
Honolulu International Airport
Capacity Enhancement Plan
July 1992

Honolulu International Airport

Airport Capacity Enhancement Plan

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Prepared jointly by the U.S. Department of Transportation, Federal Aviation Administration, the State of Hawaii, Department of Transportation, Airports Division, and the airlines and general aviation serving Honolulu and the State of Hawaii.

Figure 2 Capacity Enhancement Alternatives and Annual Delay Savings

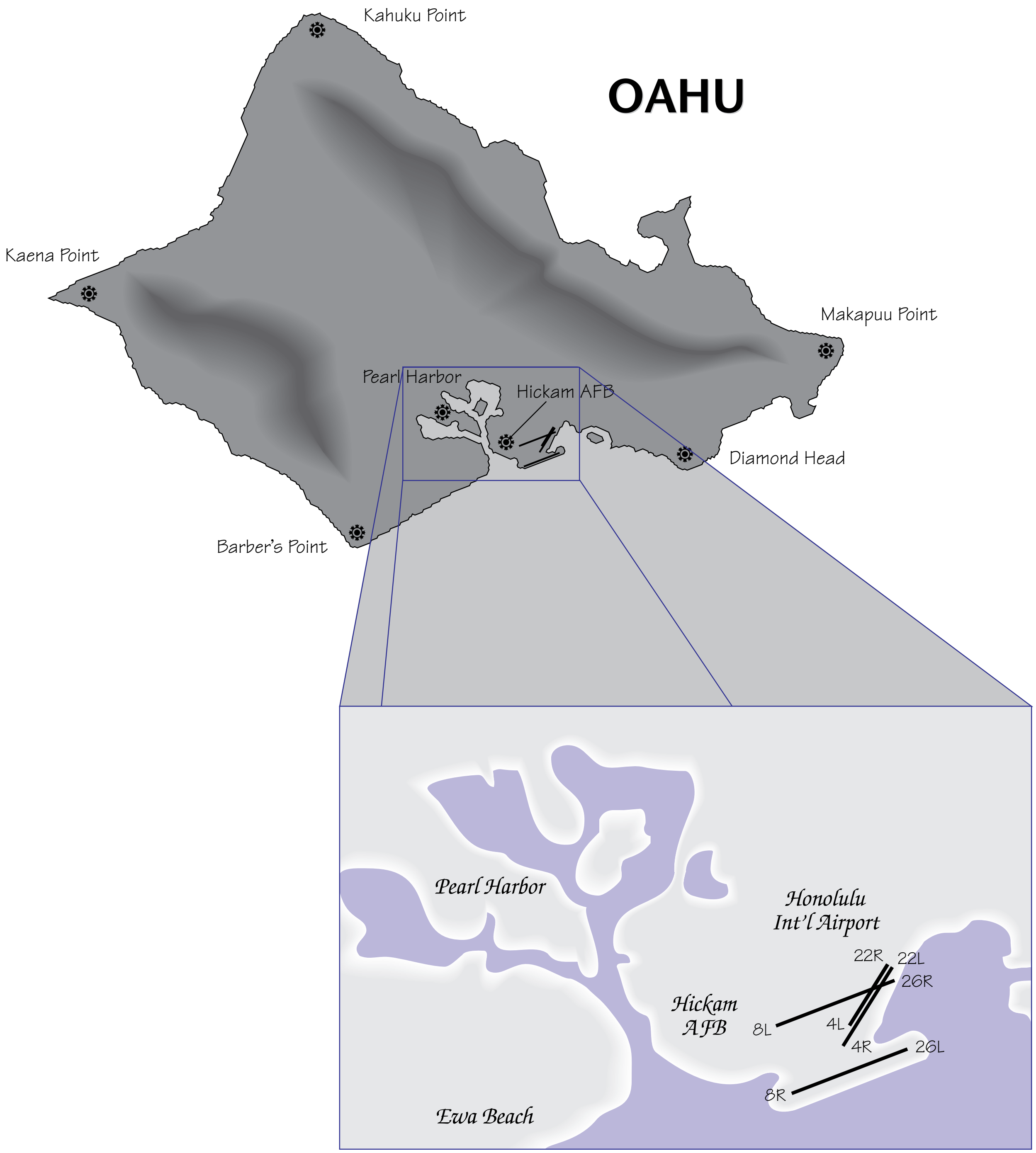
Alternatives	Project Cost	Estimated Annual Delay Savings* Baseline (407,000)	Future 1 (500,000)	Future 2 (700,000)
Airfield Improvements				
1. Effect of new international terminal	$678.0		**	
2. Relocate and consolidate general aviation (GA) on the south side	$2.8		**	
3. Relocate commuter terminal	$5.0		**	
4. Extend Runway 4L/22R to SW to 10,000 ft.	$44.8	7,290/$14.2	32,920/$64.1	42,420/$82.6
5. Extend Runway 4R/22L to SW to 10,000 ft.	$25.0	620/$1.2	410/$0.8	2,310/$4.5
6. Extend both Runway 4L/22R and Runway 4R/22L to SW to 10,000 ft.	$70.0		†	
7. Construct new GA runway in Keehi Lagoon	$40.5	4,370/$8.5	31,790/$61.9	186,590/$363.3
8. Extend Runway 8R/26L 1,000 ft.	$5.0		†	
9. Construct new Runway 8C/26C	$86.0	13,510/$26.3	57,880/$112.7	382,490/$744.7
10. Construct engine run-up pad at east end of Taxiway RA	$7.5		†	
11. Construct arrival holding area	$8.5		†	
12. Construct angled exits on Runways 4R, 8L, and 26L	$10.0	460/$0.9	7,860/$15.3	32,820/$63.9
Facilities and Equipment Improvements				
13. Install Category II ILS on Runway 8L and Category I ILS on Runway 8R	$3.0		†	
14. Install Microwave Landing System (MLS) on Runways 8L, 8R, and 26L	—		†	
Operational Improvements				
15. Increase use of Runway 8R for arrivals	—	560/$1.1	11,560/$22.5	94,860/$184.7
16. Effect of noise abatement procedures	—	3,600/$7.0	7,760/$15.1	21,060/$41.0
17. Distribute traffic more uniformly within the hour	—	1,690/$3.3	2,620/$5.1	7,190/$14.0
18. Relocate general aviation (GA) to reliever airports	—			
18a. Relocate 50% of GA		3,950/$7.7	27,940/$54.4	145,200/$282.7
18b. Relocate 100% of GA		4,980/$9.7	32,970/$64.2	245,150/$477.3
19. Relocate military aircraft	—			
19a. Relocate 50% of military aircraft		2,470/$4.8	19,720/$38.4	87,620/$170.6
19b. Relocate 100% of military aircraft		4,110/$8.0	28,200/$54.9	163,120/$317.6
19c. Increase military to 150% of current level and relocate 100% of GA		4,160/$8.1	30,720/$59.9	175,500/$341.7

* In hours and millions of 1991 dollars. The savings benefits of these alternatives are not necessarily additive.

