passengers and baggage and before cargo. Therefore mail service is generally available and service is reasonably frequent.

Data on mail service to the outer islands was received from Pacific Missionary Air. Their data for one fiscal year is presented in Table 3-18. This table also contains data on mail movements between the outer islands.

Table 3-18. Inter-island Mail Arrivals and Departures - July 2008 through June 2009.

	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	TOTAL
Departures	24	176	24	144	125	449	414	180	742	0	607	174	3,059*
Arrivals	3	0	6	6	3	3	15	12	262	3	9	16	338*
Inter-island	0	155	181	0	0	0	109	0	0	0	0	0	445*
Total	27	331	211	150	128	452	538	192	1004	3	616	190	3,842*

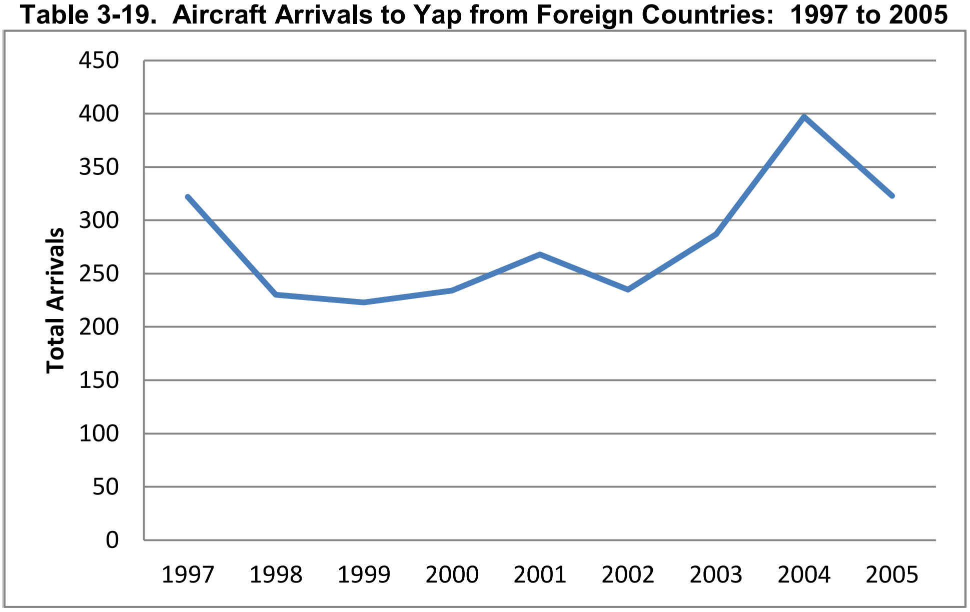
*Weight shown is in pounds.

Source: Data provided by Pacific Missionary Air on July 23, 2009

3.5.3 Aircraft Operations

Aircraft arrivals from foreign countries to Yap initially began to decline from the year 1997. These arrivals began to increase slightly in 2001 until the September 11th attacks on the United States changed the arrivals to decline again. This trend was short-lived, as the arrivals began to increase yet again in 2002, but had another significant drop in 2005.

Table 3-19. Aircraft Arrivals to Yap from Foreign Countries: 1997 to 2005



Source: FSM Office of Statistics

Since there are no fixed base operators or general aviation aircraft based at Yap International Airport, it is safe to assume that the number of departures will match the number of arrivals. That would mean that the total average use of the airport over the nine-year time period would average approximately 560 flights (total of both arrivals and departures) per year. However, as will be noted below, this number does not appear to include the all inter-island operations performed by Pacific Missionary Air.

a) Air Carrier

Commercial aircraft arrivals equal departures, so only one set of data is provided for this item. It should be noted that Pacific Missionary Air does not appear to be included in Table 3-20. This may be because PMA operates without a schedule and the airport management may be unaware of when they perform an operation. PMA operations are discussed in a later section.

Table 3-20. Aircraft Arrivals by Type: 2000 to 2007

Types of Aircraft	2004	2005	2006	2007
Total	418	323	226	237
Commercial	383	311	219	230
Freighter	6	0	0	0
Military	20	0	0	0
Private Aircraft	9	12	7	7
Others	0	0	0	0

Source: 2000 through 2004 data: Yap Branch Statistics Office, Division of Statistics, 2007 Annual Statistical Yearbook, Yap State, Table 8.7
Source: Yap Branch Statistics Office, Division of Statistics, DRAFT 2008 Annual Statistical Yearbook, Yap State, Table 8.7. Data reported to be from Immigration & Labor, FSM Department of Justice

Aircraft occupancy essentially equates to the average number of passengers per flight. To arrive at a realistic ratio of numbers of passengers per flight, we will need to derive a correlation between aircraft departures and the number of departing passengers, using historic data for visitor/transit passengers, as well as historic data for the number of aircraft departures.

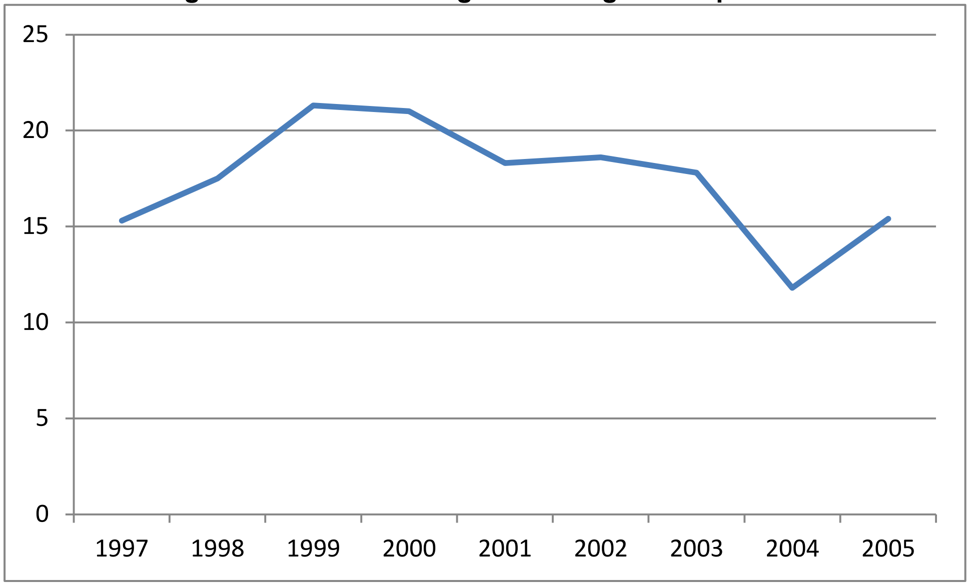
Continental Airlines uses a Boeing 737-800 series aircraft, which has a total capacity of 155 passengers. There are 14 First/Business Class seats and 141 economy seats. With Yap International Airport being a stop between Guam and Palau, the entire 155 seats' final destination is not Yap. Data on passenger arrivals and average passengers per flight is shown in Table 3-21.

Table 3-21. Average Passenger Per Aircraft Arrivals at Yap: 1997 to 2005

	1997	1998	1999	2000	2001	2002	2003	2004	2005
Passenger Arrivals	4930	4031	4750	4905	4908	4361	4182	4694	4989
Flight Arrivals	322	230	223	234	268	235	287	397	323
Average Passengers to Yap	15.3	17.5	21.3	21.0	18.3	18.6	14.6	11.8	15.4

Source: FSM Office of Statistics

Table 3-22. Average Number of Passengers Per Flight to Yap: 1997 to 2005



Source: FSM Office of Statistics

The highest average passenger count over the nine year period was an average of 21.3 passengers per flight arrival in the year 1999. The overall average passengers arriving per flight over the nine year period was approximately 17.4 passengers per flight.

b) Inter-island Aircraft Operations (PMA)

One interesting observation regarding the above tables is that they do not appear to include the operations performed by Pacific Missionary Air. This air service operates on an unscheduled basis, and its operations are generally unobserved by the airport staff. We also have not verified if Immigration and Customs is ever called to meet an incoming flight. Since almost all PMA activity is between Yap State islands, this is all domestic activity. Data from Pacific Missionary Air for one year are presented in Table 3-23.

Table 3-23. PMA Inter-island Aircraft Departures from Yap - July 2008 through June 2009.

	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	TOTAL
Departures	12	13	8	16	9	16	14	12	12	13	23	18	166

Source: Data provided by Pacific Missionary Air on July 23, 2009

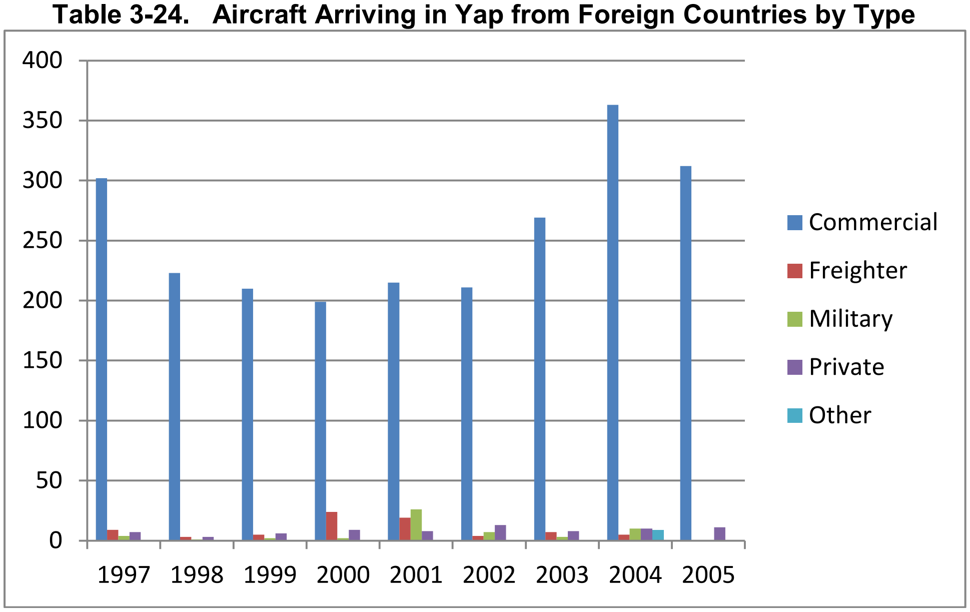
3.5.4 Other

Historically the only other operations at the airport have been military and occasional other aircraft. The airport has very limited support facilities, so it is not generally used as a stopover for long over water flights. Yap does not have a reputation for catering to high end visitors so it traditionally has not been a destination or stopover point for private aircraft seeking unique or unusual opportunities on the island.

3.5.5 Aircraft Mix

There was an initial decrease in commercial aircraft arrivals after 1997, but then that amount remained consistent until a significant increase in 2003. The average number of commercial aircraft to arrive over the nine-year period is approximately 256 per year. The highest number of commercial aircraft to arrive over the nine-year period was 363 aircraft in 2004. Freighter, military, private, and other classifications of aircraft have contributed to a small amount of aircraft arrivals. The overall average of all types of aircraft arriving at Yap International Airport was approximately 280 per year for the nine-year time span.

Table 3-24. Aircraft Arriving in Yap from Foreign Countries by Type



Source: FSM Office of Statistics

3.5.6 Peak Hour Operations

Peak operations are normally two operations per hour, specifically the arrival and departure of either Continental Micronesia or an occasional local flight by PMA. On rare occasions when Continental Micronesia had daytime flights on Wednesday one PMA flight might arrive or depart during the same hour. This is extremely rare, and will remain so for many years due to restrictions applied to the airspace surrounding this region of the Pacific.

3.6 FORECASTS

3.6.1 Introduction and Discussion

Forecasting for the Yap International Airport takes on a different dimension when the reality of Yap State is introduced as part of the equation. The population forecast for the entire state as noted above is 15,000 persons. The present aircraft serving the airport, the Boeing 737-800, can carry 155 passengers. This aircraft could move the entire state population in less than 100 departures. The imbalance between aircraft capacity and the local area is substantial.

3.6.2 Passenger Forecasts

a) International (Air Carrier and Charter) Passengers

There is no reason to believe that Yap will become a population growth or decline center anytime within the next 20 years. Although more persons may leave or return in any one-year, such a one-year imbalance appears to be evened-out over time. This is based on the historic traffic patterns discussed above. There is no justifiable reason to foresee Yap becoming an airline hub. All outer islands lie northeast and east from the center of the airport. An Inter-island hub, should it ever develop, would probably be on one of the outer islands. Therefore forecasts of either departures or arrivals, assumed to be equal in each year, are considered appropriate for planning purposes at this airport. These forecasts will concentrate on arrivals since more data appears to be available for this group of passengers.

The Air carrier passenger forecasts for the low, most likely and high assumptions, are shown in Table 3-25.

Table 3-25. Forecasted Passenger Arrivals

Year	Low	Most Likely	High
2010	8,881	8,970	9,059
2011	8,881	9,060	9,240
2012	8,881	9,150	9,425
2013	8,881	9,242	9,613
2014	8,881	9,334	9,805
2015	8,881	9,427	10,001
2020	8,881	9,908	11,042
2025	8,881	10,414	12,192
2030	8,881	10,945	13,461

b) Inter-island Passenger Forecasts

Inter-island passenger and cargo movements will be limited by costs and the ability of travelers and shippers to pay. The volume of travel will also be limited by availability of aircraft. The forecasts will assume that Pacific Missionary Air or a similar organization will continue to service Yap State.

The passenger data provided by PMA shows a significant imbalance between the 921 arrivals and the 613 departures to the outer islands. However, it is not clear if this is a permanent relationship or the results of events during the one-year period data is available. The higher out migration may represent permanent movement from the outer islands to the center of the state. It may also reflect conditions existing during part of the year when the State field trip ship was unable to visit the islands. The forecasts will be made only for arrivals, as this is the higher movement pattern.

The low passenger forecast will assume limited growth of funding for travel and cargo. One assumption will be continued limited funding for medical and educational trips through the entire forecast period. Passengers will be assumed to only double per year to 1,001 arrivals in the final year. The most likely forecast assumes enhanced funding for government services on the outer islands resulting in more trips, but only limited increase in income and, therefore, only limited increase in personal travel. The forecast for the final year is for 1,234 arrivals.

The high forecast will assume significant change in expenditures, services, and training on the outer islands. There will be more medical, educational, etc. trips made each month, reaching an almost daily travel pattern at the end of the forecast period. Outer island leaders, educators, health professionals, etc. will be brought to the State center for training. Outer island sports and educational teams will be brought into a central point for training and competition. Similar activities will be funded and encouraged. The high forecast also includes an assumption of more travel by tourists and visitors. The high forecast will be for 1,517 arrivals.

The Inter-island departures forecasts are shown in Table 3-26.

Table 3-26. Forecast of Inter-island Passenger Departures

Year	Inter-island Passenger Departures		
	Low	Most likely	High
2010	1,001	1,011	1,021
2015	1,001	1,063	1,127
2020	1,001	1,117	1,245
2025	1,001	1,174	1,374
2030	1,001	1,234	1,517

3.6.3 Air Cargo Forecasts

Forecasts of cargo are difficult for the many of the same reasons discussed above. As noted, Yap businesses minimize their use of air cargo services due to the negative experiences that are the result of weight restrictions on the aircraft. This restriction might continue in the future, be somewhat improved, or significantly greater air cargo capacity might be made available. The low, most likely and high forecasts will be based on these assumptions. (Note that this assumption is based on most cargo is coming from or going to Guam. This has not been verified at this time.)

Another concern is to differentiate between inbound and outbound cargo. The current imbalance appears to result from limitations of weight available both inbound and outbound. The higher outbound appears to be the result of more capacity being available on the outbound aircraft. There is most likely less cargo departing from Palau to Guam than going from Guam to Palau and, therefore, it appears that there is more capacity available for Yap cargo in the outbound direction to Guam.

While the inbound air cargo may increase in the different forecasts, the outbound cargo is expected to reach a limit not significantly higher that its present volume. That is because, at this time, no product has been identified that could be produced on Yap which would justify the high cost of air shipment. It appears that the present situation does not satisfy all the demand for outbound shipments as illustrated by the first class shipment of betel nuts. However, even the most optimistic forecast of betel nuts and other product indicates only a moderate increase in total outbound shipments.

a) International Air Cargo Forecasts

The low cargo forecasts a growth each way to one ton per day inbound and outbound. This could be handled on a continued limited aircraft operation pattern similar to that existing today. The only assumed change is that the airline will provide more frequent schedules to meet this small demand.

The most likely forecast will also be made on a judgment basis at this time. The assumptions are that there will be more demand for cargo, especially inbound, to service the increased tourist trade.

The most likely forecast of outbound cargo is increased from an inbound total of 120 tons in 2010 to 147 tons in 2030.

The high forecast will take a similar approach. The outbound cargo will continue to be limited since no products of sufficient value have been identified to justify a large outbound forecast. However, assuming lower air cargo costs and more availability, the volume can be assumed to increase. However, the inbound forecast will assume much more significant overall growth, not only of visitors and tourists, but also for the public and private sectors of the economy.

The inbound and outbound air cargo forecasts are presented in Tables 3-27 and 3-28.

Table 3-27. Forecast of Inbound International Cargo

Year	Inbound Cargo - Tons		
	Low	Most likely	High
2010	119	120	121
2015	119	126	134
2020	119	133	148
2025	119	140	163
2030	119	147	180

Table 3-28. Forecast of Outbound International Cargo

Year	Outbound Cargo - Tons		
	Low	Most likely	High
2010	277	229	232
2015	277	241	256
2020	277	253	282
2025	277	266	312
2030	277	280	344

b) Inter-island Air Cargo Forecasts

Inter-island air cargo will be limited due to the size of aircraft that can operate this service and the high cost of air cargo relative to ability of the islands to pay. The outer islands already have a much higher population density per square mile than the central islands of Yap State. Therefore, it is unlikely that the outer island population will grow significantly as the population may already be approaching the capacity of the islands. In FY 2009 Pacific Missionary Air moved 90,000 pounds (45 Tons) of outbound cargo and 31,531 pounds (15.8 tons) of inbound cargo.

Unless air cargo to and from outer islands increases dramatically, it will and can be carried on the existing or similar aircraft by providing increased flights per month. The low forecast will assume a doubling of the outbound cargo to 90 tons, the most likely to 180 tons and the high forecast to 270 tons.

3.6.4 Aircraft Operations Forecasts

a) International Air Carrier Operations Forecasts

The current aircraft serving Yap is a Boeing 737-800 model flown by Continental Airlines. The current July 2009 schedule provides three Guam to Yap and Palau and three Palau to Yap and Guam flights, a total of six flights per week or approximately 312 flights per year. Starting October 2010, Continental reduced service to Yap by one third. This reduction was made in hopes of increasing the number of enplaned passengers on its route to Yap. If successful there should be no further reduction in service by Continental Micronesia.