** These improvements were included in Baseline for modeling purposes as though the projects were in place.

† These improvements were not simulated. Therefore, no dollar figures are available. There is a description of each of these items in Section 2 — Capacity Enhancement Alternatives.

Figure 3 Honolulu International Airport — Relative Location



Summary

The Federal Aviation Administration (FAA), airport operators, and aviation industry groups have initiated joint Airport Capacity Design Teams at various major air carrier airports throughout the U.S. These Capacity Teams identify and evaluate alternative means to enhance existing airport and airspace capacity to handle future demand. A Capacity Team for Honolulu International Airport (HNL) was formed in 1991.

Steady growth at HNL has made it one of the busiest airports in the country. Activity at the airport has increased from 15,261,993 passenger enplanements and deplanements in 1983 to 22,302,362 in 1990, a 46 percent increase. In 1990, the airport handled 407,048 aircraft operations (either takeoffs or landings).

The HNL Capacity Team identified and assessed various actions which, if implemented, would increase HNL's capacity, improve operational efficiency, and reduce aircraft delays. The purpose of the process was to determine the technical merits of each alternative action and its impact on capacity. Additional studies will be needed to assess environmental, socioeconomic, or political issues associated with these actions.

Selected alternatives identified by the Capacity Team were tested using computer models developed by the FAA to quantify the benefits provided. Different levels of activity were chosen to represent growth in aircraft operations in order to compare the merits of each action. These annual activity levels are referred to throughout this report as:

Baseline — 407,000 operations;
Future 1 — 500,000 operations; and
Future 2 — 700,000 operations.

If no improvements are made at HNL (the Do Nothing scenario), the annual delay cost will increase from 20,650 hours or $40.2 million at the Baseline level of operations to 467,440 hours or $910.1 million at a level of 700,000 operations.

The major alternatives resulting from the HNL study include:

Alternative	Future 2 Annual Delay Savings: Hours	Future 2 Annual Delay Savings: Millions of 1991 $
• Construct new Runway 8C/26C.	382,490	$744.7
• Construct new GA runway in Keehi Lagoon.	186,590	$363.3
• Increase use of Runway 8R for arrivals.	94,860	$184.7
• Extend Runway 4L/22R to the southwest to 10,000 feet in length.	42,420	$82.6

Figure 4 Airport Capacity Curve — Aircraft Demand Versus Average Delay

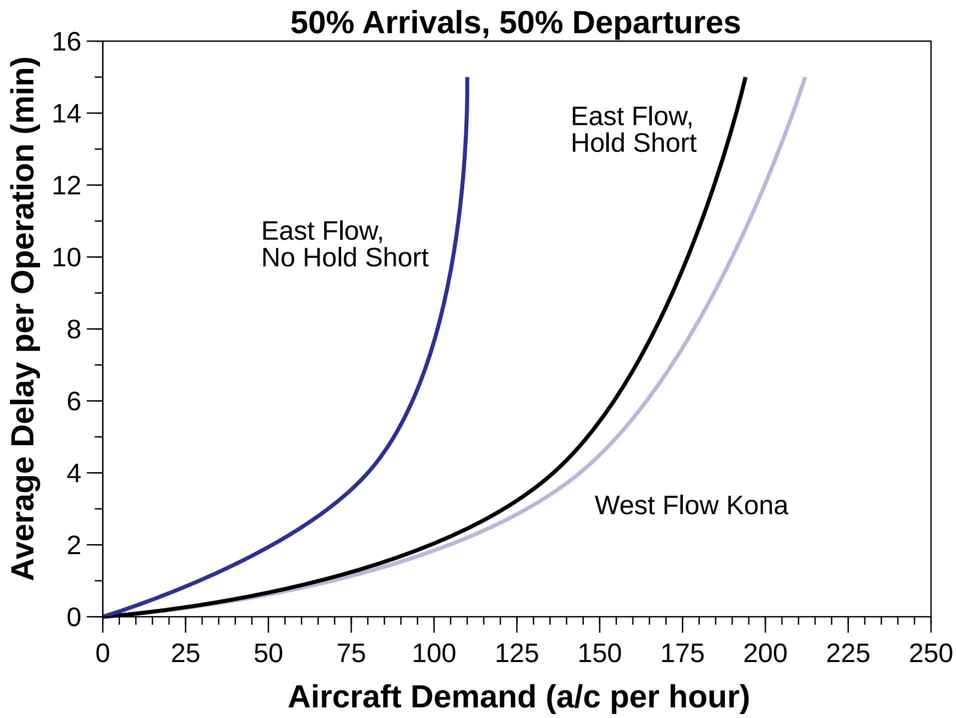


Figure 5 Profile of Daily Demand — Hourly Distribution

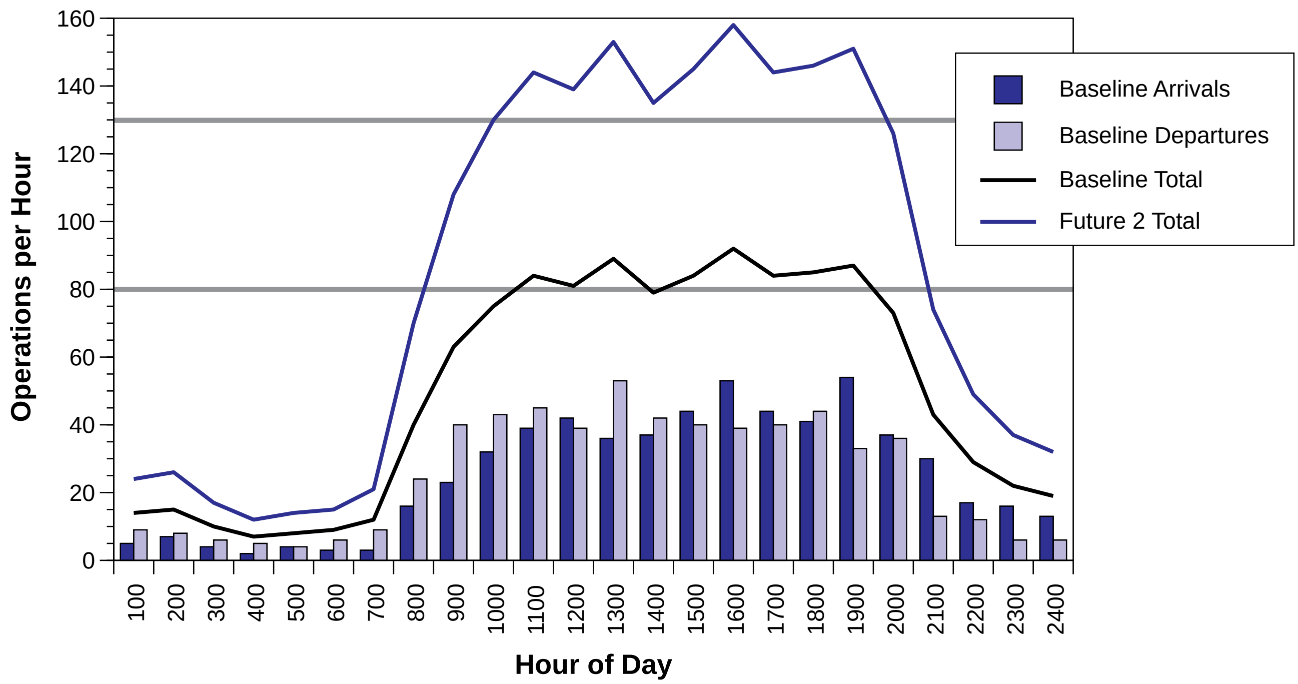
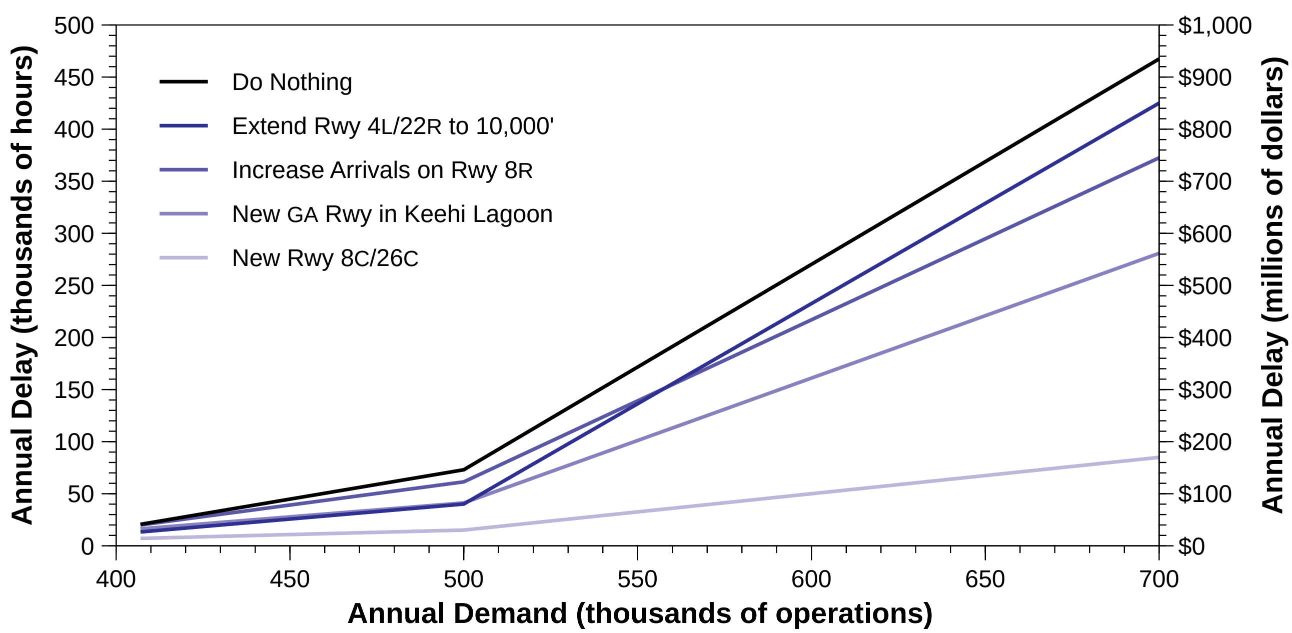


Figure 4 illustrates the capacity and delay curves for the current airfield configuration at HNL under east flow (Trade Wind), no-hold-short conditions. They show that aircraft delays will begin to escalate rapidly as hourly demand exceeds 80 to 130 operations per hour. Figure 5 shows that, while hourly demand exceeds 80 operations during certain hours of the day at Baseline demand levels, 130 operations per hour is frequently exceeded at the demand levels forecast for Future 2.

Figure 6 shows how delay will continue to grow at a substantial rate as demand increases if there are no improvements made in airfield capacity, i.e., the Do Nothing scenario. Annual delay costs will increase from 20,650 hours or $40.2 million at the Baseline level of operations to 467,440 hours or $910.1 million by Future 2. The graphs also show that significant savings in delay costs would be provided by:

- Constructing new Runway 8C/26C.
- Constructing new GA runway in Keehi Lagoon.
- Increasing use of Runway 8R for arrivals.
- Extending Runway 4L/22R to the southwest to 10,000 feet in length. ❧

Figure 6 Annual Delay Costs — Capacity Enhancement Alternatives



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Background

The national air transportation system is being called on to handle unprecedented growth and ever increasing activities. The challenge for the air transportation industry in the nineties is to enhance existing airport and airspace capacity and to develop new facilities to handle future demand. As environmental, financial, and other constraints continue to restrict the development of new airport facilities in the U.S., an increased emphasis has been placed on the redevelopment and expansion of existing airport facilities.

To begin to meet this challenge, the FAA, along with airport operators and aviation industry groups throughout the country, have initiated joint Airport Capacity Design Teams to study airport capacity enhancement at the major air carrier airports in the U.S. The objectives of these studies are to identify various alternatives for increasing capacity and to evaluate their potential for reducing delays.

In the past decade, Honolulu International Airport (HNL) has been one of the nation's busiest airports. Passenger enplanements and deplanements at HNL rose from 15,261,993 in 1983 to 22,302,362 in 1990, a 46 percent increase. HNL's total aircraft operations reached 407,048 in 1990.

This report has established benchmarks for development based upon traffic levels and not upon any definitive time schedule, since actual growth can vary year to year from projections. As a result, this report should retain its validity until the highest traffic level is attained regardless of the actual dates paralleling the development.

A Baseline benchmark of 407,000 aircraft operations (either takeoffs or landings) was established based on the projected annual traffic level for 1990, the base year of the study. Two future traffic levels, Future 1 and Future 2, were established at 500,000 and 700,000 annual aircraft operations respectively, based on Capacity Team consensus of potential traffic growth at Honolulu. If no improvements are made at HNL, annual delay levels and delay costs are expected to increase from an estimated 20,600 hours and $40.2 million at the Baseline activity level to 467,400 hours and $910.1 million by the Future 2 demand level.

The Capacity Team studied various proposals with the potential for increasing capacity and reducing delays at HNL. The improvements evaluated by the Capacity Team are delineated in Figure 2 and described in some detail in Section 2 — Capacity Enhancement Alternatives.