3.6.5 International Charter Operations Forecasts

At this time there are no plans for international charter operations. If such operations occur they will offset the operations by the air carrier unless the forecast of passengers changes.

3.6.6 Military Operations Forecasts

Military from the United States or any other countries have not operated in Yap in recent years. At some point they may begin to operate but the frequency is expected to be very small.

3.6.7 Inter-island Operations Forecasts

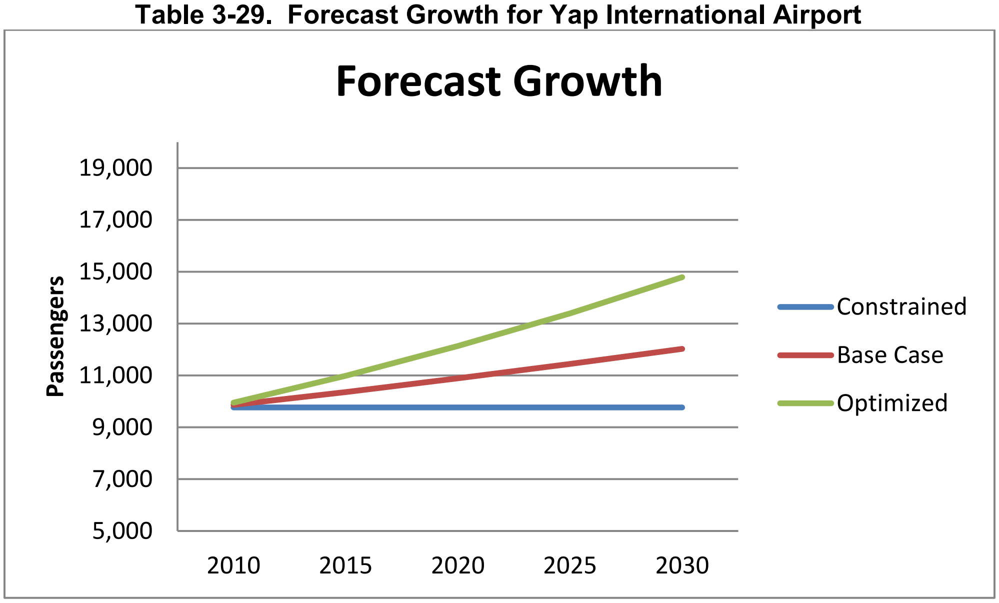
Inter-island operations will grow to accommodate the demand. At some point, when demand becomes steady the operator may publish schedules and provide scheduled service to the outer islands, the operations per day will increase. The capacity of the PMA aircraft and crews will be discussed on Yap with the organization and their input obtained on both the forecasts and aircraft in order to forecast the aircraft operation frequency.

3.6.8 Other Operations Forecasts

Other operations by private aircraft, stop over aircraft refueling, etc., may occur as in the past. None of these activities is expected to have an impact upon the airport.

3.6.9 Forecast Summary

Table 3-29. Forecast Growth for Yap International Airport



The “most likely case” is shown with a one percent per year growth rate, while the “high case” indicates a two percent growth rate, and the “low case” projects a flat growth rate.

Subsequent chapters will utilize the “base case” growth rate as this applies to passenger counts, numbers of flight operations, peak hour conditions, and other parameters that will be useful in determining when facility improvements are needed.

CHAPTER 4: DEMAND CAPACITY ANALYSIS

4.1 AIRPORT CAPACITY: AIRSIDE

Airport capacity can be calculated using the procedures in FAA Advisory Circular 150/5060-5. The title of this Advisory Circular is “Airport Capacity and Delay.” The Advisory Circular is over 20 years old, but the procedures, methodology and principles included therein are reasonably appropriate for today’s aircraft and operations. However, because this manual is primarily applicable to high volume/high operations airports that are approaching capacity, and plan to increase their capacity or to develop an entirely new airport, it is not appropriate for calculating annual capacity at Yap International Airport since demand is so far below even the most restricted instrument flight rules (IFR) capacity.

The FAA methodology for capacity analysis involves a step-by-step process that addresses three components of the airfield’s capacity which are determined using the method in FAA AC 150/5060-5, including the hourly capacity of the runways, the annual service volume, and the annual aircraft delay.

Hourly Capacity of Runways: This basic measure of capacity is related to peak hour activity, and regulates the maximum number of aircraft operations that can take place in one hour.

Annual Service Volume: This number refers to the annual capacity or maximum level of aircraft operations that can occur at an airport during one year. This volume can be used as a reference in planning the runway system.

Annual Aircraft Delay: This is a measure of the total delays incurred by all aircraft on the airfield in one year.

4.2 FACTORS AFFECTING CAPACITY

Airfield capacity is defined as the number of aircraft operations that an airfield configuration can process or accommodate during a specified interval of time when there is a continuous demand for service (i.e., an aircraft is always waiting to depart or land). The capacity of an airport is affected by several factors including the runway/taxiway system (airfield layout), meteorological conditions, aircraft mix, touch and go operations, and percentage of arrivals. These items are described below.

4.2.1 Runway/Taxiway System Capacity

The capacity of the runway/taxiway system is a primary determinant of the level of activity that can take place at the airport. An airport is assumed to reach capacity when the average delay for an arrival or departure exceeds a certain predetermined level. Yap has one runway (7-25) and a single stub taxiway. The layout of both the runway and taxiway are constrained to the current configuration by the lack of available land and Yap's geographical terrain.

4.2.2 Meteorological Condition

Aircraft operating parameters are dependent upon the weather conditions, such as the cloud ceiling height and visibility range on and near the airfield and, more importantly, wind because aircraft land and takeoff into the wind. As weather conditions deteriorate, pilots must rely on instruments to define their position both vertically and horizontally. Capacity is lowered during such conditions because aircraft are spaced further apart when they cannot see each other. Also, some airports, such as Yap International Airport, may have limitations with respect to their instrument approach capability which impacts capacity during bad weather. The FAA defines three general weather categories, based upon the height of the clouds above ground level and the visibility:

- Visual Flight Rule (VFR): Cloud ceiling is greater than 1,000 feet above ground level (AGL) and the visibility is at least three statute miles. All airports are able to operate under these conditions.

- Instrument Flight Rule (IFR): Cloud ceiling is at least 500 AGL but less than 1,000 feet AGL and/or the visibility is less than three statute miles but more than one statute mile. Aircraft operations are limited if the aircraft and the airport are not equipped with the proper instrument facilities.

- Poor Visibility and Ceiling (PVC): Cloud ceiling is less than 500 feet AGL and/or the visibility is less than one statute mile. Most airports, even those with precision instrument capabilities, have limited operations during these conditions

This factor is important in determining the percent of time that aircraft operations are conducted under VFR and IFR conditions or below visibility minimums, as the capacity of the airport differs under VFR versus IFR conditions.

4.2.3 Aircraft Mix Index

The operational fleet at an airport influences an airfield's capacity based upon differing aircraft requirements. Various separations are set by the FAA for a number of safety reasons. For example, an airfield's capacity is influenced by the time needed for the aircraft to clear the runway either on arrival or departure. As aircraft size and weight increases, so does the time needed for it to slow to a safe taxiing speed or to achieve the needed speed for takeoff. Therefore, a larger aircraft generally requires more runway occupancy time than a smaller aircraft would. Thus, as additional larger aircraft enter an airport's operating fleet, the capacity for that airfield will be lowered.

There are four categories of aircraft used for capacity determinations under the FAA criteria. These aircraft classifications are based upon the maximum certificated takeoff weight, the number of engines, and the wake turbulence classifications.

Table 4-1. Aircraft Classifications

AIRCRAFT CLASSIFICATIONS			
Aircraft Class	Maximum Certificated Takeoff Weight (lbs)	Number of Engines	Wake Turbulence Classifications
A	12,500 or less	Single	Small
B	12,500 or less	Multi	Small
C	12,500 – 300,000	Multi	Large
D	Over 300,000	Multi	Heavy

Source: FAA AC 5360-5, Change 2, "Airport Capacity and Delay."

The aircraft mix at Yap International Airport contains class A, B and C aircraft. The mix index is the mathematical expression of the aircraft mix, and is the percent of C aircraft plus three (3) times the percent of D aircraft [%(C+3D)]. The mix index for Yap International Airport is 100 percent.

4.2.4 Percentage of Arrivals and Percentage of Touch and Go's

The percentage of aircraft arrivals is a factor of the ratio of landing operations to the total operations of the airport. This percentage is considered because aircraft approaching an airport for landing require more runway occupancy time than an aircraft departing the airfield. The percentage of touch and goes is the ratio of landings with an immediate takeoff to total operations. There are currently no touch and go operations at Yap. Arrivals and Departures at the airport are equal, thus arrivals comprise 50 percent of the total operations.

4.3 AIRFIELD CAPACITY ANALYSIS

Yap International Airport should not experience any runway related capacity problems during the planning period. YAP was designed with a paved runway together with a connecting taxiway to the terminal apron to be used for Commercial Service operations (Airport Classification , ARC, D-III), The capacity of the single runway configuration was evaluated within the parameters of US FAA Advisory Circular, AC 150/5060-5 together with the National Plan of Integrated Airport Systems service level criteria and has been determined to be adequate for the foreseeable future. Construction of a parallel taxiway would not be feasible due to the required separation standard distance from the runway centerline to the parallel taxiway centerline for the critical/design aircraft (B737-800).

Flights are managed through the prior notification process for arriving and departing aircraft at Yap International Airport. Ground Communication Facilities under airfield jurisdiction, required operating procedures, the Common Traffic Advisory Facility (CTAF), observation from airport ground vehicles and the Aircraft Rescue and Fire Fighting Station assure the runway is clear.

The runway capacity is assured and adequate for the foreseeable future, subject to the above capability of airport management.

4.4 APRON PARKING AREA

An aircraft parking apron is usually located adjacent to the passenger terminal. The loading and unloading of passengers, baggage, cargo, and mail; as well as the fueling, servicing, and light maintenance of the aircraft take place at the aircraft parking apron. The distance between the passenger terminal and adjacent runways and taxiways is determined in part by the depth of apron required for the maneuvering and parking of the aircraft. Adequate depth for the apron should be preserved for maneuvering and parking of both current and future aircraft and for apron activities.

In 2009 Yap International Airport completed a FAA AIP funded apron improvement project. The apron is constructed of concrete and is 520 feet long parallel to the runway centerline and 300 feet wide parallel to the taxiway centerline. The apron is designed to accommodate two 757-300 aircraft in a power-in/power-out configuration. The apron has full safety and object free area clearances on three sides. The terminal building is beyond wing tip clearance criteria for the

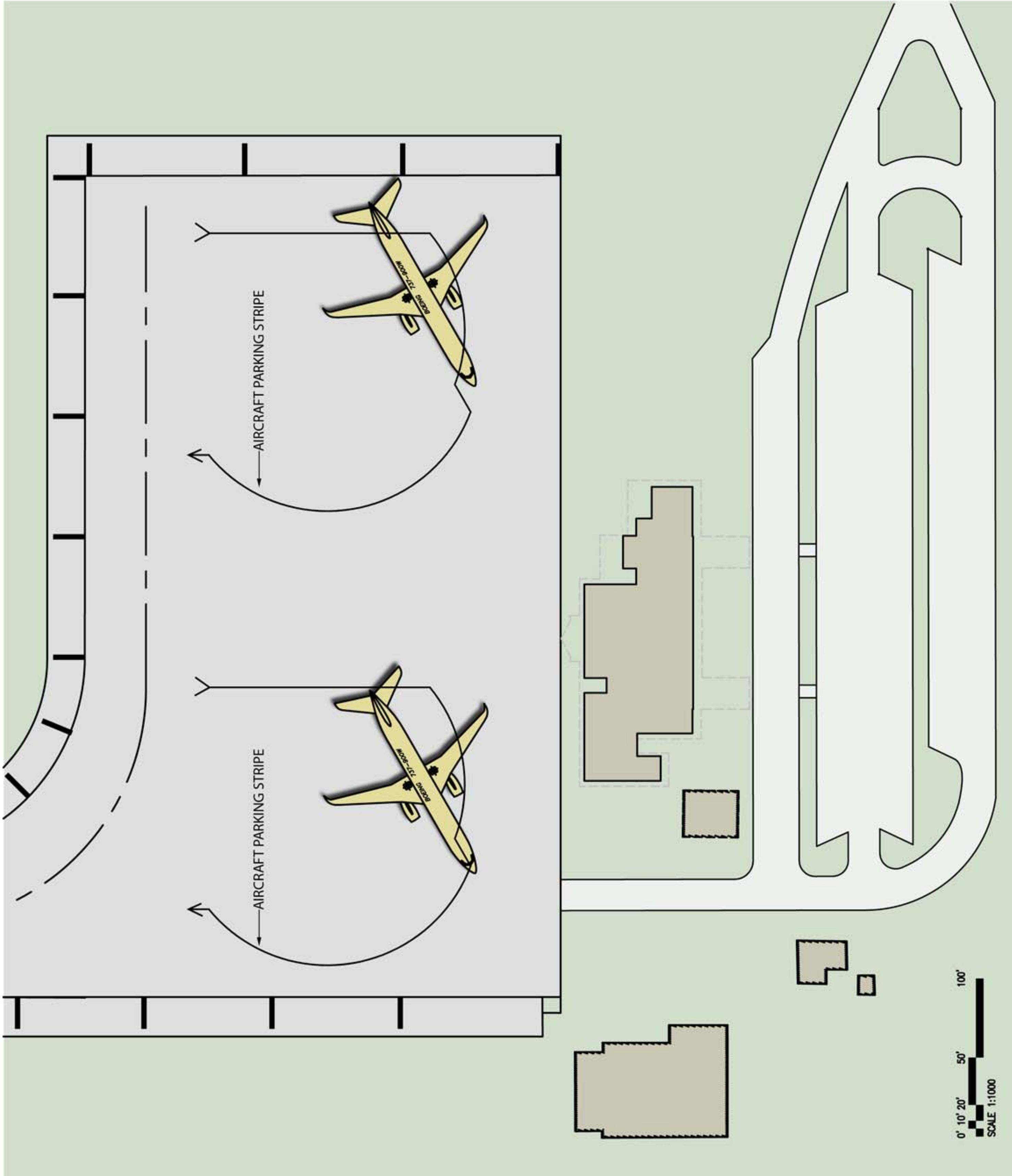


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FIGURE 4-1. APRON LAYOUT PLAN

aircraft using the facility. Two fuel hydrants (one at each parking apron) were installed with underground pipes in 2009. The aircraft parking apron meets the capacity needs of Yap International Airport

At this time there is no plan or need for future loading bridges. However, the apron layout has considered the future provision of one or two loading bridges. The primary purpose of incorporating the loading bridges is to permit the apron to be designed to accommodate them should they be desired in the future

4.5 AIRPORT CAPACITY: LANDSIDE

"Landside" relates to the terminal area facilities that are used primarily for passenger movements. This area includes the terminal/administrative buildings, the ARFF facility, general aviation facilities, parking and access roads. The following subsections address the abilities of these landside facilities to accommodate existing demand, and to identify the requirements needed to handle future projections.

FAA's AC 150/5360-7, "Planning and Design Considerations for Airport Building Development," describes a methodology for translating forecasted passenger activity into design peak hour demands. The procedure utilizes historic and projected passenger levels and aircraft movements to develop a hypothetical design day activity table from which passenger peaking activity can be analyzed. The circular also provides "average" peaking charts and rules-of-thumb for rough estimating of various peak (high level of activity) hour demand activities.

Airport terminals and related vehicle access and parking are planned, sized, and designed to accommodate peak passenger demands of the forecasted period. But planning for absolute peak demands (the greatest demands anticipated); will result in impractically oversized and under-utilized facilities except on rare occasions.

In the case of Yap International Airport, the uses of AC 150/5360's methodology for finding peak hour design are unnecessary as there is only one scheduled flight a day into Yap. This flight, Continental's "Island Hopper" is the only current aircraft flying into Yap. This aircraft is a 737-800 series, which has a total capacity of 155 passengers.

Based upon observations of peak hour operations, the landside and access facilities should accommodate both existing and forecasted demand through the planning horizon. However, there is a correlation between the capacity of landside/access facilities and airline arrivals/departures. It is important to emphasize the role of airport management in taking a proactive role to establish optimized operational time slots for airlines' arrivals/departures. Operational control emanating from airport management is crucial in regulating the arrivals/departures throughout the day to avoid congestion and situations that could overwhelm the terminal and landside capacity. A good example would be to avoid having more than two aircraft at a time proceeding with arrival/departure operations simultaneously as this scenario would overtax YAP facilities.

4.6 AIR RESCUE/FIREFIGHTING STATION

Requirements for aircraft rescue and firefighting (ARFF) services at an airport are established under Federal Aviation Regulations (FAR) Part 139. An airport's ARFF Index determines the minimum ARFF equipment and extinguishing agents to comply with FAR Part 139.315. The Index is determined by a combination of factors including aircraft length and an average of five daily departures by the largest air carrier aircraft using the airport over a recent consecutive three month period. In the case of Yap, where there are less than five (5) daily departures of the largest air carrier aircraft using the airport, § 139.319 (c) is applicable:

"…the certificate holder may reduce the rescue and firefighting to a lower level corresponding to the Index group of the longest air carrier aircraft being operated"…

In the case of YAP, the largest air carrier aircraft operating at the airport is the B 737-800, which is 129.6 feet long. Thus, according to § 139.315 (b), YAP is currently an Index C airport. A new ARFF facility was completed in March 2010 and meets all requirements for an Index C airport.

4.7 COMMUTER, GENERAL AVIATION, AND BUSINESS JET

When placing general aviation parking, airport security will in large part determine the location of the parking area. Since persons using these aircrafts have usually not been screened for security, their movement in the aircraft operational areas and their access to the terminal building must be controlled. In addition, provisions must be made to permit unscreened individuals deplaning from general aviation aircraft to have access to terminal facilities without passing through "sterile" secure areas.

Currently Pacific Missionary Air flies out of Yap International Airport and has its own facilities located to the west of the terminal. PMA has a hanger that is home to its three based aircraft. This hanger also operates as the main office building and terminal area. All passengers traveling on PMA enter and exit the airport through this hanger area, no unscreened passengers enter the main terminal facility. The current operating procedures and hanger meet the needs of PMA.