Objectives

The major goal of the Capacity Team was to identify and evaluate proposals to increase airport capacity, improve airport efficiency, and reduce aircraft delays. In achieving this objective, the Capacity Team:

- Assessed the current airport capacity and the causes of delay associated with the airfield, the immediate airspace, and the apron and gate-area operations.
- Evaluated capacity and delay benefits of alternative air traffic control (ATC) procedures, navigational improvements, airfield development, and operational improvements.

Scope

The Capacity Team limited its analyses to aircraft activity within the terminal area airspace and on the airfield. They considered the technical and operational feasibility of the proposed airfield improvements, but did not address environmental, socioeconomic, or political issues regarding airport development. These issues need to be addressed in future airport system planning studies, and the data generated by the Capacity Team can be used in such studies.

Methodology

The Capacity Team met periodically for review and coordination. The FAA Technical Center's Aviation Capacity Branch provided expertise in airport simulation modeling. Other Capacity Team members contributed suggested improvement options, data, text, and capital cost estimates.

Initial work consisted of gathering data and formulating assumptions required for the capacity and delay analysis and modeling. Where possible, assumptions were based on actual field observations at HNL. Proposed improvements were analyzed in relation to current and future demands with the help of two computer models, the Airfield Delay Simulation Model (ADSIM) and the Runway Delay Simulation Model (RDSIM). Appendix B briefly explains these models.

The simulation models considered air traffic control procedures, airfield improvements, and traffic demands. Alternative airfield configurations were prepared from present and proposed airport layout plans. Various configurations were evaluated to assess the benefit of projected improvements. Air traffic control procedures and system improvements determined the aircraft separations to be used for the simulations under both VFR and IFR.

Air traffic demand levels were derived from *Official Airline Guide* data, historical data, and Capacity Team and other forecasts. Aircraft volume, mix, and peaking characteristics were considered for each of the three different demand forecast levels (Baseline, Future 1, and Future 2). From this, annual delay estimates were determined based on implementing various improvements. These estimates took into account historic variations in runway configuration, weather, and demand. The annual delay estimates for each configuration were then compared to identify delay reductions resulting from the improvements.

Following the evaluation, the Capacity Team developed a plan of recommended alternatives for consideration, which is included in Figure 7. ❧

Figure 1 shows the current layout of the airport, plus the airfield improvements considered by the Capacity Team.

Figure 2 lists the capacity enhancement alternatives evaluated by the Capacity Team and presents the estimated annual delay savings benefits for selected improvements. The annual savings are given for the activity levels Baseline, Future 1, and Future 2, which correspond to annual aircraft operations of 407,000, 500,000 and 700,000 respectively. The delay savings benefits of the improvements are not necessarily additive.

Figure 7 presents the recommended action and suggested time frame for each capacity enhancement alternative considered by the Capacity Team.

The capacity enhancement alternatives are categorized and discussed under the following headings:

- Airfield Improvements.
- Facilities and Equipment Improvements.
- Operational Improvements.

Figure 7 Capacity Enhancement Alternatives and Recommended Actions

Alternatives	Action	Time Frame
Airfield Improvements		
1. Effect of new international terminal	Recommended	Baseline
2. Relocate and consolidate general aviation (GA) on the south side	Recommended	Baseline
3. Relocate commuter terminal	Recommended	Baseline
4. Extend Runway 4L/22R to SW to 10,000 ft.	Recommended	Baseline
5. Extend Runway 4R/22L to SW to 10,000 ft.	Study*	
6. Extend both Runway 4L/22R and Runway 4R/22L to SW to 10,000 ft.	Study*	
7. Construct new GA runway in Keehi Lagoon	Study*	
8. Extend Runway 8R/26L 1,000 ft.	Recommended	Baseline
9. Construct new Runway 8C/26C	Recommended	Future 1
10. Construct engine run-up pad at east end of Taxiway RA	Recommended	Baseline
11. Construct arrival holding area	Recommended	Future 1
12. Construct angled exits on Runways 4R, 8L, and 26L	Recommended	Baseline
Facilities and Equipment Improvements		
13. Install Category II ILS on Runway 8L and Category I ILS on Runway 8R	Recommended	Future 1
14. Install Microwave Landing System (MLS) on Runways 8L, 8R, and 26L	Recommended	Future 1
Operational Improvements		
15. Increase use of Runway 8R for arrivals	Recommended	Future 1
16. Effect of noise abatement procedures	Study*	
17. Distribute traffic more uniformly within the hour	Recommended	Future 1
18. Relocate general aviation (GA) to reliever airports 18a. Relocate 50% of GA 18b. Relocate 100% of GA	Recommended	Baseline
19. Relocate military aircraft 19a. Relocate 50% of military aircraft 19b. Relocated 100% of military aircraft 19c. Increase military to 150% of current level and relocate 100% of GA	Study*	

* The term "Study" suggests that a specific study be conducted or that it become part of a larger planning effort, such as a Master Plan Update or a FAR Part 150 Airport Noise Compatibility Study. These individual proposals require further investigation at a level of detail that is beyond the scope of this effort.

Airfield Improvements

1. Effect of new international terminal.

A new international terminal building will be constructed within the Diamond Head Service Court. The design for this building is nearly completed, and construction should commence in 1992. Together with this new terminal building, the Diamond Head Concourse will be extended to Aolele Street.

These related projects will enhance and increase the landside capacity of the airport. The new gates on the Diamond Head concourse will assist in alleviating the gate shortage problem at the airport, minimize the transfer of aircraft from hardstands to gates, and reduce the waiting period for gates. The new international terminal building will increase the throughput and reduce the processing time of arriving international passengers.

Estimated 1991 construction cost is $678.0 million.

2. Relocate and consolidate general aviation (GA) on the south side.

The GA facilities located on the North Ramp were displaced by the Diamond Head concourse extension in No. 1. These GA facilities have been relocated to and combined with those located on the South Ramp.

Estimated 1991 construction cost is $2.8 million.

3. Relocate commuter terminal.

The existing north-ramp commuter terminal has been relocated to a temporary location within the existing inter-island terminal. Upon completion of the new inter-island terminal building, the commuter terminal will be relocated to a permanent location within the inter-island complex.

Estimated 1991 construction cost is $5.0 million.

4. Extend Runway 4L/22R to the southwest to 10,000 feet in length.

The extension of Runway 4L/22R to 10,000 feet would allow for Trade Wind (east flow) arrivals on 4L and Kona Wind (west flow) departures on 22R for overseas aircraft. These aircraft are presently using Runway 4R/22L and must cross an active runway (Runway 4L/22R), which obviously causes delays. Although the 500 foot spacing between these runways would require restrictive air traffic control (ATC) procedures, e.g., dependent arrivals, extending Runway 4L/22R to support overseas aircraft operations would decrease runway crossings by providing the capability to segregate traffic to allow air carrier aircraft operating from the North Ramp to use Runway 4L/22R while cargo, air taxi, and GA aircraft operating from the South Ramp use Runway 4R/22L.

Estimated 1991 construction cost is $44.8 million, not including relocation or property acquisition.

Annual savings at the Baseline activity level will be 7,290 hours or $14.2 million, and, at Future 2 activity levels, 42,420 hours or $82.6 million.

5. Extend Runway 4R/22L to the southwest to 10,000 feet in length.

The extension of Runway 4R/22L would allow aircraft currently departing from Runway 26L during Kona winds to use Runway 22L.

Estimated 1991 construction cost is $25.0 million.

Annual savings at the Baseline activity level will be 620 hours or $1.2 million, and, at Future 2 activity levels, 2,310 hours or $4.5 million.

6. Extend both Runway 4L/22R and Runway 4R/22L to the southwest to 10,000 feet in length.

The extension of both runways to 10,000 feet would combine the benefits of alternatives 4 and 5 and would also allow for greater flexibility in runway use. Although the centerline-to-centerline separation of the runways is only 500 feet, additional capacity may be gained by using minimal departure separation criteria, especially for non-widebody aircraft.

Estimated 1991 construction cost is $70.0 million, not including relocation or property acquisition.

7. Construct new general aviation (GA) runway in Keehi Lagoon.

This project would construct a runway on the triangle-shaped island in Keehi Lagoon with taxiway bridges to the South Ramp. This runway would be used by air taxi and GA aircraft for both itinerant and local traffic. Most of the benefit from this project results from the reduction of flight arrival delays. There could be a sacrifice of flight departure capacity because of the interaction with Runways 8R and 8L.

Estimated 1991 construction cost is $40.5 million.

Annual savings at the Baseline activity level will be 4,370 hours or $8.5 million, and, at Future 2 activity levels, 186,590 hours or $363.3 million.

8. Extend Runway 8R/26L 1,000 feet.

Extending Runway 8R/26L by adding 500 feet to each end would enhance the ability of the runway to support long-haul, heavy-load, intercontinental flights and maintain the integrity of the informal noise abatement runway use program.

Estimated 1991 construction cost is $5 million.

9. Construct new Runway 8C/26C.

This project would construct an 8,000 foot runway parallel to and 1,600 feet south of Runway 8L/26R. This new runway would serve primarily as an arrival runway during Trade Wind (east flow) conditions and a departure runway during Kona Wind (west flow) conditions. The project would require relocation of the airport traffic control tower, several recreational facilities, hazardous cargo capability, and Air National Guard facilities.

Estimated 1991 construction cost is $86.0 million, not including relocation or property acquisition.

Annual savings at the Baseline activity level will be 13,510 hours or $26.3 million, and, at Future 2 activity levels, 382,490 hours or $744.7 million.

10. Construct engine run-up pad at the east end of Taxiway RA.

Presently, engine run-ups for maintenance and equipment checks are performed on active runways and taxiways. This closes the runway or taxiway to other aircraft operations. The construction of a run-up pad on the east end of Taxiway RA would eliminate the need for closure of runways or taxiways for engine run-ups.

Estimated 1991 construction cost is $7.5 million.

11. Construct arrival holding area.

Construction of an arrival holding area to hold arriving aircraft waiting for gates would relieve congestion near the terminal area and permit more efficient taxiway utilization. This alternative is exclusive of alternative 9. If Runway 8C/26C is constructed, the arrival holding area would have to be removed or relocated.

Estimated 1991 construction cost is $8.5 million, not including relocation costs.

12. Construct angled exits on Runways 8L, 4R, and 26L.

The addition of improved exits and the realignment of existing taxiways will reduce runway occupancy time of certain aircraft and increase individual runway capacity. On Runway 8L, the taxiway combinations of G, L, and X, and D, S, and Y should be reconfigured to allow for more efficient use and faster exiting by aircraft such as the DC-9, B-737, and DC-10. On Runway 4R, an angled taxiway should be constructed near Taxiway K and a new taxiway could be added near Taxiway F. On Runway 26L, two angled exits should be constructed prior to the existing Taxiway RM to reduce runway occupancy time during west flow operations.

Estimated 1991 construction cost is $10 million.

Annual savings at the Baseline activity level will be 460 hours or $0.9 million, and, at Future 2 activity levels, 32,820 hours or $63.9 million.

Facilities and Equipment Improvements

13. Install Category II ILS on Runway 8L and CAT I ILS on Runway 8R.

Although instrument meteorological conditions (IMC) restricting operations occur only about 0.02 percent of the time, the impact of the associated delays can be significant. The addition of a capability to land on Runway 8L under CAT II conditions would enhance the operational flexibility and ensure the integrity of operations in response to wind and other limiting conditions. The increased use of Runway 8R for arrivals (see alternative 14) will require a CAT I ILS on Runway 8R.

Estimated 1991 project cost is $3 million.

14. Install Microwave Landing System (MLS) on Runways 8L, 8R, and 26L.

The MLS will be the international standard replacement for the current Instrument Landing System (ILS). MLS will provide positive course guidance for approaches and departures under Instrument Meteorological Conditions (IMC). MLS's ability to support improved instrument procedures, like curved approaches, reduced minimums, simultaneous arrivals, and diverse departures, could significantly improve capacity under instrument conditions.

Operational Improvements

15. Increase use of Runway 8R for arrivals.

Under this alternative, up to 10 percent of the arrivals would be shifted to Runway 8R.

Annual savings at the Baseline activity level will be 560 hours or $1.1 million, and, at Future 2 activity levels, 94,860 hours or $184.7 million.

16. Effect of noise abatement procedures.

This alternative evaluates the effect on airport capacity of the current noise abatement procedures and compares that effect to the potential capacity if these procedures were eliminated.

Annual savings at the Baseline activity level will be 3,600 hours or $7.0 million, and, at Future 2 activity levels, 21,060 hours or $41.0 million.

17. Distribute traffic more uniformly within the hour.

A more uniform distribution of airline flights during peak periods would promote a more orderly flow of traffic, reduce arrival and departure delays, and reduce ground congestion near the terminal and on the taxiway system.

Annual savings at the Baseline activity level would be 1,690 hours or $3.3 million, at Future 1 activity levels, 2,620 hours or $5.1 million, and, at Future 2 activity levels, 7,190 hours or $14.0 million, but, in order to properly evaluate the overall impact of hubbing and the redistribution of scheduled operations, the entire system must be studied, not any one individual airport.

18. Relocate general aviation (GA) to reliever airports.

The percentage of general aviation activity is expected to remain relatively constant at about 20 percent of the annual operations for the three demand levels. GA should be encouraged to use other airports on Oahu. This alternative would relocate at least 50 percent and up to 100 percent of the GA traffic at HNL to other airports on Oahu.