4.8 PARKING

The AC 150/5360- 9 recognizes that parking requirements and characteristics vary from airport to airport and its guidelines may not meet the specific airport's needs. Data analyzed at many airports revealed that public automobile parking requirements are more accurately relatable to annual enplaned passengers than to peak hour passengers. According to AC 150/5360-9 the general rule for non-hub airports is that there are 50 parking stalls for every 25,000 annual enplaned passengers. Normally 15% to 25% of the total public spaces should be allotted to short –term parking (up to 3 hours' duration) with the remaining stalls used for long-term parking.

Using FAA calculations, the vehicle parking at Yap International meets the airports demand. The parking lot is presently bituminous surfaced and is in good condition. The lot consists of two lanes. The lane closest to the terminal has parking on both sides and has space for over 60 vehicles parked on the left and right of the central lane. This lane ends at the exit road from the terminal where vehicles turn left and either exit the airport, park in the third parking lane or return to the terminal frontage road.

4.9 AIRPORT ACCESS ROAD

The roadway system includes the roadway serving the terminal building and associated parking areas, and the service roads which provide access to terminal support facilities, to the airfield and other nonpublic areas. AC 150/5360-9 states that an adequate vehicular access, efficient circulation, and parking are essential to the success of a passenger terminal.

The access road to the airport terminal was constructed at the same time as the airfield. This road is bituminous paved and is still in relatively good condition. The road extends from the public road to the parking lot and terminal frontage road. There is parking space available in front of the terminal building. Beyond the terminal building the road turns left to permit vehicles to enter the parking lot or right for access to the Pacific Missionary Aviation office and the secure access entrance to the airfield.

There is a separate and new Portland Cement Concrete access road from the public road to the new ARFF building. This road was constructed in 2010 and is in excellent condition.

4.10 AIRPORT CAPACITY: TERMINAL

The terminal building is a one-story structure approximately 12,590 square feet in area. It was completed in the late 1980s. Major additions since completion include expansion of the Arrivals Lobby and Immigration and Customs area, addition of an entry canopy and porte cochere, and reroofing of the central lobby. A review of the capacity of the terminal processor (generally defined as the public areas) focused on four major components, ticketing, baggage, circulation areas, and the security checkpoints. The following is a review of those areas and other public spaces.

a) Ticketing Area

All check-in luggage is hand checked before the passenger proceeded to the ticketing area. The existing check-in counter are is approximately 20 feet long, with two check-in stations. In discussions with Continental Airlines, the two check-in stations are adequate for most flights, but on flights with more than twenty passengers or more, another check-in station is required.

Yap state law now requires the airport to collect a departure fee from all enplaning passengers; collection of the fee will also take place at the check-in counter. With the combination of the departure fee and a likely increase in peak activity due to the new flight schedule, it is recommended that the check-in area be expanded by approximately 15 feet to allow for a third station and fee collection. The expansion would bring the total counter space to 35 feet.

b) Baggage Claim

The existing baggage claim area is approximately 612 square feet. Baggage is manually loaded on to the baggage claim counter; the counter is approximately 18 feet long. The current lay out of the terminal area causes congestion and overcrowding in the baggage claim area. Currently passengers who claim their luggage must flight back through passengers exiting immigration and passengers waiting for customs inspection to exit the terminal. The lack of available counter space for baggage is also a problem and causes delays in passengers receiving their luggage.

To improve passenger movement and to reduce delay in passengers' ability to receive their luggage and exit the airport, it is recommended that the baggage claim area be increased to approximately 1,088 feet and that an extra 14 feet of baggage counter space be added to bring the total counter space to 32 feet.

c) Security Check Point

The existing security check point is approximately 432 sq ft and exists directly into the hold room (departure lounge). The security screening area at YAP meets capacity demands, but with no advanced x-ray machines or explosives detection devices at the airport, airline staff currently has to perform physical checks on all baggage, causing delays and leaving the airport and airlines vulnerable to potential dangers arising from contraband concealed in checked or carry-on bags. The delays caused by hand searches of passengers and carry-on baggage cause the security line to back up into the main terminal lobby. Upgrade of screening equipment would increase passenger processing efficiency.

d) Lobby Area

The airport lobby is open air and approximately 1, 760 sq ft. With the limited flight schedule departing passengers are flying out on the aircraft that just arrived, so enplaning and deplaning passenger do not use the lobby at the same time. The existing lobby meets the needs of YAP.

e) Hold Room and VIP Lounge.

Yap International Airport has one gate and one hold room. The hold room was expanded in 2008 to approximately 1,600 sq ft. with a maximum capacity of a hundred people. The hold room meets the current demand including TSA regulations, which requires at Micronesian airports that half of all passengers on Continental's flight must depart the plane along with all personal items (including carry-on luggage) and proceed to the hold room while security personnel perform a search of the aircraft. YAP does not have a VIP lounge. It is proposed that a VIP lounge be added to the west end of hold room with its own bathroom and exit to the airfield.

The restroom facilities in the hold room consist of one toilet in each of the men's and women's rooms. With the added security precautions and the change in flight schedule make the current bathroom facilities in adequate and need to be expanded to add a second toilet in each. Also, there are no concessions in the hold room, a concession area should be added to provide food and crafts to transiting passengers and to provide needed revenue source for the airport.

f) Cargo Facility

Cargo facilities are usually not included in conversations about terminal capacity, but since the cargo facility is connected to the terminal and is operated by Continental, it is included in this section. The existing facility is approximately 520 sq ft. Since Continental handles cargo for Yap International Airport, the same facility is also used to hold checked baggage. The combined use of the facility stresses its capacity. In some instances, luggage is left outside in the elements as there is not enough space within the facility. Also, the cargo bay is not large enough for Continental to fit its fork lift to load larger cargo. Currently, large cargo must be hand dollied out of the cargo area and then picked up by the fork lift; this adds to the delay of loading the aircraft and complicates the handling of baggage.

It is recommended that an approximately 400 sq ft. be added to the cargo facility. This would allow room for both checked baggage and cargo to remain under cover and fit inside the facility and to enlarge the cargo bay to allow for Continental's equipment to access the cargo facility. Ideally, these two operations should be separated. Continental is required to security screen all cargo, which is done by hand.

Figures 1 shows the existing passenger movement at Yap International Airport, Figure 2 Shows recommended enhancements to the terminal building and improved passenger movement. It is important to note that arriving and departing passenger do not mix; all enplaning passengers are clear of the lobby area and are in the hold room when the flight arrives. .

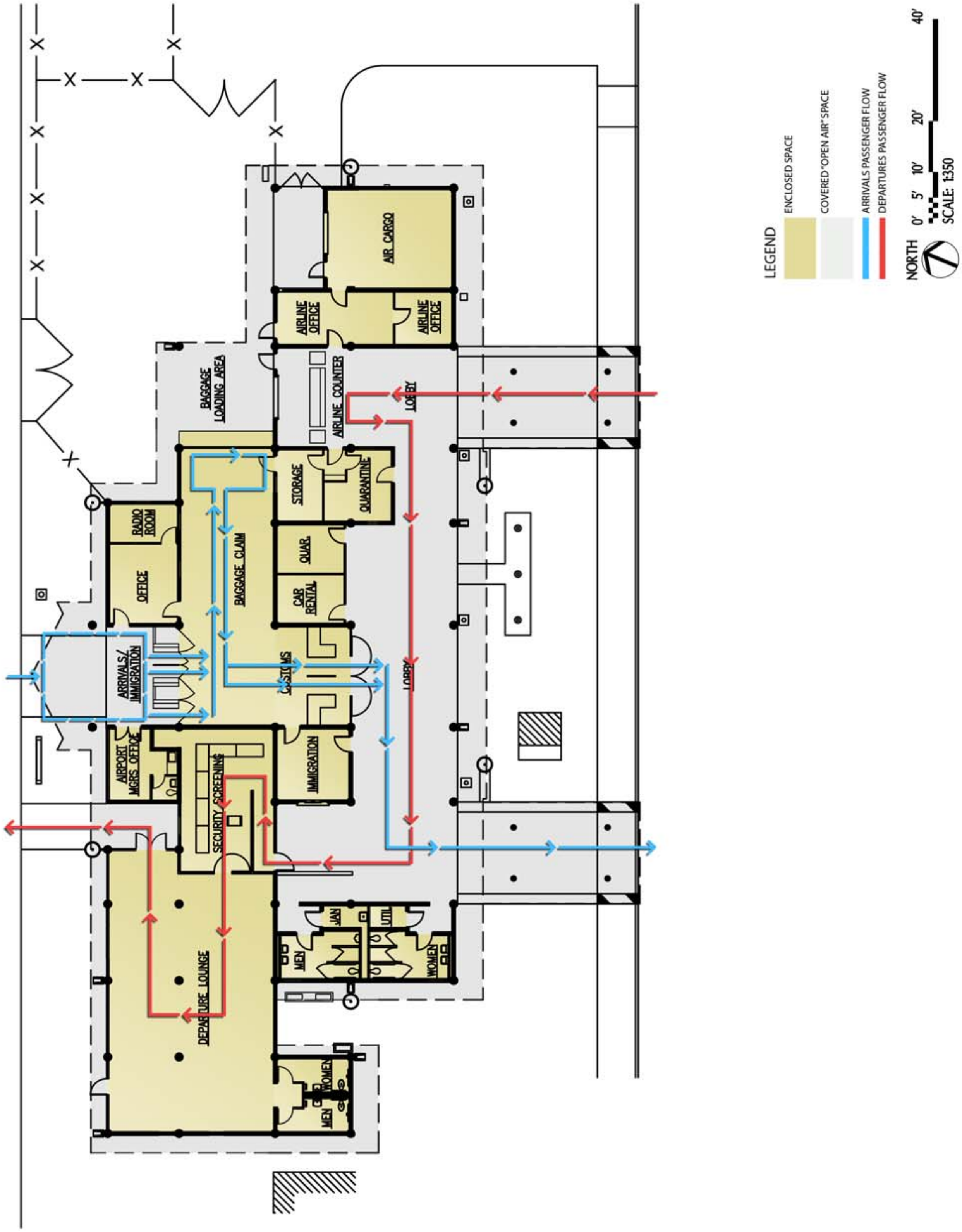

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FIGURE 4-2. EXISTING PASSENGER MOVEMENT DIAGRAM

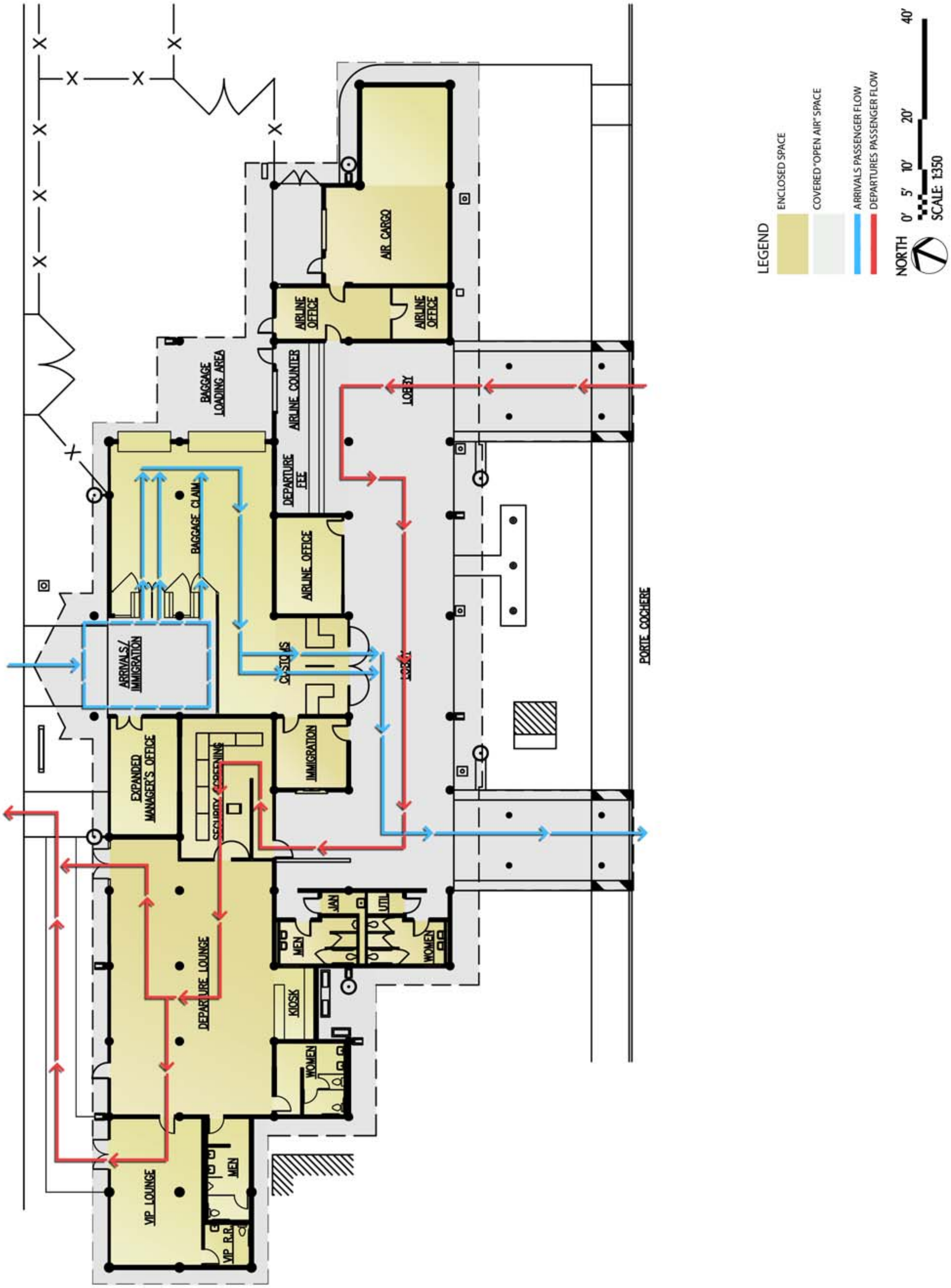

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FIGURE 4-3. PROPOSED PASSENGER MOVEMENT DIAGRAM

CHAPTER 5: FACILITY REQUIREMENTS

5.1 DESIGN STANDARD ISSUES

Airport design standards are spelled out in several FAA publications. Design standards for civil airports set forth in the FAA's Airport Design Advisory Circulars. These standards have been applied in the determination of facilities requirements for Yap International Airport. These circulars also recognize that each airport is unique and that some adjustments made be need to best fit each airport's needs.

5.2 AIRSIDE FACILITIES

"Airside" relates principally to the airfield facilities, which include the runways, taxiways, apron area, runway approach surfaces, runway protection zones and navigational aids (NAVAIDS). The following subsections address the ability of airside facilities to accommodate existing and future traffic loads, and to identify the requirements needed to handle future traffic.

5.2.1 Critical Design Aircraft

FAA AC 150/5325-4B provides guidance for determining the potential range of critical design airplanes through establishing a "substantial use threshold" of 500 or more annual itinerant operations at the airport (landings and takeoffs are considered as separate operations). If an aircraft were to meet this substantial use threshold, it would be eligible for consideration as a design aircraft. The critical design aircraft for this study is the Boeing 737-800 series. Previously, the Boeing 737-800 series aircraft was the only scheduled aircraft that flew into Yap and with more than 250 arrivals and departures, thus meeting FAA criteria for critical design aircraft. With the reduction of service to Yap, Continental Airlines has changed half of its flights from the 737-800 series to the 737-700 series. While these aircrafts now operate equally out of YAP, the 737-800 series will still be considered the critical design aircraft in determining facility requirements. In the past, Continental has talked about the possibility of change from the 737 aircraft to a 757 aircraft. If this change were to happen it would switch the critical design aircraft from the 737 to the 757.

Table 5-1. Critical Design Aircraft

Aircraft	Approach Speed (Knots)	Maximum Takeoff Weight (LB)	Maximum Landing Weight (LB)	Wingspan (Feet)	Length (Feet)	Max Tail Height (Feet)
Boeing 737-800	142	174,200	146,300	112.6	129.5	41.4
Boeing 757-300	143	273,000	224,000	124.8	178.6	44.8

5.2.2 Airport Reference Code

The FAA Advisory Circular 150/5300-13, *Airport Design*, has established a coding system to relate airport design criteria to the operational and physical characteristics of aircraft expected to use the airport. This code, the airport reference code (ARC), has two components. The first component, depicted by a letter, is the aircraft approach speed (operational characteristic); the second component, depicted by a Roman numeral, is the airplane design group and relates to aircraft wingspan (physical characteristic). Generally, aircraft approach speed applies to runways and runway-related facilities, while aircraft wingspan primarily relates to separation criteria involving taxiways, taxilanes, and landside facilities. Aircraft in lower ARC classifications would be accommodated by a higher ARC (i.e., A-I or a B-II fits into a D-III).

According to AC 150/5300-13, an aircraft's approach category is based upon 1.3 times its stall speed in landing configuration at that aircraft's maximum certificated weight. The five approach categories used in airport planning are as follows:

- ***Category A:*** Speed less than 91 knots.
- ***Category B:*** Speed 91 knots or more, but less than 121 knots.
- ***Category C:*** Speed 121 knots or more, but less than 141 knots.
- ***Category D:*** Speed 141 knots or more, but less than 166 knots.
- ***Category E:*** Speed greater than 166 knots.

Based on the critical design aircraft's tail height and wingspan, the airplane design group for Yap is Airport Design Group III.

Table 5-2. Airplane Design Groups

Airplane Design Groups (ADG)		
Group #	**Tail Height (feet)**	**Wingspan (feet)**
I	<20	<49
II	20 - <30	49 - <79
III	30 - <45	79 - <118
IV	45 - <60	118 - <171
V	60 - <66	171 - <214
VI	66 - <80	214 - <262

The design aircraft (737-800) would give the airport an existing airport reference code (ARC) of D-III. The ARC is not anticipated to change throughout the planning period. However, there is a possibility that Continental Airlines, the only commercial carrier into YAP, is looking into the possibility of using a Boeing 757 for its route through Micronesia. If Continental was to change aircraft, the ARC would change to C-IV.