A 50 percent reduction in the anticipated GA activity at HNL would result in annual savings at the Baseline activity level of 3,950 hours or $7.7 million, and, at Future 2 activity levels, 145,200 hours or $282.7 million.

A 100 percent reduction in the anticipated GA activity at HNL would result in annual savings at the Baseline activity level of 4,980 hours or $9.7 million, and, at Future 2 activity levels, 245,150 hours or $477.3 million.

19. Relocate military aircraft.

This alternative will evaluate the airfield capacity at HNL that would become available for civil aircraft if military aircraft (including Hawaii Air National Guard aircraft) were relocated to other airports. The capacity will be evaluated at three levels: relocate 50 percent of military aircraft; relocate 100 percent; and increase military aircraft by 150 percent with all GA traffic relocated to other airports.

A 50 percent reduction in the anticipated military aircraft activity at HNL would result in annual savings at the Baseline activity level of 2,470 hours or $4.8 million, and, at Future 2 activity levels, 87,620 hours or $170.6 million.

A 100 percent reduction in the anticipated military aircraft activity at HNL would result in annual savings at the Baseline activity level of 4,110 hours or $8.0 million, and, at Future 2 activity levels, 163,120 hours or $317.6 million.

Increasing military aircraft to 150 percent and relocating 100 percent of GA aircraft would result in annual savings at the Baseline activity level of 4,160 hours or $8.1 million, and, at Future 2 activity levels, 175,500 hours or $341.7 million. ❧

Figure 8 demonstrates the impact of delays at Honolulu International Airport. The chart shows how delay will continue to grow at a substantial rate as demand increases if there are no improvements made in airfield capacity, i.e., the Do Nothing scenario. The graphs also show that significant savings in delay costs would be provided by:

- Constructing new Runway 8C/26C.
- Constructing new GA runway in Keehi Lagoon.
- Increasing use of Runway 8R for arrivals.
- Extending Runway 4L/22R to the southwest to 10,000 feet in length.

Figure 9 illustrates the average delay in minutes per aircraft operation for these same alternatives. Under the Do Nothing alternative, if there are no improvements made in airfield capacity, the average delay per operation of about 3 minutes in Baseline will increase to over 40 minutes per operation by Future 2.

Figure 8 **Annual Delay Costs — Capacity Enhancement Alternatives**

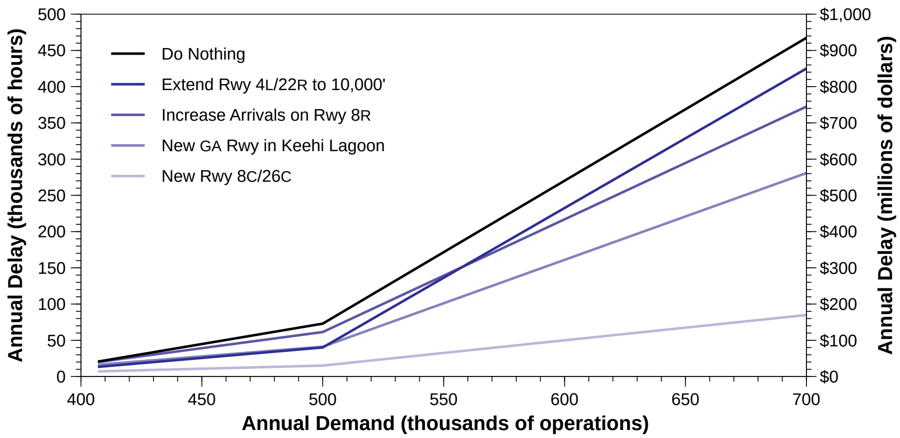
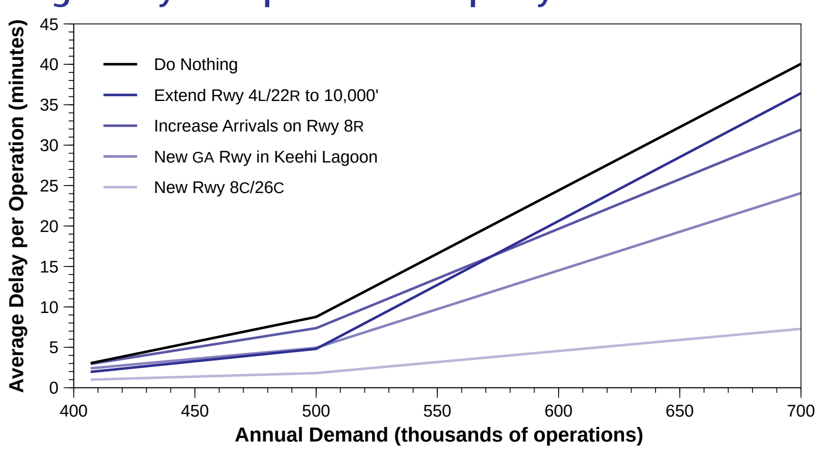


Figure 9 **Average Delay Per Operation — Capacity Enhancement Alternatives**



Overview

The Honolulu International Airport Capacity Team evaluated the efficiency of the existing airfield and the proposed future configuration. Figure 10 illustrates airfield weather conditions, Figure 11, runway utilization, and Figure 12, annual distribution of traffic. The potential benefits of various improvements were determined by examining airfield capacity, airfield demand, and average aircraft delays.

The Capacity Team used the Runway Delay Simulation Model (RDSIM) to determine aircraft delays during peak periods. Delays were calculated for current and future conditions.

Daily operations corresponding to an average day in the peak month were used for each of the forecast periods. Daily delays were annualized to measure the potential economic benefits of the proposed improvements. The annualized delays provide a basis for comparing the benefits of the proposed changes. The benefits associated with various runway use strategies were also identified.

Figure 10 Airfield Weather

Ceiling/Visibility		Occurrence
VFR	1,000 feet/3 sm and above	99.98%
IFR	Below 1,000 feet/3 sm	0.02%

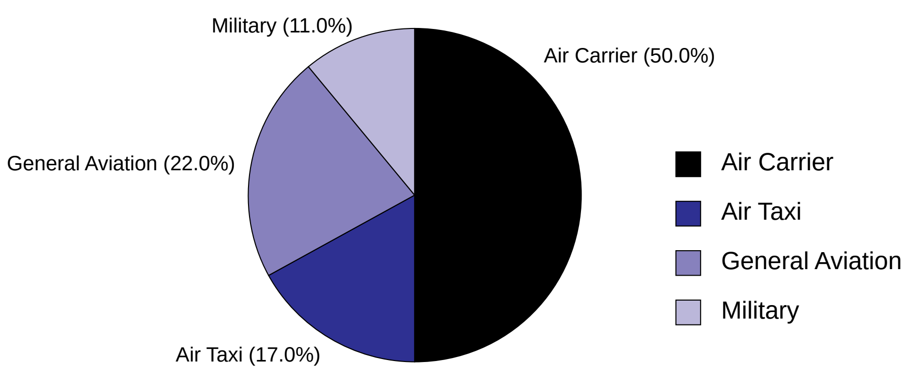
VFR - Visual Flight Rules
IFR - Instrument Flight Rules
sm - Statute Miles

Since Honolulu International Airport (HNL) experiences only about 100 minutes of Instrument Meteorological Conditions (IMC) each year, IMC were not simulated. Runways 8R and 8L and 4R and 4L are used when winds are from the northeast, the Trade Winds. When the runways are wet or there are mild crosswinds, aircraft may not be able to “hold short” of the intersection of Runway 8L with Runways 4R and 4L. Therefore, two Trade Wind (east flow) configurations were simulated: Trade Winds — Hold Short and Trade Winds — No Hold Short. When winds are from the southwest, the Kona Winds, Runways 22R and 22L and 26R and 26L are used.

Figure 11 Runway Utilization (percentage use)

Configuration		Percentage Use
East Flow (Trade Winds) Runways 4L, 4R, 8L, and 8R	⇒ Hold Short ⇒ No Hold Short	65 20
West Flow (Kona Winds) Runways 22L, 22R, 26L, and 26R		15
		Total = 100

Figure 12 Annual Distribution of Traffic



The fleet mix at Honolulu International Airport (HNL) has an average direct operating cost of $1947.00 per hour. This figure represents the costs for operating the aircraft and includes such items as fuel, maintenance, and crew costs, but it does not consider passenger inconvenience, lost passenger time, disruption to airline schedules, or any other intangible factors. Figure 13 shows the estimation process used to derive this weighted average cost per hour.

The cost of a particular improvement was measured against its annual delay savings. This comparison indicates which improvements will be the most effective.

For expected increases in demand, a combination of improvements can be implemented to allow airfield capacity to increase while aircraft delays are minimized.

Figure 13 Aircraft Average Direct Operating Costs

Aircraft Class	Costs per Hour	Proportion of Aircraft in Schedule	Total
1	$4,864	0.21	$1005.93
2	$2,137	0.40	$851.96
3	$256	0.33	$85.47
4	$60	0.06	$3.64
		Total	$1,947.00

Class 1 (D)	Heavy aircraft weighing more than 300,000 pounds.
Class 2 (C)	Large aircraft weighing more than 12,500 and up to 300,000 pounds and small jets.
Class 3 (B)	Small, twin-engine props weighing 12,500 pounds or less.
Class 4 (A)	Small, single-engine props weighing 12,500 pounds or less.

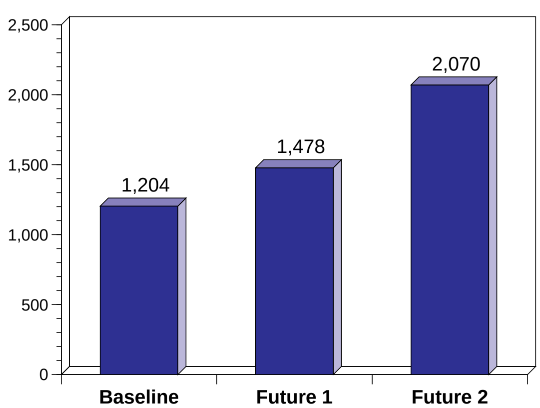
Airfield Capacity

The HNL Capacity Team defined airfield capacity to be the maximum number of aircraft operations (landings or takeoffs) that can take place in a given time. The following conditions were considered:

- Level of delay.
- Airspace constraints.
- Ceiling and visibility conditions.
- Runway layout and use.
- Aircraft mix.
- Percent arrival demand.

Figure 14 illustrates the average-day, peak-month arrival and departure demand levels for HNL for each of the three annual activity levels used in the study, Baseline, Future 1, and Future 2.

Figure 14 Airfield Demand Levels — Aircraft Operations and Average Day of Peak Month



	Annual Operations	24-Hour Day (Average Day, Peak Month)	Peak Hour
Baseline	407,000	1,204	92
Future 1	500,000	1,478	113
Future 2	700,000	2,070	158

Figures 15 and 16 present the airport capacity curves for HNL for the current runway configuration. These curves illustrate the relationship between airfield capacity, stated in the number of operations per hour, and the average delay per aircraft. These curves are based on the assumption that arrival and departure demand is randomly distributed within the hour. Other patterns of demand can alter the demand/delay relationship.

Figure 15 Airport Capacity Curves — East Flow (Trade Winds) Aircraft Demand Versus Average Delay

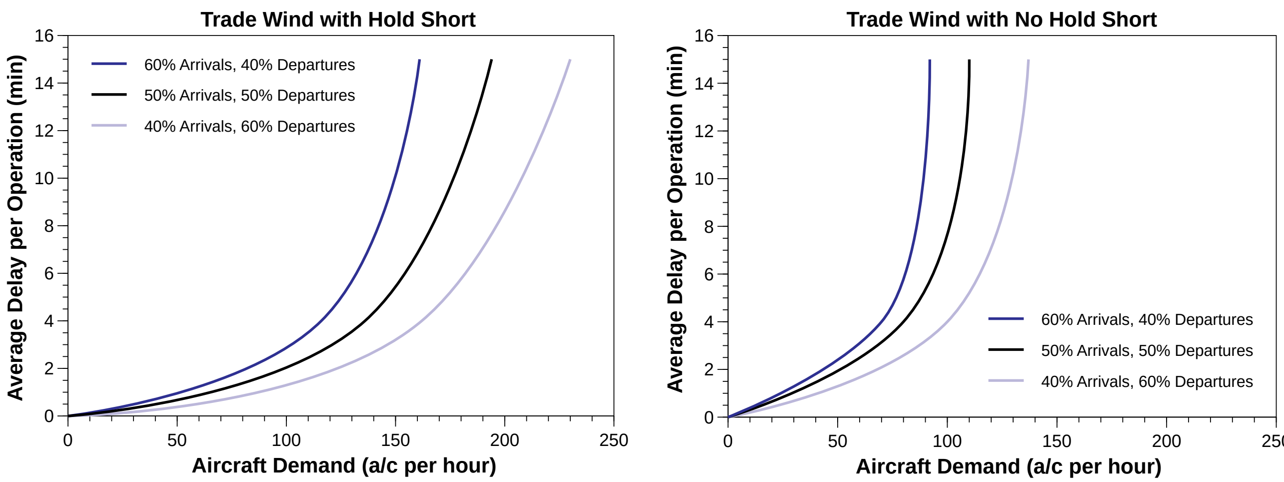


Figure 16 Airport Capacity Curves — West Flow (Kona Winds) Aircraft Demand Versus Average Delay