Table 5-3. Airport Reference Code

Aircraft	Airport Reference Code
Boeing 737-800	D-III
Boeing 757-300	C-IV

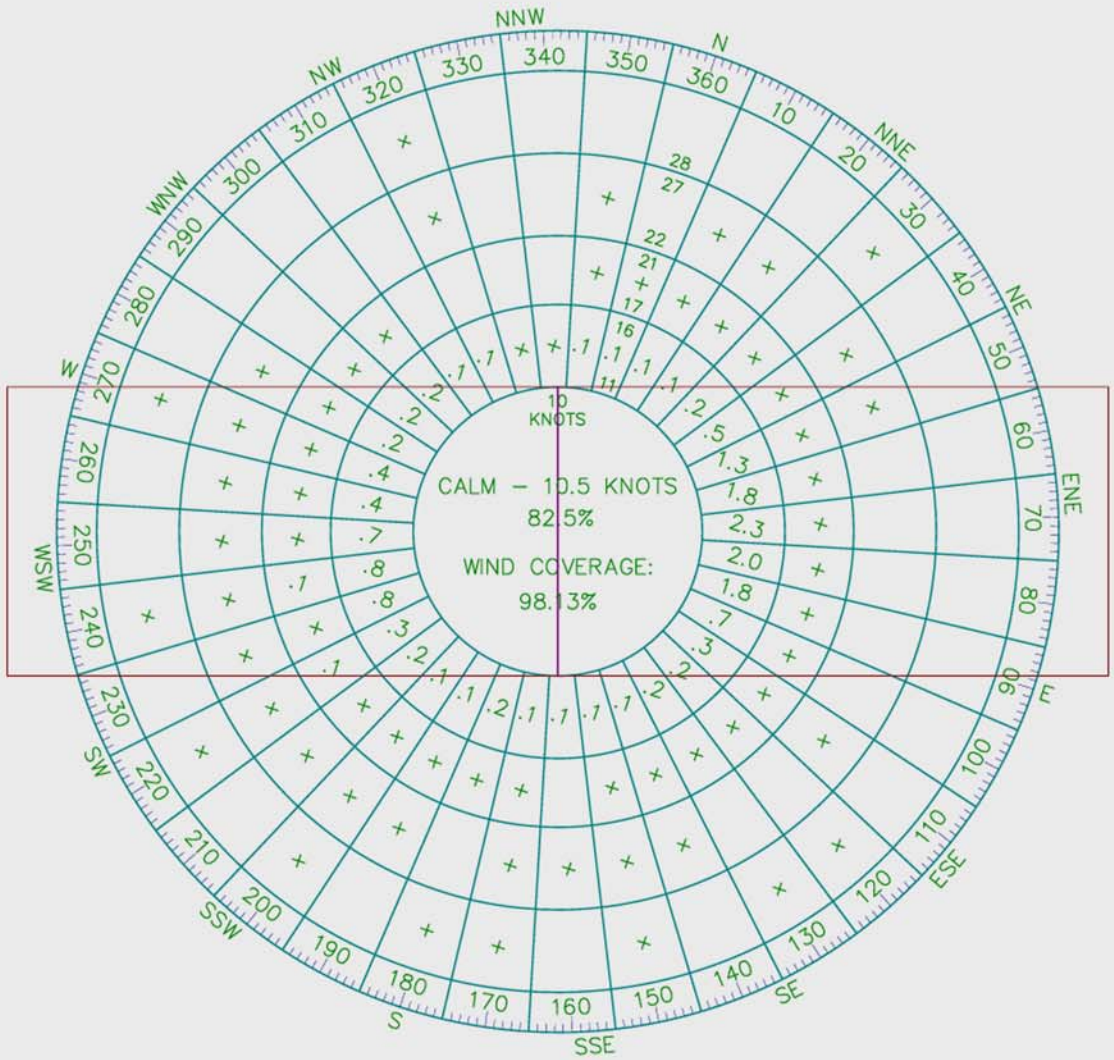
5.2.3 Wind Analysis

A factor influencing runway orientation and number of runways is wind. Ideally a runway should be aligned with the prevailing wind. Wind conditions affect all airplanes in varying degrees. The most desirable runway orientation based on wind is the one which has the largest wind coverage and minimum crosswind components. Wind coverage is that percent of time crosswind components are below an acceptable velocity. The desirable wind coverage for an airport is 95 percent, based on the total numbers of weather observations. Yap International Airport exceeds the desired wind coverage with 98.3 percent coverage (NOAA, Data taken between 1999-2008). See Figure 5-1, Wind Rose.

5.2.4 Runway Length

Runway length is a crucial consideration in airport planning and design. Aircraft need specified runway lengths to operate safely under varying conditions of wind, temperature, takeoff weight, and surface conditions. Yap International Airport has a single runway, Runway 7-25, that is 6000 feet long.

The current critical design aircraft for YAP is the Boeing B-737-800. It is the design aircraft based on current operations and determinations based on application of the Federal Aviation Administration-National Plan of Integrated Airports System Plan (NPIAS) and grant funding priority under the Airport Improvement Program, as amended. The above parameters are within programming planning criteria even though this location may have less than 500 total annual operations and less than a minimum of 2500 enplanements. This location is grandfathered based on prior grants and being programmed within the NPIAS.



YAP WIND DATA

1999 - 2008

CALM	5.9%
0-3 KNOTS	0.1%
4-6 KNOTS	27.1%
7-10.5 KNOTS	49.5%
	82.5%

RUNWAY 7-25 99.5% COVERAGE AT 16 KNOTS

SOURCE: NOAA NATIONAL DATA CENTERS
U.S. DEPARTMENT OF COMMERCE

YAP WIND ROSE
STATION NUMBER 91413
FILE NAME AN91413A.PRN
NAME YAP, PI
ANNUAL SUMMARY
1999 - 2008
CEILING/VISIBILITY: ALL
PRESENT WEATHER: ALL
HOURS: ALL

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FIGURE 5-1. WIND ROSE

a) Aircraft Landing and Takeoff Calculations

Aircraft Performance is calculated from guidance in US FAA Advisory Circular AC 150/5325-4B, "Runway Length Requirements for Airport Design "for the Boeing B-737-800 Aircraft. The Advisory Circular Guidance for runway design is not to be used for flight operations. Flight operations must be conducted in accordance with applicable aircraft flight manuals.

Table 5-4. Airport and Aircraft Data

Airport and Aircraft Data		
Airport Elevation - Sea Level	Zero Wind	Maximum Temp - 86˚F(Standard Day + 27˚F)
Auto Spoilers Operating	Anti-Skid Operating	Maximum Differences in Runway Elevation – 2 ft (Pacific Supplement)

Table 5-5. Aircraft Landing and Takeoff Calculations

Boeing B-737-800	
Max. Landing Design Weight	146,000 lbs.
Max. Takeoff Design Weight	174,200 lbs.
Landing Length - 30˚ Flaps	Wet Runway 6,200 feet, Dry Runway 5,800 feet
Takeoff Length	8,100 feet

The FAR Landing and Takeoff Runway Length Requirements for landing aircraft indicate a dry runway requirement of 5800 feet and wet runway requirement of 6,200 feet. An 8,100 foot takeoff runway requirement exists for a maximum takeoff design weight (MTOW) of 174,000 lbs. The Advisory Circular guidance is for airport runway design and is not to be used for flight operations. Flight operations must be operated in accordance with the applicable aircraft manual.

b) User Aircraft Landing and Takeoff Recommendations-System Operation Data

Commercial Air Carrier Service for Yap International Airport is provided by Continental Micronesia Airlines. The data in Table 5-6, Runway Landing Length-Airline User Data, includes the landing distances for various aircraft operational configurations and runway conditions. Local and area weather may cause variation in the airport environs and impact aeronautical operations. The scenarios in Table 5-6, include ground operational changes based on a dry runway with light rain, to moderate rain or heavy rain causing a wet runway surface resulting in poor braking action. The data in the table specifies the Runway Condition and Braking Action associated with Normal and Non-Normal Landing Conditions.

Table 5-6. Runway Landing Length – Airline User Planning Data

Runway Landing Length - Airline User Planning Data				
Runway Conditions	Normal Landing	Non-Normal Landing	Landing	Non-Normal Landing
Braking Action (BA)	Configuration	Configuration	Configuration	Configuration
	Flap 40 degree	One-Engine Inoperative	Anti-Skid Inoperative	One Engine Inoperative
	Braking Maximum V Ref 40 knots	Flaps 1 to 15 degrees	Flap 1 to 40 degrees	Hydraulics A/B System Inoperative
	Landing Distance	Landing Distance	Landing Distance	Landing Distance
New, Dry, Clean, Normal (BA)	3,298 feet	3,338 feet	5,302 feet	4,956 feet
Island, Day, Intermittent Rain, Good (BA)	4,618 feet	4,730 feet	5,922 feet	6,158 feet
Moderate Rain, Fair (BA)	6,235 feet	6,814 feet	7,524 feet	8,550 feet
Heavy Rain, Poor (BA)	8,758 feet	9,354 feet	10,100 feet	11,058 feet

Two major impacts to planning aeronautical facilities and aircraft operations in Micronesia are the distances between airports and changes in the weather. The Weather Forecast Office (WFO-Guam) provides routine daily forecasts for the FSM. Heavy weather alerts and Tsunami forecasting are also part of their services.

Normal operations are conducted in light to moderate rain. All runways are grooved to increase braking action. The non-normal and anti-skid inoperative landing distance in moderate rain covers a range of 6235 to 7524 feet. For planning purposes the landing length for the design aircraft Boeing B 737-800 at maximum design landing weight on a dry runway is 5800 feet and for the wet runway is 6200 feet. Based on consideration of available land area, a cost analysis and using the balanced runway concept, a 6500 foot landing runway length would be acceptable in the initial 5 year planning time period. This allows the air carrier to plan for enroute landing weights at those airports with lesser load restrictions and variable operational cycles.

The following landing runway length for a Current (5 year), Intermediate (6 to 10 year), and Long Term (10 to 20 year) plan for Yap International Airports is based on the design aircraft operational requirements and to meet forecast utilization and needs.

Table 5-7. State Airport System Planning

Runway Length			
State Airport	0 to 5 years	6 to 10 years	10 to 20 years
Yap International Airport	6000 feet	6500 feet	6500 feet

5.2.5 Pavement Strength

Aircraft weight characteristics also affect the design of an airport. Pavement design of the runways, taxiways, and aprons is based on a design aircraft. The design aircraft is different from the critical aircraft described previously. The design aircraft is determined by landing gear configuration (i.e., single wheel, double tandem, etc.), and the known or forecast number of operations of aircraft with the heaviest maximum gross takeoff weights. The dual wheel main gear, 174,200 pound maximum takeoff weight Boeing 737-800 series is expected to be the most demanding aircraft to frequent YAP. The current strength rating on Runway 7-25 is 75,000 pounds single wheel loading (SWL), 160,000 for double wheel loading (DWL), and 230,000 for a dual tandem wheel loading (DTWL).

The International Civil Aviation Agency, (ICAO), standard for reporting airfield pavement strength is the Pavement Classification Number, (PCN). The United States FAA is presently transitioning airport pavement strength reporting into this international system. The information and guidance for determining the PCN is provided in FAA Advisory Circular AC 150-5335-2B. Two approaches may be used to calculate the airport PCN. These are the “using” aircraft method or the “technical” evaluation method. Briefly, the “using” aircraft method determines the Aircraft Classification Number (ACN), of the most critical aircraft using the airport. See the Advisory Circular for more information on the definition and determination of the aircraft ACN. Generally this aircraft ACN number is then published as the airport PCN. The “technical” method allows evaluation of a range of aircraft including those that might use the airport in an emergency situation or for expansion of air services to the community. This method provides a PCN value that considers the aircraft wheels and the pavement structure that must support the aircraft loads.

The “technical” evaluation method was used to prepare YAP’s PCN values. The Yap International Airport has a flexible PCN value of 47/F/B/X/T and a rigid PCN value of 77/R/B/X/T. These values will permit reasonable use by any civilian or military aircraft that might chose to operate at the airport.

5.2.6 Pavement Condition Index

Proper maintenance of airfield pavements is considered an important part of airport safety and economic operation of airports. The Federal Aviation Administration (FAA) has also recognized the significant benefit of having some formal requirement for a pavement maintenance program at all airports and has encouraged airports to have such a program in place. The advantage of using a formal pavement maintenance program with regularly scheduled maintenance activity ensures that the cost of pavement maintenance is reduced and pavement performance optimized.

The MicroPAVER™ procedure describes the pavement condition by assigning a value from 0 – 100 to the represent the pavement condition. This value is known as the Pavement Condition Index (PCI) of the pavement. A brand new pavement is assigned a PCI of 100 at the time of completion. A major project, such as an overlay, is also assigned a PCI of 100. As each subsequent pavement survey is made, the information is used to compute a new PCI. Each individual airport can create its own standards, but the US Air Force guidelines recommend that localized preventive work should be continuous at all times. When the PCI declines to 70 global preventive maintenance work should be undertaken to inhibit further rapid deterioration. In the event the pavement declines to a PCI of 50, major rehabilitation projects should be undertaken.

A pavement condition surveys was conducted using MicroPAVER™ in 2011, the runway PCI was 80.

5.2.7 Runway Grades

The FAA Advisory Circular 150/5300-13, "Airport Design," allows a maximum longitudinal grade of 2.0% for A and B type runways and 1.5% for C and D runways. Gradient changes shall be such that any two points five feet above the runway centerline shall be mutually visible for the complete length of the runway. The effective gradient of the existing runway is 0.00% according to the Airport Layout Plan.

5.2.8 Runway Width

Runway width is a dimensional standard that is based upon the physical characteristics of the aircraft using the Airport. The most important physical characteristic is the wingspan. The FAA Advisory Circular 150/5300-13, "Airport Design," recommends a runway width for a Design Group III aircraft of 100 feet, unless the airport is used by aircraft exceeding 150,000 pounds, in which case the runway width should be increased to 150 feet. Presently, Runway 7-25 is 150 feet wide. Thus, a runway widening is not necessary.

5.2.8 Runway Blast Pad

Runway Blast Pads for ARC D-III airports are required to be 140 feet wide, except when serving Group III aircraft with a maximum takeoff weight greater than 150,000 pounds, for these aircraft the width of the blast pad is required to be 200 feet wide, which is the same required width for ARC C-IV airports. The required length for runway blast pads for both ARC D-III and C-IV is 200 feet. The existing blast pad length on runway 7 is 203 ft. and for runway 25 it is 201 ft. The widths for both ends of runway 7-25 are 200 ft. Runway 7-25 both in width and length meet the requirements set forth in AC 150/5300-13.

5.3 SAFETY AREA STANDARDS

The FAA has established several safety surfaces to protect aircraft operational areas and keep them free from obstructions that could affect their safe operation. These include the runway safety area (RSA), object free area (OFA) and runway protection zone (RPZ). The dimensions of these safety areas are dependent upon the critical aircraft ARC and approach visibility minimums. The entire RSA is required to be on airport property. If applicable design standards push the RSA beyond the airport property line, then fee simple acquisition will need to be undertaken. The OFA and RPZ can extend beyond airport land boundaries as long as obstructions do not exist within these areas. While it is not required that the RPZ be under airport ownership, it is strongly recommended.

5.3.1 Runway Safety Area (RSA)

RSA standards are defined in AC 150/5300-13 section 305 and construction standards are found in AC 150/5370-10 P-152. According to AC 150/5300-13 section 503, the RSA must be centered on the same line as the center of the runway and the RSA must be cleared, graded and have no hazardous surface variations. For ARC D-III airports the RSA length must be 1,000 feet beyond the runway end, and its required width is 500 feet. These requirements are also the design standards for an ARC C-IV airport.

Table 5-8. Runway Safety Area

Runway	Required Length	Actual Length	Required Width	Actual Width
7	1,000 ft.	200 ft.	500 ft	500 ft.
25		200 ft.		500 ft.

Source: FAA AC 150/5300-13 Table 3-3

The existing RSA are currently only 200 ft. in length and needs to be lengthened to meet FAA requirements. FAA and ICAO have made standardizing RSAs to these dimensions a priority. A Runway Safety Area (RSA) Inventory was completed in September 2000 by the Federal Aviation Administration for airports certificated under Federal Aviation Regulation (FAR) Part 139 using guidance included in FAA Order 5200.8, Runway Safety Area Program. The purpose was to identify airports which could provide the standard runway safety area 1000 feet long with a 150 foot extended runway width within the 500 foot wide safety area. A data entry form provided a common data structure for the collection and compilation of the inventory into a national data base. Those runway ends which could not meet the standard due to natural obstacles, property limitations, environmental constraints and local developments required the evaluation for alternatives to conform to the safety requirements expected from the 1000 foot long and 500 foot wide RSA standard.

Yap International Airport, unlike many airports through Micronesia, has available land for its RSAs to meet FAA requirements.

5.3.2 Object Free Area (OFA)

The runway OFA is “a two-dimensional ground area, surrounding runways, taxiways, and taxilanes, which arc clear of objects other than objects whose location is fixed by function (i.e., airfield lighting).” The OFA is centered on the runway, extending out in accordance to the critical aircraft design category utilizing the runway. For ARC D-III aircraft, the FAA calls for the OFA to be 800 feet wide (centered on the runway), extending 1,000 feet beyond each runway end. Runway 7-25 currently meets OFA standards.

5.3.3 Approach Surfaces and Runway Protection Zones

The approach surface and the runway protection zone are important elements in the design of runways that help insure the safe operations of aircraft. A brief description of these two areas is as follows:

- The approach surface is an imaginary inclined plane beginning at the end of the primary surface and extending outward to distances up to 10 miles, depending on runway use. The approach surface governs the height of objects on or near the airport. Objects should not extend above the approach surface. If they do, they are classified as obstructions and must either be marked, lowered or removed.

- The runway protection zone (RPZ) is an area at ground level that provides for the unobstructed passage of landing aircraft through the above airspace. The runway protection zone begins at the end of the primary surface, and has a size which varies with the designated use of the runway.

Federal Aviation Regulation Part 77 indicates that the approach surface should be kept free of obstructions to permit the unrestricted flight of aircraft in the vicinity of the airport. As the approach to a runway becomes more precise, the approach surface increases in size, and the required approach slope becomes more restrictive. The existing and ultimate Part 77 surfaces for the runway are listed below in Table 5-9.

The runway protection zone is the most critical safety area under the approach path and should be kept clear of all obstructions. No structure should be permitted within the runway protection zone. It is therefore desirable that the airport owner acquire adequate property interests in the runway protection zone to insure compliance with the above. The required size of the runway protection zone is shown in Table 5-9.

Table 5-9. Runway Protection Zone

RUNWAY PROTECTION ZONE			
	Runway End	7	25
	Approach Category	D	D
	Visibility Minimums	Greater Than ¾ Mile	Greater Than ¾ Mile
RPZ	Length – L	1,700 ft.	1,700 ft.
	Inner Width – W1	1,000 ft.	1,000 ft.
	Outer Width – W2	1,510 ft.	1,510 ft.
	Acres	49	49
Approach	Length	10,000 ft.	10,000 ft.
	Inner Width	500 ft.	500 ft.
	Outer Width	4,000 ft.	4,000 ft.
	Slope (H=Horiz. V+vert.)	34:1	34:1

5.4 TAXIWAYS REQUIREMENTS

FAA Advisory Circular AC 150/5300-13 provides taxiway and taxilane criteria for pavement width, shoulder width and safety area width. The criteria also provide dimensions for the distance from the taxiway or taxilane centerline to any object. The dimensions for taxiways and taxilanes serving Group III and Group IV aircraft are:

Table 5-10. Taxiway Requirements

CRITERIA	REQUIRED WIDTH (FEET)		CENTERLINE TO EDGE (FEET)	
	Group III Aircraft	Group IV Aircraft	Group III Aircraft	Group IV Aircraft
Pavement width	50	75	25	37.5
Shoulder width	20	25	45	62.5
Safety area width	118	171	59	85.5
Taxiway Object free area width	186	259	93	129.5
Taxilane Object free area width	162	225	81	112.5

The taxiway for YAP is 88 feet wide (44 feet from centerline to edge) with 25 foot shoulders. The required width for ARC D-III taxiway is 50 feet, except for class III airplanes with a wheel base greater than or equal to 60 feet. The standard taxiway width for these aircraft is 60 feet. ARC C-IV airfields require a taxiway pavement width of 75 feet. The taxiway at YAP meets requirements for both ARC D-III and C-IV airfields.

a) Taxiway Safety Areas

The taxiway safety area, centered on the taxiway centerline, is 118 feet wide for Group III aircraft and 171 feet wide for Group IV aircraft. Group III aircraft are aircraft having wingspans from 79 feet (24m) up to, but not including 118 feet (36m). Group IV aircraft are those having wingspans from 118 feet (36m) up to, but not including 171 feet (52m). The Boeing 737-800 aircraft is a Group III aircraft and the B-757 is a Group IV aircraft. The Yap taxiway is able to accommodate the larger aircraft/wingspan. Except for the structural pavement and the 25-foot wide paved shoulders, the entire safety area is unpaved. Plants grow on this surface and require constant mowing and tree trimming. The surface becomes soft during periods of heavy rain that extend over several days. Ruts have occurred when vehicles traverse this area during such times.

b) Taxiway Obstacle Free Areas

There are two criteria that might apply to this taxiway. The taxiway object free area criteria require larger clearances than the taxi lane criteria. Taxi lane criteria are intended to apply to areas where the pilots are aware of limitations and are exercising greater care in maneuvering the aircraft. At Yap, the taxiway criteria will be used. The width of the taxiway object free area is 186 feet for Group III aircraft and 259 feet for Group IV aircraft. There are no objects within this area that penetrate the obstacle free area criteria. Therefore, the full taxiway obstacle criteria will be used.

5.5 APRON REQUIREMENTS

The existing apron is constructed of Portland Cement Concrete pavement. It is 520 feet long parallel to the runway centerline and 300 feet wide parallel to the taxiway centerline

a) Apron Safety Areas

Except on the terminal building side, there are no obstacles within 92 feet of the other three edges of the apron. Therefore, Category III and IV taxiway safety area criteria are met with the assumption that the aircraft centerline is at least 37.5 feet inside the edge of the apron. Except for the 25-foot wide paved shoulders, the entire safety area is unpaved. Plants grow on this surface and require constant mowing. The surface becomes soft during periods of heavy rain that extend over several days. Ruts have occurred when vehicles traverse this area at such times. Vehicles crossing this area may track mud and foreign objects onto the pavement.

b) Apron Object Free Areas

There are two criteria that might apply to the apron. The taxiway obstacle free criteria require larger clearances than the taxi lane criteria. Taxi lane criteria are intended to apply to areas where the pilots are aware of limitations and are exercising greater care in maneuvering the aircraft. Taxi lane criterion applies to the apron. The taxi lane obstacle free dimension width from the centerline used by the aircraft on the apron is 81 feet for Group III aircraft and 112.5 feet for Group IV aircraft. These clearances exist on the apron.

c) Apron Wingtip Clearances

These criteria may be used for specific aircraft in specific locations. At Yap these criteria apply to the clearances from the aircraft to the objects on the apron. The required wingtip clearance is 21 feet for Group III aircraft and 27 feet for Group IV. This clearance is available at this airport.

5.6 AIRFIELD MARKINGS

Guidance for marking airfield pavements is set forth in AC 150/5340-1F, Marking of Paved Areas and Airports. As stated in the AC, “runway and taxiway markings are essential for the safe and efficient use of airports, and their effectiveness is dependent upon proper maintenance to maintain an acceptable level of conspicuity.”

a) Runway Markings:

The runway Yap International Airport currently has only non-precision markings. The basic elements comprising this type of marking are as follows:

- Marking colors (runway marking is white)
- Runway centerline marking
- Designation marking (runway end identity)
- Threshold marking
- Fixed distance marking (to inform pilot of remaining available pavement)
- Holding position markings (for taxiway/runway intersections)

Non-precision instrument approaches for Yap International Airport, and associated runway markings, are adequate. However, it is suggested that, eventually, an instrument landing system and associated runway markings be provided. If a precision instrument approach is installed, the existing markings could be upgraded to precision instrument runway markings. Upgrades to these markings include:

- Touchdown zone markings (an aiming point usually 1,000 feet from the landing threshold)
- Side stripes (edge of runway)

Blast pads, stop ways, and paved safety areas must also be appropriately marked in accordance with the AC. It is emphasized that frequent maintenance is essential in assuring that pavement markings are clearly visible.

Under a recently completed capital improvement project YAP's airfield markings have been updated to precision markings.

b) Taxiway Markings:

The current stub taxiway shall continue to be appropriately marked in accordance with the FAA Advisory Circular. These markings include:

1. Marking colors (taxiway marking is yellow)
2. Taxiway centerline marking
3. Taxiway edge marking
4. Holding position markings (at runway intersection)

c) Apron Markings

The apron is presently marked with stripes that direct aircraft into and out of the two parking positions. It also has edge markings and shoulder markings that were painted in 2009 and apron entrance point surface markings provided in 2010 to conform to FAA and ICAO criteria.

5.6.1 Airfield Lighting

Guidance for airfield lighting is set forth in FAA AC's 150/5340-4C, -19, and -24. These AC's refer to runway and taxiway edge lighting, runway and taxiway centerline lighting, and touchdown zone lighting. Airfield lighting is necessary to operate the airport during periods of darkness and low visibility due to inclement weather conditions.

The existing runway has Medium Intensity Runway Lighting (MIRL). An airport beacon (white/green) signifying a lighted land airport, and a lighted wind indicator/segmented circle are also part of the airfield lighting system. Runway lighting can be activated by the pilot via the CTAF frequency.

Under YAP's recently completed capital improvement project, the airfield lighting has been updated to meet all design requirements.

5.6.2 Airfield Signage

The Standard for Airport Sign Systems, AC 150/5340-18B is the guidance for signage on airports. There are three basic color-coded sign types that provide information to the pilots on the airfield. The three types are as follows:

- Mandatory instruction signs (intersections and critical areas)
- Information signs
- Runway distance remaining signs

Under YAP's recently completed capital improvement project, the airfield signage has been updated to meet all design requirements.

5.6.3 Airspace and Navigation Aids

Enroute and terminal navigational aids help increase the overall airport and airway systems for VFR pilots, IFR pilots and the general public through increased communications and in controlled aircraft separations. Typical enroute instrument aids include Nondirectional Radio Beacons (NDB), Very High Frequency Omni directional Range (VOR), and Distance Measuring Equipment (DME). Typical terminal area visual aids include Visual Approach Slope Indicators (VASI), Precision Approach Path Indicators (PAPI) and Runway End Indicator Lights (REIL).

The lack of visual and navigational aids at an airfield can limit the airport's ability to accommodate aircraft operations during periods of darkness and poor visibility associated with inclement weather. For this reason, an analysis of both visual aids (VISAIDS) and electronic navigational aids (NAVAIDS) is an important part of an airport's expansion planning.

a) Visual Aids (VISAIDS) to Navigation:

The current visual aids at Yap International Airport include:

- Runway End Identifier Lights (REIL) for both runways 7 and 25
- Visual Approach Slope Indicator (VASI) for both runways 7 and 25

These visual aids are connected to the airfield lighting circuit and can be activated by pilots in the area via an air to ground interface by utilizing the CTAF frequency. The full complement of airfield lighting and visual aids can be activated without need for on duty ground personnel. This level of airfield lighting and VISAIDS allows night flight operations.

b) Electronic Navigation Aids (NAVAIDS):

Yap International Airport is currently served with a single Non-Directional-Beacon (NDB) that is coupled with Distance Measuring Equipment (DME).

CHAPTER 6: UTILITIES

A Facilities and Systems Maintenance Plan for Yap International Airport was recently completed. It covers existing structures, infrastructure, and supporting systems that are currently in place to facilitate airport operations. This Maintenance Plan identifies tasks, frequency and budget costs for implementation of the Plan to ensure that Yap International Airport can continue to safely operate and provide reasonable passenger accommodations at the current level of service.

This Utilities Chapter uses information from the Maintenance Plan to describe existing conditions and recommended routine maintenance. Unlike the Maintenance Plan, this section will also recommend ways to enhance airport operations, as well as plans for the future needs.

6.1 POWER

6.1.1 Airfield Electrical Systems Responsibilities

Responsibilities for electrical systems associated with airfield operations are divided between the Yap State, and the U.S. Federal Aviation Administration (FAA). The FAA is ultimately responsible for all maintenance associated with their systems, even though they may request assistance from Yap State personnel for simple tasks.

a) FAA Electrical Systems

1. Precision Approach Path Indicator (PAPI).
2. Non-Directional Beacon (NDB).
3. Distance Measuring Equipment (DME).
4. Runway End Identifier Lights (REIL).
5. Aeronautical/Aerodrome Flight Information Service (AFIS) Radio and Antenna.
6. NDB/DME Antenna Tower.
7. FAA power vault located adjacent to the Yap State airfield power vault near the Main Terminal Building. FAA power vault supports the PAPI and REIL power supplies and includes:

    a. Engine-generator set.
    b. Automatic transfer / isolation-bypass switches.
    c. Daytank.

b) Yap State Maintained Electrical Systems

1. Windsocks – multiple locations on the airfields. All the wind cones are equipped with

floodlighting.

2. Rotating Beacon – located adjacent to the Pacific Missionary Aviation Hangar.
3. Series circuit regulator/constant current transformer for runway, threshold, and taxiway edge lights.
4. Edge lighting is provided for taxiway and the main runway. Threshold lights are provided at both ends of the runway.
5. Illuminated runway distance markers and directional signage are being utilized.
6. Aviation lighting system is energized from one (1) series circuit regulator/constant current transformer. 15 kVA, 208 volt, 60 Hz, 97 FLA, single phase input with 4.8/5.5/6.6 ampere output current steps. Siemens FAA L-828.

The series circuit for lighting system components that Yap State is responsible to maintain (versus FAA responsibility) is located within the generator/power vault located adjacent to the Main Terminal Building

6.1.2 Generator/Power Vault

The Generator/Power Vault Structure houses a generator room and electrical equipment room.

Two (2) pad-mounted transformers are located in the fenced area just outside of the Generator/Power Vault structure. One transformer is the Public Service Corporation electric utility company service transformer which energizes all loads of the power vault. Its physical dimensions (no nameplate visible) suggest it is rated approximately 75 kVA, which correlates with the 3P225A main circuit breaker in the vault switchboard. This oil-filled, pad-mounted utility transformer also supplies the FAA Power Vault loads. The second pad-mounted transfer is a dry-type unit, with rain guards for its ventilation openings, rated 25kVA single-phase, 120/240 to 2400V that is used for FAA circuits and is not the responsibility of Yap State.

The utility transformer is supplied by underground primary circuits originating from a utility company riser pole located halfway down the hill to the south from the power vault. Overhead utility lines traverse the rest of the way down the hill to the overhead distribution system routed along the public roadway that runs in an east-west direction.

The generator room houses a 125 kVA Onan generator set and 400 ampere Onan automatic transfer switch that does not have isolation/bypass maintenance switching features. The utility company transformer receives 13.8 kV, 3 phase, 3-wire power from the Public Service Corporation (PSC) incoming underground distribution circuits. It converts to a 208Y/120v, 3-phase, 4-wire secondary output power source which is routed underground to a main service switchboard located in the electrical room of the Generator/Power Vault.

The main service switchboard is manufactured by Westinghouse, POW-R-Line model, with 400 ampere main bus. The switchboard is equipped with a utility company revenue meter for utility company billings. The meter does not have a demand register or power factor data. The main service switchboard directly or indirectly (via transformers, control devices, transfer switches) energizes all loads associated with the vault, airfield, and Main Terminal Building. The electrical room houses the power supplies and controls for airfield electrical and lighting systems. Mechanical systems for the Generator/Power Vault include: out-of-service main fuel tank located outdoors, generator set skid-base mounted daytank, and out-of–service window air conditioning unit (1 each).

6.1.3 Main Terminal Building Electrical Systems

a) Incoming Power Service

Incoming power from Public Service Corporation (PSC) delivered at 13.8 kV, 3 phase, 3 wire. Primary power (13.8 kV) is delivered from the PSC overhead distribution system along the public roadway adjacent to the airport compound via overhead pole spans halfway up the hill to a riser pole and then converted to underground ductlines to a pad-mounted service transformer within a fenced area outside the Power Vault structure described previously. A 75 kVA (estimated) service transformer is used to step down from 13.8 kV to the 208Y/120 volts, 3 phase, 4 wire secondary distribution voltage. Secondary service feeder is routed underground from the service transformer to the Main Service Switchboard within the Power Vault electrical room.

b) Emergency Power Supply

Emergency power is supplied by an engine-generator set manufactured by Onan. The engine-generator set has a standby rating of 100kW, 208Y/120 volts, 3 phase, 4 wire, 0.8 PF. The output from the engine-generator set is protected by a 3P400A main circuit breaker that delivers power to the automatic transfer switch (ATS) located within the generator room. The ATS does not have isolation-bypass switching capabilities to facilitate ATS maintenance.

The generator set is housed in a dedicated generator room of the Power Vault. The engine-generator set is connected to the entire airfield and Main Terminal Building load, but has insufficient capability to support the entire combined load. Airport management has selectively shed loads so that they can operate without an overload failure. The generator set installation does not have load bank or provisions to connect a load bank to facilitate engine-generator set maintenance.

The inability of the generator set to support the full load of the Main Terminal Building is, at best, an undesirable situation. The types of loads currently de-energize includes all lights on selected aircraft apron floodlighting poles. Reduced and non-uniform lighting has adverse impacts to airport security, airport operations, and airline operations. Upsizing of the engine-generator set and undersized portions of the electrical distribution system is a highly recommended short term goal.

The Onan generator set is not the only generator set located at the Power Vault. The Onan set resides in a dedicated generator room that was added after the airport loads grew beyond the capabilities of the originally installed King-Knight Company. This older30 kW generator no longer supports any of the airport's operational loads and has remained out-of-service for some time. It resides within the originally constructed generator room of the power vault. It recently has been tested for alternative use by the Southern Yap Water System. It is considered a non-functional part of the airport inventory and will not be further considered in this master plan for that reason.

c) Main Service Switchboard

The Main Service Switchboard is manufactured by Westinghouse and located within the electrical room of the Power Vault. PSC secondary switchboard mounted meter number for billings is 28-578-398. The Main Service Switchboard receives incoming secondary service from the 75 kVA utility transformer within the fenced area outside of the Power Vault. The main switchboard has a 3P225 ampere main circuit breaker. The distribution section of the Main Service Switchboard includes 2 each 3P100A, 1 each 3P125A, and 1 each 3P150A feeder circuit breakers.

6.1.4 ARFF Electrical Systems

a) Incoming Power Service

Incoming power from Public Service Corporation (PSC), the electric utility, delivered at 13.8 kV, 3 phase via underground ductlines from the public roadway south of the airport complex to a pad-mounted service transformer located within the ARFF compound. A pad-mounted 500 kVA service transformer is used to step down from 13.8 kV to the 208Y/120 volts, 3 phase, 4 wire secondary distribution voltage.

PSC secondary meter for billings is mounted adjacent to the pad-mounted transformer for the ARFF facility. PSC meter number is 28-578-397. 1200:5A current transformers are used by the meter to monitor electrical consumption. The current transformers are mounted within the secondary compartment of the pad-mounted transformer to monitor each phase of the outgoing secondary service feeder cable sets.

b) Emergency Power Supply

Emergency power is supplied by a Kohler engine-generator set. The engine-generator set has a standby rating of 440 kW, 208Y/120 volts, 3 phase, 4-wire, 0.8 PF. The output from the engine-generator set is protected by a 3P1600A main circuit breaker that delivers power to an ASCO automatic transfer/isolation-bypass switch (ATS/ISO-BP). The generator set is housed in a dedicated generator room. The engine-generator set supports the entire ARFF facility load. A fixed-mounted loadbank is installed in-line with the generator set radiator exhaust cowling. The loadbank is connected via a 3PI600A circuit breaker mounted along with the generator set output main circuit breaker.

c) Main Electrical Secondary Service

The main electrical secondary service is protected by a 3P1600A main circuit breaker. This main circuit breaker receives incoming service feeders from the pad-mounted transformer and sends normal utility power on to the ATS/ISO-BP located within the main electrical room. The secondary feeders from both the service disconnect switch and engine-generator set are fed through an automatic transfer/isolation-bypass switch. The ATS/ISO-BP is rated 4P1600A. Output power from the ATS/ISO-BP is routed to a Siemens Main Distribution Panel located adjacent to the ATS/ISO-BP within the main electrical room of the ARFF. The Main Distribution Panel utilizes circuit breakers to energize power panels and other significant loads of the ARFF facility.

6.2 TELEPHONE

a) Main Terminal Building

Telephone service originates from the FSM Telecommunications underground distribution system number along public roadway south of the airport complex. There exists a telephone EPBAX system manufactured by NEC utilized for administrative phones. The EPBAX has an integral battery backup and is mounted within the electric room near the public restrooms of the Main Terminal Building. Telephone instruments are located at point of use.

b) ARFF Building

Underground ductlines are used to route incoming service cables from the adjacent public road into the ARFF compound. Telephone lines derived directly from FSM Telecommunications.

6.3 POTABLE WATER / SANITARY SYSTEM / STORM WATER SYSTEM

6.3.1 Potable Water

The Airport water supply is supplied by two utility companies. Water to the Terminal is supplied by PCS, while water supplied to the ARFF Building is supplied by Southern Yap Water System.

a) Terminal Building

Water is supplied from a utility main in the public road and is distributed to the terminal and apron facilities. There is also a waterline currently not in use from the apron area to a water tank on the hill to the northwest of the apron. The utility company water meter is located adjacent to the west walkway into the Main Terminal Building from the parking lot. Standard plumbing for building occupancy in use within the Main Terminal Building, consisting of lavatories (7 each), water closets (7 each), urinal (1 each), sink (1 each), and service sink (1 each). There is also one (1) Asian style water closet in the Women's restroom. Water heating is not provided for general use within the Main Terminal Building.

b) ARFF Building

Standard plumbing for building occupancy in use, consisting of lavatories (5 each), kitchen/janitor/service sinks (5 each), water closets (3 each), and urinals (1 each). Water heating provided for lavatories, sinks, and showers (3 each), as well as for the washing machines. A duplex potable water booster pump set is utilized to supply water to the ARFF facility. A rainwater harvesting storage tank and catchment water transfer pump are used to supplement the domestic water supply. A domestic water storage tank is used to ensure continuous supply of water to the ARFF facility.

6.3.2 Sanitary Sewer

Sanitary sewer lines are located in the entrance road. This sanitary sewer is connected to the island-wide sanitary sewer system.

6.3.3 Storm Water System

a) Runway Drainage Systems.

Surface drainage is by sheet flow essentially perpendicular to the centerline of the runway. There are no paved or unpaved drainage ditches within the safety area dimensions. There are underground drainage systems within the limits of the runway safety areas. On the north side the runoff is collected through a series of ditches and channels parallel to the runway centerline. The ditches in turn carry the water to three (3) main cross drainage structures under the safety area or past the ends of the safety area. The inlet/outlet for these main structures is outside the safety area. On the south side, the drainage is collected by a system of drainage channels parallel to the runway and surrounding the terminal area. These drainage channels are all outside the safety areas. Subsurface drainage system elements run along both sides of runway with series of cleanouts and drains to subdrain manholes approximately 3 feet from the edge of the pavement and then connected to the existing open ditches draining to daylight.

b) Taxiway Drainage Systems

Drainage is by sheet flow. There are no paved or unpaved drainage ditches within the safety area dimensions. There is a subdrain system with cleanouts on the sides of the taxiway.

c) Apron Drainage Systems

The apron is drained is by two trench drains that are connected to a drainage ditch on the east side of the apron. There is a subdrain system on the west, north and east sides of the apron.

6.4 AIRCRAFT FUELING SYSTEM

The aircraft are currently serviced by a fuel truck. There is a complete fueling tank farm including pumps and other equipment to permit the use of the new underground fuel lines in the apron. This system was originally installed and maintained by Mobile but was abandoned about five years ago after the apron expansion damaged the in-pavement fuel lines. The fuel farm is protected by its own perimeter fence and has access on the public side for fuel delivery and access on the secure airfield side to permit the fuel truck to enter the airfield.

A new underground fueling system was installed at the time the apron pavement was built in 2009. It consists of two fuel hydrants, one for each of the parking positions. These hydrants are connected via underground fuel lines with piping stubbed out for connection in the vicinity of the fuel storage and handling facility. This fuel farm facility is located at the southeast corner of the apron. The fueling system has not yet been connected and placed into service at this time.

A leak detection system has been provided as part of the new fueling system in the apron. A provision for an emergency shutdown system was also installed. When the underground fuel lines are placed into service, this system should be integrated with the fuel operation system. The decision to reactivate this system will rest with the current operator, FSM Petroleum Company and Airport Management.

6.5 REMEDIAL WORK REQUIRED

a) Airfield

The emergency generator's fueling system and ventilation system is in serious disrepair. With the main fuel tank out-of-service and fuel lines with transfer pump between the main fuel tank to daytank removed, the emergency generator set relies upon the daytank that is integrated into its skid base as the sole source of fuel. To ensure that the emergency generator remains on-line during an extended utility power outage, it is necessary for maintenance personnel to hand pump fuel from 55-gallon drums into the daytank while the generator is operating. This clearly is a hazardous operation that cannot be recommended.

The cowling from the radiator to the generator room wall louver is missing and the resultant recirculation of hot air within the generator room creates significant adverse effects upon generator operations. The higher ambient temperature reduces the efficiency of the generator, reduces the energy potential of the diesel fuel and thereby further erodes generator output potential, and the higher temperature will create an environment hotter that the 40˚C maximum recommended for electrical installations/equipment and thus accelerate a decline in the useful life of the electrical system. Both the fueling and ventilation systems need to be repaired quickly to mitigate operational, safety, maintenance, and life cycle concerns. The modernized fueling system should include leak detection capabilities for both fuel tanks and fuel lines to conform to environmental protection goals related to petrochemical products.

Consideration should be given to upgrading generator capacity to provide full emergency power support for the Main Terminal Building. The existing generator set is not capable to support all airport loads. Management has de-energized circuits to ensure the existing generator can operate with its ratings. Important circuits such as a portion of the aircraft apron floodlighting system have been turned off. See Chapter related to the Main Terminal Building for further discussions.

The generator room, transformer vault, and electrical equipment room are being used to stockpile materials totally unrelated to the function of those spaces. Code-mandated access to electrical equipment is being seriously and dangerously compromised. Additionally, dirt and debris has been allowed to accumulate far beyond acceptable levels and to the detriment of the equipment installation. All stored items need to be removed and rooms thoroughly vacuumed (not swept or blown about) to restore a safe, orderly and neat environment.

The generator room is recommended to have emergency (battery backup) lighting installed. Emergency lighting will allow for cursory inspection, adjustment, and/or trouble-shooting in the event that generator power does not become available when there is a utility company outage. The electric room already has sealed beam type emergency floodlights. However, its battery pack is in need of replacement.

The out-of-service window air conditioning unit for the electrical room requires replacement as soon as possible. High ambient temperatures will accelerate the aging of the electrical installation.

Occupational Safety and Health Administration (OSHA) advocates deluge shower and eyewash for maintenance involving hazardous chemicals. The starting batteries of the engine-generator set contain corrosive acid electrolyte fluid and, therefore, fall under this requirement. Installation of the deluge shower/eyewash immediately outside of the door to the generator room is suggested since unrestrained water within the generator room could pose a higher level shock hazard.

b) Main Terminal Building

Existing luminaries were sometimes found with missing or unsecured diffusers. It is recommended that diffusers be properly installed as continued exposure of luminaries interior will accelerated product deterioration and cause unreliable operation in the high humidity environment typically found.

Damaged and out-of-service photovoltaic exterior lights should be repaired or replaced to provide for safe movement of vehicles and pedestrians using the access driveway and parking lot for the Main Terminal Building.

Replacement of out-of-service window air conditioning unit recommended as soon as possible providing 40°C maximum ambient temperature for main electric room of the Power Vault. Excessive temperatures will exponentially accelerate electrical system degradation.

c) ARFF Facility

As the ARFF facility is brand new, there should not be a need for any remedial work. As the ARFF facility remains under warrantee, there should be little need for routine maintenance other than janitorial services.

Over the long term, maintenance needs to be performed in accordance with procedures prescribed in the operations and maintenance documentation required by the construction specifications of the ARFF facility.

6.6 FUTURE NEEDS

a) Airport Main Power Vault

As noted above in the remedial work section for utilities, it is strongly recommended that the incoming main power supply and emergency generator set be replaced to accommodate the higher level of power demand associated with loads added to the airport complex over time. As the complexity and magnitude of work required accomplishing this goal while allowing the airport to continue to operate is sufficiently large to require complete replacement of the airport's Main Power Vault, it is further recommended that the new power vault be located within the Air Operations Area (AOA) of the airport complex. Such a location will provide better security (avoid malicious mischief and vandalism) for this vital component supporting airport operations, provide better access for maintenance, and renew aging components which will soon be reaching their end of useful life.

While not the responsibility of Yap State, the FAA power vault and associated equipment located in the vicinity of the Yap State Main Power Vault should be considered for relocation within the AOA at the same time as the recommended construction of a replacement main power vault.

b) Landside Fire Hydrants

Presently, there are no fire hydrants on the landside of the terminal building. It is suggested that multiple fire hydrants be placed on the edge of the vehicle parking lot area, adjacent to and south of the terminal complex. Placing the hydrants in this location would aid the fire department's efforts in handling a fire in the terminal complex.

c) Water Storage Tank Facility

Yap International Airport is served by two distinct water sources. These sources come from different location on the island and together provide a reasonably reliable potable water source for the terminal building and various other uses on the airport. However, there is concern with the flow rates and volume available to the airport from either or both of these sources related to the condition and age of the existing underground water distribution system, and whether that system can support high pressure/high flow rates needed during critical (emergency) periods.

It is recommended that a water storage tank should be built within the AOA area. This tank would be 'fed' water from either or both of the existing sources, at relatively low nominal pressure so the existing infrastructure is not overly stressed. The outflow water lines from the tank would be routed to both the new ARFF station as well as the terminal area fire hydrants. Flow rate and line pressure would be boosted by an electrically driven booster pump, and the distribution lines would be new and able to handle the high pressures and flow rates that would be required during a critical firefighting event.

CHAPTER 7: LAND USE PLAN

7.1 INTRODUCTION

The primary objective of the Airport Land Use Plan is to provide a review of the current land use and to develop guidelines for the future land use at and surrounding Yap International Airport. The Master Plan contains forecasts of aviation demand to help define the physical requirements for airport development over the next 20 years.

Airport master plans typically assess airport compatible land uses and ways to minimize the number of people exposed to frequent and/or high levels of airport noise, or high cumulative noise levels. However, this chapter does not analyze the effect of noise level to the surrounding land use at the Yap International Airport given the limited number of scheduled and unscheduled operations per day and the negligible noise level produced at the airport.

This chapter examines the physical setting, existing land use, potential aviation related uses for airport lands and discusses the potential need to expand airport property. It also focuses on preserving the airport airspace to minimize the risk of potential aircraft accidents in the vicinity of the Airport by avoiding the development of land uses and land use conditions which pose hazards to aircraft in flight.

7.2 PHYSICAL SETTING/EXISTING LAND USE

The entire airfield was constructed with local materials and by cutting and filling along the slope of a hill between 1978 and about 1982. The bituminous pavement was placed at the same time. The Airport is accessed by land via one two-lane road, which is in good condition and connects the Airport to Colonia, the capitol. The access road is the only road between the Airport and Colonia, about two (2) to three (3) miles from the Airport.

Figure 7-1. Aerial View of Yap International Airport

7.3 AVIATION RELATED LAND USE

The following narrative discusses the various aviation related planned land use facilities, for airside, landside, and terminal. This discussion does not include the numerous FAA ACIP funded projects already completed, or in the construction phase, for Yap International Airport. These newly completed facilities, and those currently under construction, include:

- ARFF facility and new ARFF trucks
- Rehabilitated PCC apron area including fuel lines/hydrant pits
- Runway seal coat
- Airfield lighting and signage
- Paved shoulders and turnarounds
- Enhanced terminal hold room area, upgraded electrical, roof (terminal building)
- Airport perimeter fence

7.3.1 Airside

a) Runway Extension

Presently the useable runway length at Yap International Airport is 6,000 feet. While this runway length is adequate to serve the B 737-800 aircraft currently utilized by Continental Air Micronesia, the airline has requested additional runway length at FSM airports wherever practical for given terrain and cost considerations. This request to add runway length is based upon the desire for increased safety margins and desire for higher payloads (cargo/fuel) that would result from a modest runway extension. The development of the FSM system plan is currently in progress and is a stand-alone, system-wide assessment and recommendation for the overall aviation system in FSM. This system-wide plan assesses the runway lengths in FSM and provides recommendations for airfields improvements where terrain and financial practicality allow. The optimal runway length, with the exception of Pohnpei International Airport, should be 6,500 feet. This runway length applies to Yap International Airport, as the airport is landlocked with 'workable' terrain and, therefore, falls under the category of practical. The potential 500 foot runway extensions with both expanded runway safety areas are displayed on the western end of the runway on the Land Use Plan Overview, Airside Figure 7-2.

This potential project is proposed late in the 20-year planning horizon in order to make assessments in real time to ascertain if there are cost/benefit advantages to the project. The key elements for such a considered in this assessment are:

- Level of aviation activity, both commercial and private
- Cargo/mail payloads as compared to recent and historical trends
- Aircraft in use on the routes throughout FSM

It is important to monitor these elements going forward as the current trend in aviation activities per Continental's recent route structures is to reduce the number of flights per week into Yap and utilize a smaller (B 737-700) aircraft.

b) Runway Safety Area (RSA)

RSA standards are defined in AC 150/5300-13 Section 305. Construction standards are found in AC 150/5370-10 P-152. According to AC 150/5300-13 Section 503, the RSA must be aligned on the center line of the runway and the RSA must be cleared, graded and have no hazardous surface variations. For ARC D-III airports the RSA length must be 1,000 feet beyond the runway end, and its required width is 500 feet. The existing RSA are currently only 200 feet in length (and need to be lengthened to meet FAA requirements). FAA and ICAO have made standardizing RSAs to these dimensions a priority. Yap International Airport, unlike many airports throughout Micronesia, has available land for its RSAs to meet the new requirements.

The Yap International Airport Land Use Plan Overview, Figure 7-2, shows expansion of these runway safety areas at both ends of the runway to comply with the current FAA Advisory Circular criteria.

c) AOA Access/Central Security Facility

The Land Use Plan-Landside, Figure 7-3, shows the recommended location of this combined AOA access and security facility located adjacent to and west of the terminal building. This location is ideal for both guard shack/entry control to the AOA, as well as the co-joined facility for administration support.

d) Health Center/Quarantine Area

The Land Use Plan Overview, Figure 7-2, shows the recommended location of this combined use facility adjacent to and west of the terminal building. Presently, there is a small office within the terminal area for quarantine that should be relocated to this joint use facility. The internal layout and function of the terminal building itself is discussed in the following Terminal section of this chapter.

e) Electrical Vault/Engine Generator

Presently, the airport's electrical vault and backup generator are located outside the AOA, adjacent to and west of the vehicle parking area. It is recommended that this facility be relocated inside of the AOA for the security and safety of this important infrastructure item. Additionally, the present vault/generation site would be ideal for a rental car kiosk facility. The current rental car office is located within the existing terminal building. Its relocation and the recommended internal layout and function of the terminal building are discussed separately under the Terminal section of this chapter.

f) Water Storage Tank Facility

Presently, the Yap International Airport is served by two distinct water sources. These sources come from different locations on the island and together provide a reasonably reliable potable water source for the terminal building and various other uses on the airport. However, there is concern with the flow rates and volume available to the airport from either or both of these sources to support the high volume needs of ARFF operations or the recommended fire hydrants for the terminal building. An issue related to questionable water volume/pressure is the condition and age of the existing underground water distribution system and whether that system can reliably support high pressure/high flow rates needed during critical (emergency) periods.

In order to address this issue in a practical manner the following improvements are suggested:

- A water storage tank is sited within the AOA area. The capacity of this tank, based upon preliminary estimates, is in the range of 250K gallons. The tank would be ‘fed’ water from either or both of the existing sources, at relatively low nominal pressure, so the existing infrastructure is not overly stressed.
- The outflow water lines from the tank would be routed to both the new ARFF station as well as the terminal area fire hydrants. Flow rate and line pressure would be increased by an electrically driven booster pump, and the distribution lines would be new and able to handle the higher pressures and flow rates that would be required during a critical firefighting event.
- The suggested location of the water storage tank, shown on the Land Use Plan Overview, Figure 7-2, is between the new ARFF facility and the terminal complex, south of the runway.
- The suggested locations of the multiple fire hydrants are on the edge of the vehicle parking lot area, adjacent to and south of the terminal complex. These locations would facilitate the fire department’s efforts in handling a fire in the terminal complex.

g) <u>US Postal Service Mail Storage Facility</u>

Presently, mail is delivered to Yap on the scheduled Continental flights and is stored in a makeshift container located on the apron space northeast of the terminal building. The recommendation is to provide a small structure in the same location to give the USPS a more permanent, weather proof shelter.

h) <u>Cargo Storage</u>

Currently, cargo storage is limited within the terminal building and Continental needs more space for storage of outgoing cargo. This situation that is made more severe by the recent reduction in flights per week offered by Continental causing increased stockpiling of cargo. In addition to minor enhancements to the terminal layout (see terminal study) to provide more cargo storage area, a small cargo facility is recommended to be located near the terminal building, adjacent and east of the USPS storage facility, as shown on the Land Use Plan Overview, Figure7- 2.

7.3.2 East Apron Edge

On the eastern edge of the newly rehabilitated apron space, there is an area of airport land, within the AOA, that is ideal for a number of aviation related facilities, some of which would be good candidates for third party development. These various suggested airside facilities are described here, and are displayed on the Land Use Plan Overview, Figure 7-2:

a) Multi-Use Cargo Facility

This would provide for a cargo facility that could serve as a public access point for cargo shipping. An access road, shown on the Land Use Plan Overview, would provide public access to the east side of the facility. The apron side of the facility would be safely within the AOA.

b) Maintenance Facility/Ground Service Equipment (GSE) Storage

The airport needs a maintenance facility, and the primary airline serving Yap, Continental, needs an area to store and access their ground service equipment. This joint use facility, shown on the Land Use Plan Overview, would remedy both of these needs. The GSE storage area is indicated by the cross hatching. It is intended to be an exposed area (no roof), while the maintenance facility would be enclosed. The access road mentioned under the multi-use cargo area would be utilized for non-AOA access.

c) Mixed-Use Warehouse/USPS/Continental

A mixed-use warehouse could be sited on the north east corner of the apron area that would provide warehousing storage for USPS, Continental, etc. This proposed warehouse would provide additional capacity in the event that storage and warehouse areas addressed in other areas of the airport and terminal are not enough to meet the airports needs in future years.

d) Hangar

It is recommended that a hangar be sited at the upper north east corner of the apron area and sized to accommodate, at a minimum, a twin turboprop aircraft of roughly 40 passenger capacity. The recommendation is to address in the event that either commuter service developing, or to accommodate corporate aircraft. This area needs to be ‘earmarked’ for this type of facility as there has been interest shown by regional airlines based in Guam and Saipan to provide commuter routes between Yap and Palau.

7.3.3 Landside

a) Rental Car Kiosk

Presently, the rental car office located in the terminal building provides administrative support for rental car operations. The proposed internal improvements of the terminal building (see discussion below regarding terminal building recommended layout) result in displacing/relocating this rental car office to the landside area adjacent to and west of the vehicle parking area. This is shown on the Land Use Plan Overview, Figure7- 2.

b) Additional Parking Spaces

Currently, there is unused airport land located to the south of the existing vehicle parking lot area. It is recommended that this area be utilized, should demand require it, for vehicle parking, adding roughly 72 parking spaces to the existing 76. Expansion of vehicle parking area should be reassessed throughout the planning horizon to determine the need for additional capacity.

7.3.4 Terminal

The existing Yap International Airport Terminal building is in good condition and functions reasonably well for the given the flight frequency and limited number of passengers that are served per flight operation. The LEO A DALY team met with airline, airport management, and stakeholders to discuss the overall layout of the terminal and invited suggestions on how to best accommodate the airport/airline/passenger needs in a cost effective way. This collaborative approach was intended to provide passenger throughput enhancements and increased efficiencies without incurring exorbitant costs since these types of improvements are based on limited and more difficult to find grant funding.

The proposed summary below is based on high-value/low-cost types of upgrades:

- Additional ticket counter space for check in
- Additional under roof cargo storage area
- VIP hold room area, including restroom(s)
- Concession area within main hold room
- Additional area for baggage claim, along with longer ‘bench’ for baggage
- Better weather protection for arriving passengers, i.e., queuing outside of terminal
- Enhanced passenger flow through the arrivals, immigration, baggage claim, and customs functions

YAP INTERNATIONAL AIRPORT FEDERATED STATES OF MICRONESIA	LEO A DALY PLANNING ARCHITECTURE ENGINEERING INTERIORS EST. 1915	NOT TO SCALE	PROJECT #081-10015-010
		LAND USE PLAN - LANDSIDE	FIG 7-3

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NOT TO SCALE	PROJECT #081-10015-010
LAND USE PLAN OVERVIEW	FIG 7-2

The attached Figure 7-5, Improvement Plan, provides a conceptual layout plan of the terminal building that accommodates these various upgrades, while limiting the expansion of the terminal by adding small areas to the east (cargo) and west (VIP lounge). We note that some internal space currently used administration offices, etc., have been utilized for baggage claim enhancement, adding that these as office areas that were slated for relocation to the new ARFF facility. The office space within the terminal for the airport manager remains in its present location. The small areas dedicated to quarantine and rental car operations have been relocated outside of the terminal building as discussed in preceding sections. The attached Figure 7-5 illustrates the areas within the terminal building that will be affected during the construction phase.

A Rough Order of Magnitude cost estimate for these improvements are based upon the following assumed cost per square foot values:

- New areas (VIP & Cargo): $250/s.f.
- Overhaul of internal existing areas: $150/s.f.

Using these values, the ROM cost for the described terminal upgrades is in the range of $700K to $850K.

7.4 COMPATIBLE LAND USE

Airport compatible land uses can be defined as those developments that comply with generally accepted restrictions on location, height, and activity that provide for safe aircraft movement and airport operations. It is important to identify those safety risks associated with air transportation in order to minimize the consequences of potential accidents. Also, specific areas near airports are exposed to various levels of accident potential. Identifying and protecting these specific areas through effective land use controls is essential for the safe and efficient operation of an airport. It also protects the public from the impacts of a potential aircraft accident.

Most of the risk involved with air transportation is associated with the takeoff and landing portions of flights. The critical areas at an airport that need to be secured and protected from a land use compatibility standpoint include the approach paths and departure paths to the runways. To enhance airport safety, it is important to maintain obstruction-free airport airspace and a reasonable amount of vacant land at both ends of each runway. Areas to be maintained and the size of these areas are dependent upon the type(s) of aircraft that operate at the airport.

Additionally, compatible land use includes the preservation of public health, safety, and welfare for those persons located in the airport environs. Safety issues are a primary area of concern with compatible land uses. Areas around the airport should be free of development that could pose a

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SCALE: 1/16" = 1'-0"

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EXISTING TERMINAL PLAN

FIG 7-4

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SCALE: 1/16"=1'-0"

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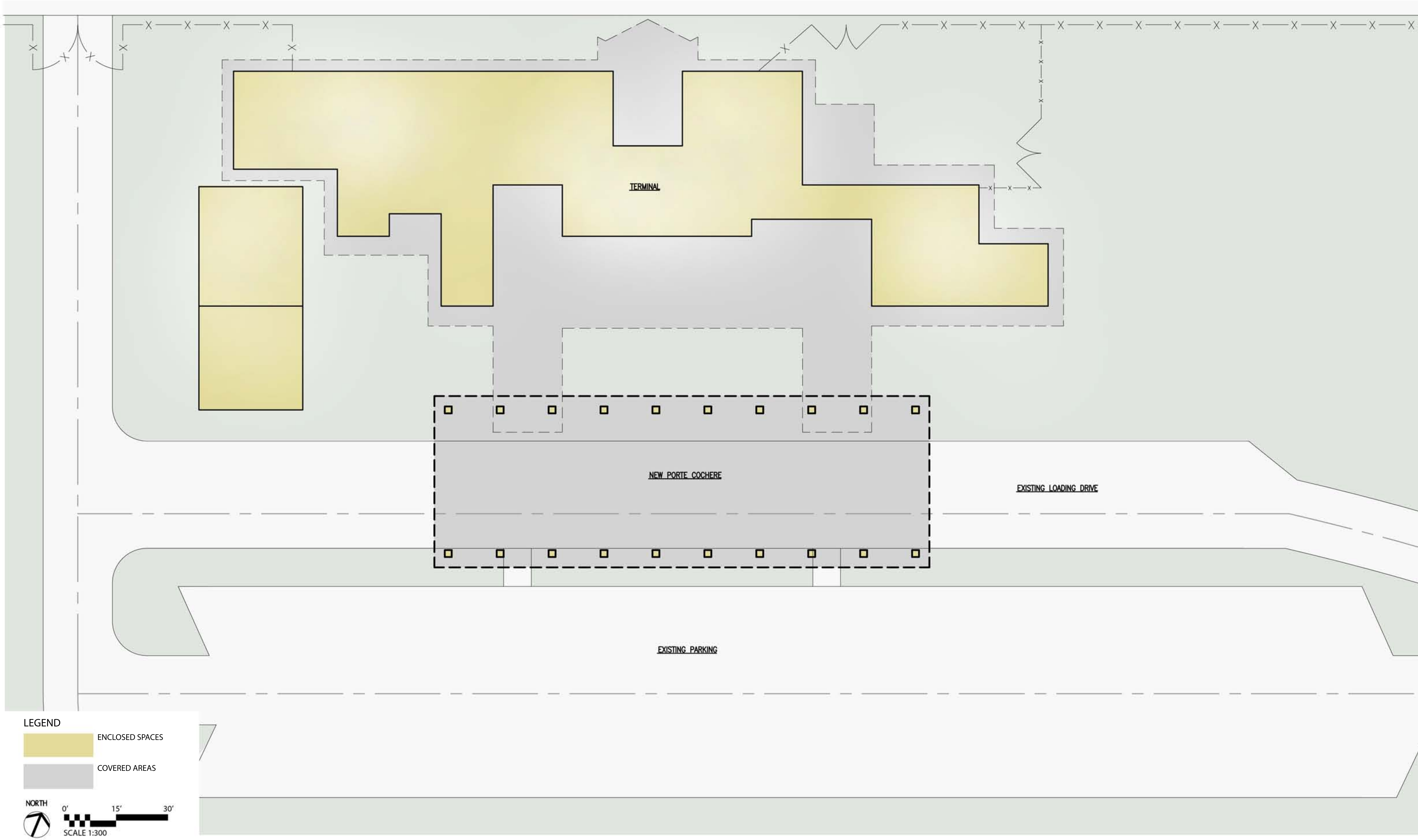
PROPOSED TERMINAL IMPROVEMENT PLAN

FIG 7-5



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SCALE: 1:300	PROJECT #081-10015-010
PROPOSED PORTE COCHERE EXPANSION PLAN	FIG 7-6

hazard to operating aircraft in the airport environments. Four primary characteristics of land use that reflect safety related issues are:

a) High Concentrations of People

High concentrations of people can be defined as the number of people within a particular land area and is often measured by the number of people per unit of area. Density may be categorized as high, medium, or low depending on the number of people that a development contains. Available accident data suggests that the greatest concentration of aircraft accidents occur near the ends of a runway during approach and departure. The risk of damage and personal injury to both people on the ground and in the aircraft can be reduced significantly by limiting the number of people in areas adjacent to airports, particularly near runway ends.

There are no high areas of concentrated people near Yap International Airport. The airport has title to a large area surrounding the currently developed facilities. This area is provided to protect the arrival and departure surfaces and also allow for future expansion.

b) Height Obstructions

Another pertinent aspect of airport safety is height restrictions for buildings and structures on or near airports. Low-level flight occurs during approach, departure, and search and rescue operations. Inadvertent collisions with tall structures during any of these stages of flight are detrimental to the safety and welfare of those people in the aircraft and persons on the ground. Tall structures may include buildings and objects, as well as natural features such as trees and terrain. It is critical to avoid tall structures within the airport's approach and departure surfaces, as described in FAR Part 77. Tall objects adversely affect approach corridors and instrument approach altitudes.

Federal Aviation Regulations (FAR) Part 77 imaginary surfaces to determine height restrictions for natural and man-made objects are as follows:

Primary Surface: A surface longitudinally centered along the runway, extending 200 feet beyond each end of the paved runway and having a total width of 250 feet.

Horizontal Surface: A horizontal plane 150 feet above the established airport elevation, the perimeter of which is constructed by scribing an arc 5,000 feet out from the center of each end of the primary surface and connecting the arcs with tangents.

Conical Surface: A surface extending outward and upward from the periphery of the horizontal surface at a slope of 20 to 1 for a horizontal distance of 4,000 feet.

Approach Surface: A surface longitudinally centered on the extended runway centerline, extending outward and upward from each end of the primary surface at a slope of 20 to 1 for a length of 5,000 feet. The width of this surface starts the same as the Primary Surface, 250 feet, and flares to 1,250 feet at 5,000 feet.

Transitional Surface: A surface extending outward and upward from the sides of the primary surface and from the sides of the approach surfaces at a slope of 7 to 1.

Figure 7-7 FAR 77 shows the FAR Imaginary Surfaces.

An Obstruction Survey is currently under way at Yap International Airport in order to update the existing FAA/NOAA database on terrain at and near the airport environment. This data is routinely used to determine the minimum descent altitude (minimums) for published instrument approaches into the airport. NOAA (a US Federal Agency) was previously responsible for data collection and providing obstruction surveys to the FAA. Under new guidelines, FAA has taken responsibility for the new obstruction surveys and has developed guidelines for the survey. These guidelines include the need for aerial photography (photogrammetry) along with land based survey efforts.

c) Visual Obstructions

Land uses that obscure pilot visibility should be limited to facilitate safe navigation. Visibility can be obscured by a number of items including: dust, glare, light emissions, smoke, steam, and smog.

- ***Dust*** carries dirt or sand particles through the air, which create hazardous conditions due to severe reduction in visibility. When construction activities occur within the vicinity of an airport, there is a risk for exposed earth materials to be carried by high winds across airport operational areas.

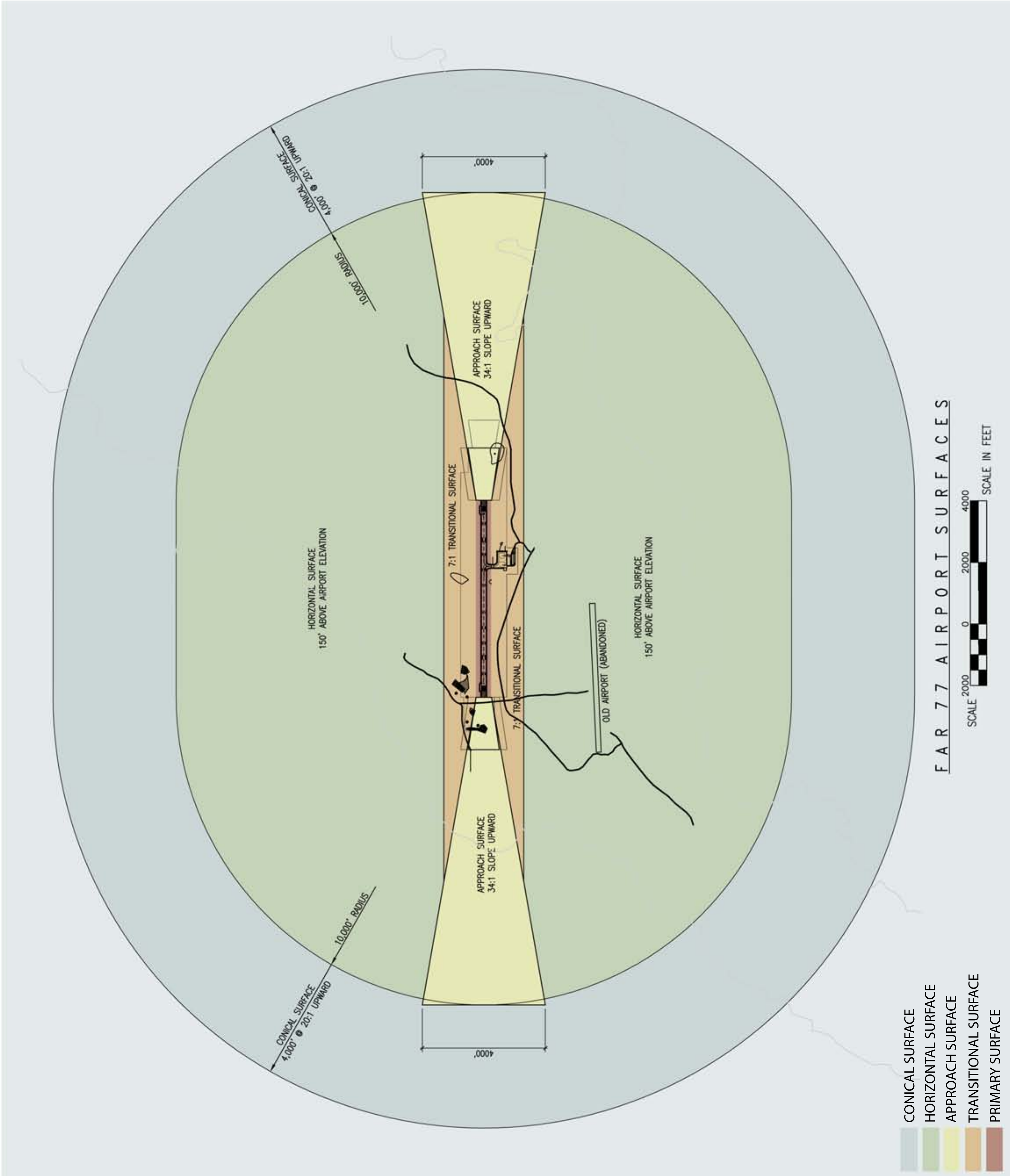

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FIGURE 7-7. FAR 77 IMAGINARY SURFACES

- ***Glare*** produced from reflective surfaces can blind or distract pilots during low level flight altitudes. Water surfaces such as storm water detention ponds and light-colored or mirrored building materials can produce glare as well. It is important to evaluate these conditions during site plan review and to consider whether or not they may impact visibility.

- ***Light emissions*** are often the result of lights that shine upward in the flight path. A pilot's ability to identify an airport during low-level flight altitudes can be hindered by emissions during evening hours, storm events, or times of reduced visibility such as fog. Also, lights arranged in a linear pattern can be mistaken for airport lights depicting operational areas.

- ***Smoke and steam,*** can create a hazardous haze that contributes to reduced visibility for a pilot while operating an aircraft. Generation of these conditions by land uses such as manufacturing and ethanol plants or utilities such as electrical generation and nuclear power plants can pose a problem for pilots. The location of these types of land uses relative to the airports operational areas should be carefully considered.

YAP management needs to make sure that any activities that may cause issues with visibility are regulated and/or do not occur during aircraft approaches and departures.

d) Wildlife and Bird Attractants

Monitoring wildlife activity and habitats on or near airports is an important first step in determining how to protect airports from wildlife hazards. Development and implementation of a wildlife management plan also plays a critical role in airport planning and zoning by giving an airport the tools and techniques to properly maintain habitat management controls. FAA Advisory Circular (AC) 150/5200-33A, *Hazardous Wildlife Attractants on or Near Airports,* discusses various incompatible land uses and wildlife mitigation measures.

YAP, with the assistance of the United States Department of Agriculture (USDA), is in the process of developing a Wildlife Hazard Management Plan, including a mitigation plan for the airport. Prior to the development of this plan, there will be a data collection phase (for 12 months) to gather actual statistics on types, quantity, and locations of birds on and near the airport. The Wildlife Hazard Assessment for Yap International Airport was completed and approved by the in June 2010; a completed Wildlife Management Hazard Plan is currently under review by the FAA.

CHAPTER 8: CAPITAL IMPROVEMENT PROGRAM

8.1 INTRODUCTION

The Capital Improvement Program (CIP) represents a phasing concept and cost estimate for implementing the airport improvements that emerged from the AMP process. The CIP is divided into three phases: short-term (2010-2015), near term (2016-2020), and long-term (2021-2030). The CIP must be viewed as a constantly evolving document. Planning for Yap International Airport should remain flexible and should incorporate annually updated estimates of costs and priorities. The CIP is structured in a manner that presents a logical sequence of improvements, while attempting to reflect available funding from available sources to the airport. Such as loans and grants from various foreign agencies.

Projects in the ACIP respond to FAA’s emphasis on the following goals:

- Ensure that the air transport of people, services and goods is provided in a safe and secure environment.
- Preserve and upgrade the existing airport system in order to allow for increased capacity, as well as to ensure reliable and efficient use of existing capacity.
- Improve the compatibility of airports with the surrounding communities.
- Provide sufficient access to an airport for the majority of the population.

Using these emphases, key development projects for the airport’s future have been identified and defined. In summary, these projects address existing demands and projected demands on the airport. The initial project phase, addresses many pressing issues on the airside or airfield, and follows a program of development which focused on the landside, i.e., terminal, new passenger parking and circulation, and so on.

8.1.1 Facilities Phasing Plan

The planning horizon for this master plan update is 20 years with 5, 10 and 20-year milestones shown in Table 8-1.

Table 8-1. Facilities Phasing Plan

Phase	Year
Phase I	2012 to 2016
Phase II	2017 to 2021
Phase III	2022 to 2031

The overall phasing and scheduling of developments mentioned in this chapter are a merging of Yap International Airport's existing Capital Improvement Program and the recommended facilities and projects that are the output of this Airport Master Plan Update. A cursory review of the CIP project listing indicates a significant 'front loading' of recommended projects within Phase I, representing the years 2012 to 2016.

For Yap International Airport, a variety of airfield upgrades and improvements will need to be undertaken to improve the basic infrastructure and provide additional measures of safety to support ongoing aircraft operations. The FAA ACIP program implemented by the FAA Airports Division, has helped transform the airports in the Federated States of Micronesia in terms of bringing up the level of airport infrastructure, airfield paving, signage/lighting, ARFF facilities and trucks, and various training programs to transfer expertise and technical skills to the staff and management of these airports and public works sectors. As such, it is important to achieve the most important airport infrastructure projects remaining for Yap International Airport in Phase 1 in order to take advantage of the FAA's funding for these elements, while the FSM remains eligible for these funds

Both the Phase 2 and Phase 3 projects provide the Airport with an outlook of future needs. But, as they move into the near term horizon, they need to be re-assessed as demand changes or funding sources are better defined.

For airfield upgrade and infrastructure projects, the recommended early phasing of these types of projects is primarily due to the anticipated life span of the FAA ACIP program. This program, implemented by the FAA Airports Division, has literally transformed the airports in the Federated States of Micronesia in terms of bringing up the level of airport infrastructure, airfield paving, signage/lighting, ARFF facilities and trucks, and various training programs to transfer expertise and technical skills to the staff and management of these airports and public works sectors.

Order-of-magnitude engineering costs were developed for each of the master plan projects and can be found in the tables below. The cost estimates associated with the Master Plan projects reflect allowances for Sponsor administration, engineering/design, contingencies, and construction management of 30%. In addition, project costs include an assumption of 5% simple interest to account for future inflation in Phase 2 and Phase 3 projects.

8.2 Phase 1 Improvements (2012 – 2016)

Phase 1 development consists of the following capital projects:

- Relocation of Electrical Vault
- Runway Safety Area Improvements
- Airfield Service Road (Along Perimeter Fence)
- Remove/Mitigate Obstructions: Approach and Airfield Environment
- Terminal Building Upgrades
- Central Security Facility/AOA Access
- Upgrade Area Lighting (Landside)
- Fire Hydrants: Public (Landside) Of Terminal Building

Table 8-2. Facilities Phasing Plan CIP Phase 1

Capital Improvement Program- Phase I (2011-2016)	
Projects	**Cost (US Dollars)**
Relocation of Electrical Vault	$780,000
Runway Safety Area Improvements	Runway 25 -$1,950,000 Runway 7 - $3,250,000
Airfield Service Road (Along Perimeter Fence)	$3,640,000
Remove/Mitigate Obstructions: Approach and Airfield Environment	$390,000
Terminal Building Upgrades	$2,080,000
Central Security Facility/AOA Access	$390,000
Upgrade Area Lighting (Landside)	$325,000
Fire Hydrants: Public (Landside) Of Terminal Building	$97,500
Total	**$6,922,500.0000**

8.3 Phase 2 Improvements (2017 – 2021)

Phase 2 development consists of the following capital projects:

- Runway/Taxiway Seal Coat and Marking Upgrades
- Remove/Mitigate Obstructions: Approach and Airfield Environment
- Water Storage Tank/Lines/Pumps (Potable &Fire Water Storage)
- GPS Precision Approach
- LED Upgrade for Airfield Lighting
- Ground Service Equipment Yard and Maintenance Area
- Mixed Use Warehouse: USPS & Airlines
- Aircraft Hanger
- Health Center/Quarantine Area
- Vehicle Parking Lot & Access Road Upgrade

Table 8-3. Facilities Phasing Plan CIP Phase 2

Capital Improvement Program- Phase 2 (2017-2022)	
Project	**Cost (US Dollars)**
Runway/Taxiway Seal Coat and Marking Upgrades	$2,175,000
Remove/Mitigate Obstructions: Approach and Airfield Environment	$435,000
Water Storage Tank/Lines/Pumps (Potable &Fire Water Storage)	$1,740,000
GPS Precision Approach	$580,000
LED Upgrade for Airfield Lighting	$725,000
Ground Service Equipment Yard and Maintenance Area	$870,000
Mixed Use Warehouse: USPS & Airlines	$725,000
Aircraft Hanger	$2,900,000
Health Center/Quarantine Area	$362,500
Vehicle Parking Lot & Access Road Upgrade	$1,812,500
Total	**$12,325,000.00**

8.4 Phase 3 Improvements (2022 – 2031)

Phase 3 development consists of the following capital projects:

- Remove/Mitigate Obstructions: Approach and Airfield Environment
- Runway Seal Coat and Airfield Marking Upgrades
- Upgrades to Airfield Lighting & Signage
- Runway Rehabilitation
- Runway Extension
- ARFF Rehabilitation
- Terminal Rehabilitation
- Water System & Sewer Upgrades

Table 8-4. Facilities Phasing Plan CIP Phase 3

Capital Improvement Program- Phase 3 (2022-2031)	
Projects	**Cost (US Dollars)**
Remove/Mitigate Obstructions: Approach and Airfield Environment	$122,500
Runway Seal Coat and Airfield Marking Upgrades	$1,100,000
Upgrades to Airfield Lighting & Signage	$2,187,500
Runway Rehabilitation	$59,500,000
Runway Extension	$17,500,000
ARFF Rehabilitation	$3,500,000
Terminal Rehabilitation	$2,625,000
Water System & Sewer Upgrades	$2,400,000
Total	**$88,935,000.00**

The following is a breakdown of the total cost of the Airport Capital Improvement Plan

8.5 Capital Improvement Plan Total Cost (2011 -2031)

Capital Improvement Program (2011-2031)	
Phase 1	**-2000**
Phase 2	$**12,325,000**
Phase 3	$**87,836,100**
Total	**$100,159,100.00**

YAP INTERNATIONAL AIRPORT

FACILITIES REQUIREMENT PLAN/CAPITAL IMPROVEMENT PROGRAM SCHEDULE

C.I.P. PROJECTS	PHASE I					PHASE II					PHASE III									
	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031
AIRSIDE																				
Relocated Electrical Vault																				
Water Storage Tank/Lines/Pumps (potable & fire water storage)																				
Runway Safety Areas & Drainage Improvements																				
East End																				
West End																				
Airfield Service Road (Along Perimeter Fence)																				
Clearing/Mitigating Obstructions in Approaches/Airport Environment																				
LED Lighting (airfield)																				
GPS Precision Approach																				
Multi use Cargo Facility																				
Ground Service Equipment (GSE) Yard & Maintenance Area																				
Mixed Use Warehouse: USPS & Airlines																				
Aircraft Hangar																				
Runway Seal Coat/Markings Upgrade																				
Runway Rehabilitation																				
Airfield Lighting Upgrade																				
Runway Extension																				
TERMINAL AREA																				
Terminal Building Upgrades																				
Health Center/Quaratine Area																				
Central Security Facility/AOA Access																				
LANDSIDE AREA																				
ARFF Rehabilitation																				
Vehicle Parking Lot & Access Road Upgrade																				
Rental Car Kiosk																				
Upgraded Area Lighting																				
Fire Hydrants: Public (Landside) Of Terminal Building																				
Water System & San Sewer upgrades																				

CHAPTER 9: ENVIRONMENTAL

9.1 INTRODUCTION

The purpose of considering environmental factors in airport master planning is to identify potential key environmental impacts of the various airport development alternatives so that those alternatives can, when possible, avoid or minimize impacts to sensitive resources. The environmental review should provide information that will help expedite subsequent environmental compliance processing.

This environmental review, while not a formal environmental assessment (EA), will consider the environmental elements described in FAA Advisory Circular 150/5070-6B, FAA Order 5050.4B, Airport Environmental Handbook, and any relevant National and State environmental regulations and procedures.

9.2 GENERAL CONDITIONS

9.2.1 History

The first inhabitants of Yap arrived approximately as early as 2000 BC by Austronesian navigators from the west (Philippines and Indonesia). The Yapese speaks a western Austronesian language that differs from the eastern Austronesian languages spoken by the other three states of the FSM. The Portuguese, captained by explorer Dioga Da Rocha were the first Europeans to visit Yap in 1525. They were followed by occasional whalers and traders until the 1870s when Spain and Germany both claimed Yap. The dispute was settled by the Pope, who ruled in the favor of Spain. In 1899, Spain sold Yap and the other Caroline Islands to Germany. After World War I, the Japanese were given a mandate over Yap in 1919. The Japanese fortified Yap and held it until the end of World War II, when it was liberated and occupied by U.S. forces.

After World War II, Yap became part of the United Nations Trust Territory of the Pacific Islands in 1947. The United States Trust Territory of the Pacific Islands was formally established in 1951, and Yap was one of six districts with the trust territory. The Yap Islands Congress first convened in May 1959 and established the foundation for Yap State, which was formally organized in 1978. In 1978, the people of the Trust Territories of the Pacific Islands developed and approved a constitution, written by elected delegates, forming the Federated States of Micronesia government, consisting of the States of Kosrae, Chuuk, Pohnpei, and Yap. By 1980, Yapese fully controlled the state and local governments.

9.2.2 Air Quality

Observations indicate that Yap has good air quality, experiencing excellent visibility throughout the year. Yap's consistent trade winds, remote location, and absence of major air polluting activates, help maintain high level air quality. Sources for air pollution in the area are emissions from cars and dust from the roadways.

9.2.3 Water Quality

Yap does not have extensive public water systems. About 75 percent of the population of Yap has piped water available to them. Portable water is available on the Main Islands, except for MAAP and Rumung.

The airfield is connected to both Colonia and Southern Yap Water Systems. The water is supplied and tapped from an island-wide distribution line in the public road and is routed to the terminal and apron facilities. There is also a waterline from the apron area to a water tank on the hill to the northwest of the apron. This line is reported to be closed at this time.

9.2.4 Biodiversity

The follow section describes Yap's terrestrial and marine diversity. Information on Yap's biodiversity is extremely limited. Reports on specific information such as endemic species, invasive species, extinct species and threatened species are very limited. In 2002, the Federated States of Micronesia completed to biodiversity reports (Marine and Terrestrial) much of the information in this section is gathered from those reports.

a) Terrestrial

According to the <u>Terrestrial Biodiversity of the Federated States of Micronesia</u> (February 2002) Yap is unique in the FSM by having metamorphic rock and associated soils resulting from uplift of the ocean floor (plate tectonics), as well as old volcanic soils. Yap has the most diverse mangroves and agroforests ("agroforest" signifies the combination of agriculture and forestry practiced in Micronesia) within the FSM. The Yapese has long ago established tree garden/ taro patch systems involving landscape architecture to manage water flow through the system. Vegetation is mostly made up of food-bearing trees including breadfruit, coconuts, mango, banana, and taro and other useful and ornamental species planted by people around residences, homesteads and villages. Many of the food plants have been introduced to Yap, with approximately 39% of the plants in Yap having been introduced species. Some of these introduced species have become invasive pests that have spread out of control. The spread of invasive species is a continual threat due to increased movement of people and machinery between the islands, and needs to carefully monitor and control spreading them to additional areas.

Native mammals of the FSM include five species and subspecies of fruit bats. Other mammals have been introduced, including at least three rats, mice, dogs, cats, pigs, and goats. Some 119 species of birds have been reported in the FSM. These include 31 resident seabirds, 33 migratory shorebirds, 19 migratory land or wetland birds and five vagrant species. Yap has two types of endemic birds, The Yap Monarch and the Yap Greater White-eye.

b) Marine

According to Marine Biodiversity of the Federated States of Micronesia (February 2002) Fish species are abundant and highly diverse, reporting between 393 and 410 species and a total of 143 species of marine algae, 207 species of corals, four species of turtle and 11 types of sea cumbers. In terms of freshwater species, the Marine Biodiversity Report sates there 41 green algae, 13 blue-green algae, 2 red algae, 3 mosses and 10 angiosperms. Yap harbors 14 species of freshwater and brackish gastropods.

9.2.5 Land Use

a) Traffic

There are no real traffic issues in Yap State. Transport is primarily by private automobile. There is no organized public transport other than morning and evening buses operated to transport workers and school children from their villages to and from the urban area of the central islands. Around ten percent of all vehicles on Yap are owned by the state government.

The Airport is accessed by land via one two-lane road, which is in good condition and connects the Airport to Colonia, the capitol. The access road is the only road between the Airport and Colonia, about two (2) to three (3) miles from the Airport.

b) Noise

Yap is peaceful and quite. There are little to no major noise generating activities on the islands. The noise levels are negligible. In the more developed areas, the noise is similar to any small urban area. The majority of the noise is caused by traffic and local business. In rural areas there is barely any noise. There is no real traffic to speak of and local businesses are limited to small family-operated stores.

9.3 POTENTIAL ENVIRONMENTAL IMPACTS

9.3.1 Methodology for Assessing Impacts

This section looks at the environmental impacts of proposed actions, reasonable alternatives to that action, and environmental effects that cannot be avoided should the proposed actions be implemented. It is required that consideration of impacts includes the context, intensity, duration, type and measures to mitigate impacts.

Impacts are considered at their local, national, and regional context as appropriate.
Intensity is a measurement of the severity of an impact. The intensity of an impact may be:

- *Negligible* – when the impact is at its lowest level of detection
- *Minor* – when the impact is low but detectable
- *Moderate* – when the impact is evident and considerable
- *Major* – when the impact is severe

The duration of an impact is a measure of how long the effects of an impact will last. The duration of impacts are categorized as short-term and long- term.

- *Short term* – impacts that last less than a year
- *Long term* – impacts that last longer than a year

Types of impact:

- *Adverse* – impacts that change the affected environment in a manner tending away from the natural range of variability
- *Beneficial* – impacts that change the affected environment toward the natural range of variability
- *Direct* – impacts caused by the action and occur at the same time and place
- *Indirect*– impacts caused by the action and are later in time or father removed in distance, but are still reasonably foreseeable
- *Cumulative* – impacts on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time

9.3.2 Types of Impacts

The follow section takes a generic look at possible environmental impacts that may result from the proposed capital improvements recommended by this Master Plan. There will be a need, however, to complete coordination with federal, state, and local agencies when the recommended projects are officially slated to move forward. Without mitigation or implementation of an environmental management plan, environmental impacts can occur during both construction and operation of major infrastructure projects. Such impacts are widely documented and are summarized in the matrix shown as Table 9-1.

TABLE 9-1. Potential Impacts Caused by Capital Improvement Projects

Construction Activities	Potential Environmental Impact
Surveying and demarcation of work site	• Loss of vegetation and disruption of historical sites • Social impact on to nearby population
Earth moving activities (digging, excavations, cut and fill activities)	• Accidental discovery of archaeological assets, sites or resources • Soil erosion, slit generation and increased runoff • Sediment contamination of nearby water ways (ocean, rivers, and streams) • Turbidity in near-shore and reef environments • Loss of land uses
Contractor mobilization	• Wastes generated at construction camps • Various social impacts
Aggregate extraction	• Removal of corals damages reef and depletes marine resources • Removal of beach gravels removes shoreline protection, changes littoral drift and accelerates erosion • Dust generated affects air quality • Noise created effect on community
Vehicle Operation (machinery, trucks, etc.)	• Emission of exhaust from vehicles and machinery • Dust generated by heavy vehicles transporting materials • Traffic delays • Noise pollution
Run-off, discharges	• Increased siltation • Water pollution –streams, rivers, ocean • Hazardous effects to marine life
Emergency or accidental spills	• Soil contamination • Potential contamination of water supply sources like groundwater • Risk to people and animals • Air pollution

9.5 NATIONAL AND STATE LAWS

The following Table summarizes environmental laws that may have an effect on capital improvement projects at Yap International Airport. Before undertaking in any construction, contractors and consultants should meet with State and National EPA to make sure regulations listed below are currently being enforced and that no other regulations have been added.

The Federated States of Micronesia national government is responsible for setting minimum standards and providing technical assistants to the state level agencies responsible for environmental protection. The Yap State Environmental Protection Agency (EPA) was created in 1994 through the Environmental Quality Protection Act as passed by the Yap State Legislature. Regulations and laws for the United States are also listed has they may be applicable for projects that are funded by United States' grants and loans.

Table 9-2 Environmental Laws

National Government	Yap State	United States
Environmental Protection Act	Environmental Impact Assessment Regulations	National Environmental Policy Act
Environmental Impact Assessment Regulations	Earthmoving and Sedimentation Control Regulations	National Historic Preservation Act
Earthmoving Regulations	Oil Spill Reporting Regulations	Endangered Species Act
FSM Endangered Species Act	Pesticide Regulations	Department of Transportation Act, Section 4(f)

CHAPTER 10: AIRPORT LAYOUT PLANS

The Airport Layout Plan (ALP) is a set of drawings that show future improvements recommended by this Master Plan. In addition to the proposed airport improvements, the ALP set also shows existing runways, taxiways, airport property boundary, and other existing facilities. The ALP set includes a number of individual drawings. Several of these drawings are required while others may be included in the ALP set to provide detailed concepts that provide a clear picture of recommended capital improvements. Information that is usually included are drawings that show runway details and data, approach and departure profiles, airspace protection surfaces, obstruction information, terminal area plans, land-use information and airport property maps. The ALP is prepared in conformance with the FAA's AC 150/5070-6B, "Airport Master Plans." The FAA provides guidance in the development of the ALP set and is responsible for review and approval of the ALP set.

- Title Sheet – Contains approval signature blocks, airport location maps, and other pertinent information as required by the FAA.
- Airport Layout Plan – illustrates the existing and future airport facilities. The drawing also includes required facility identifications, description labels, imaginary surfaces, runway protection zones, runway safety areas and basic airport and runway data tables.
- Airport Surfaces: Airport Airspace/ Inner Portion of the Approach Surface – 14 CFR Part 77, Objects Affecting Navigable Airspace, define this as a drawing depicting obstacle identification surfaces for the full extent of all airport development. It also should depict airspace obstructions for the portions of the surfaces excluded from the inner portion of the approach surface drawing.
- Terminal Area Layout– Consists of two drawings showing current and planned improvements, presenting a large-scale depiction of areas with significant terminal facility development.
- Land Use Plan Existing and Land Use Plan Proposed. On and off airport drawings that depict the land uses within and adjacent to the airport property boundary.
- Airport Property Map – A drawing depicting the airport property boundary, the various tracts of land that were acquired to develop the airport, and the method of acquisition.