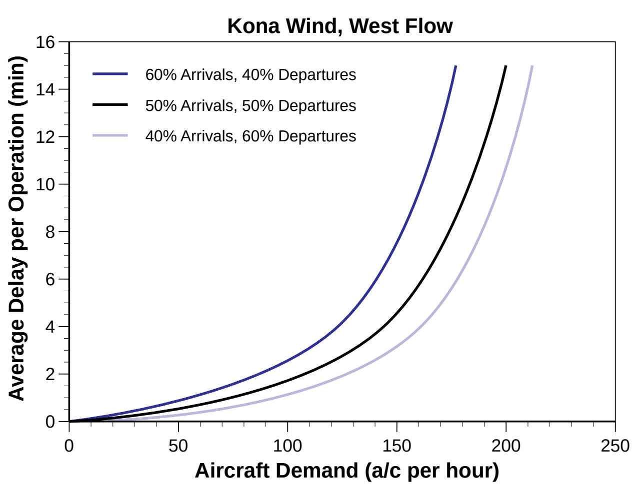


Figure 17 shows a composite of airport capacity curves, with a 50/50 split of arrivals and departures, under both east flow (Trade Wind) hold-short and no-hold-short and west flow (Kona Wind) conditions. The curves in Figure 17 illustrate that, as the number of aircraft operations per hour increases, the average delay per operation increases exponentially.

Figure 18 illustrates the hourly profile of daily demand for the Baseline activity level of 407,000 aircraft operations per year. It also includes a curve that depicts the profile of daily operations for the Future 2 activity level of 700,000 aircraft operations per year.

Comparing the information in Figures 17 and 18 shows that:

- aircraft delays will begin to rapidly escalate as hourly demand exceeds 80 to 130 operations per hour, and,
- while hourly demand exceeds 80 operations during certain hours of the day at Baseline demand levels, 130 operations per hour is frequently exceeded at the demand levels forecast for Future 2.

Figure 17 Airport Capacity Curve — Aircraft Demand Versus Average Delay

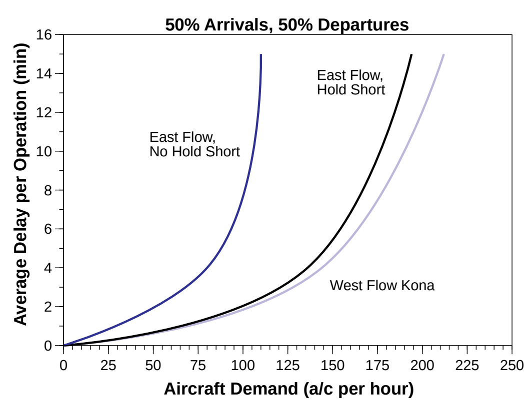
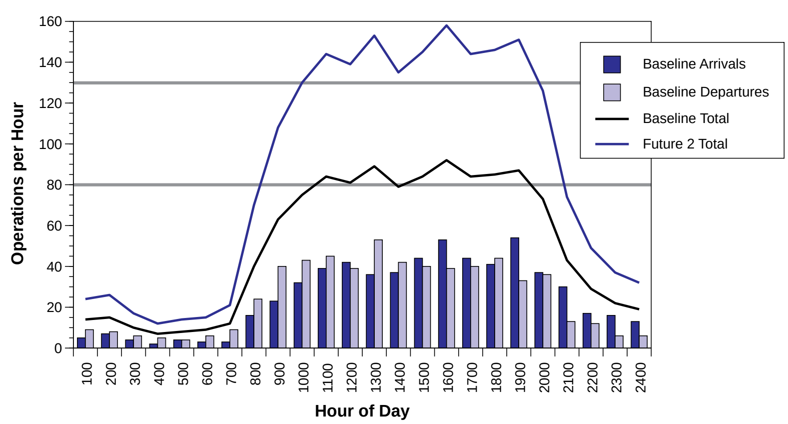


Figure 18 Profile of Daily Demand — Hourly Distribution



Aircraft Delays

Aircraft delay is defined as the time above the unimpeded travel time for an aircraft to move from its origin to its destination. Aircraft delay results from interference from other aircraft competing for the use of the same facilities.

The major factors influencing aircraft delays are:

- Weather.
- Airfield and ATC system demand.
- Airfield physical characteristics.
- Air traffic control procedures.
- Aircraft operational characteristics.

Average delay in minutes per operation was generated by the Runway Delay Simulation Model (RDSIM). A description of this model is included in Appendix B. If no improvements are made in airport capacity, the average delay per operation of 3 minutes in Baseline will increase to 40 minutes per operation by Future 2.

Under the Do Nothing situation, if there are no improvements in airfield capacity, the annual delay cost could increase as follows:

Annual	Annual Delay Costs	
Operations	Hours	Millions of 1991$
Baseline	20,650	$40.2
Future 1	72,980	$142.1
Future 2	467,440	$910.1

❧

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The HNL Capacity Team studied the effects of various improvements proposed to reduce delay and enhance capacity. The options were evaluated considering the anticipated increase in demand. The analysis was performed using several computer modeling techniques. A brief description of the models and the methodology employed follows.

Computer Models

Airfield Delay Simulation Model (ADSIM)

This is a fast-time, discrete event model that employs stochastic processes and Monte Carlo sampling techniques. It describes significant movements of aircraft on the airport and the effects of delay in the adjacent airspace. The model was validated in 1978 at Chicago O'Hare International Airport against actual flow rates and delay data. It was calibrated for this study against field data collected at HNL to insure that the model was site specific.

Inputs for the simulation model were derived from empirical field data. The model repeated each experiment 10 times using Monte Carlo sampling techniques to introduce system variability, which occurs on a daily basis in actual airport operations. The results were averaged to produce output statistics. Total and hourly aircraft delays, travel times, and flow rates for the airport and for the individual runways were calculated.

Runway Delay Simulation Model (RDSIM)

RDSIM is a short version of the ADSIM model that simulates only the runways and runway exits. There are two versions of the model. The first version ignores the taxiway and gate complexes for a user-specified daily traffic demand and is used to calculate daily demand statistics. In this mode, the model replicated each experiment forty times, using Monte Carlo sampling techniques to introduce daily variability of results, which were averaged to produce output statistics. The second version also simulates the runway and runway exits only, but it creates its own demand using randomly assigned arrival and departure times. The demand created is based upon user-specified parameters. This form of the model is suitable for capacity analysis.

For a given demand, the model calculates the hourly flow rate and average delay per aircraft during the full period of airport operations. Using the same aircraft mix, computer specialists simulated different demand levels for each run to generate demand versus delay relationships.

Methodology

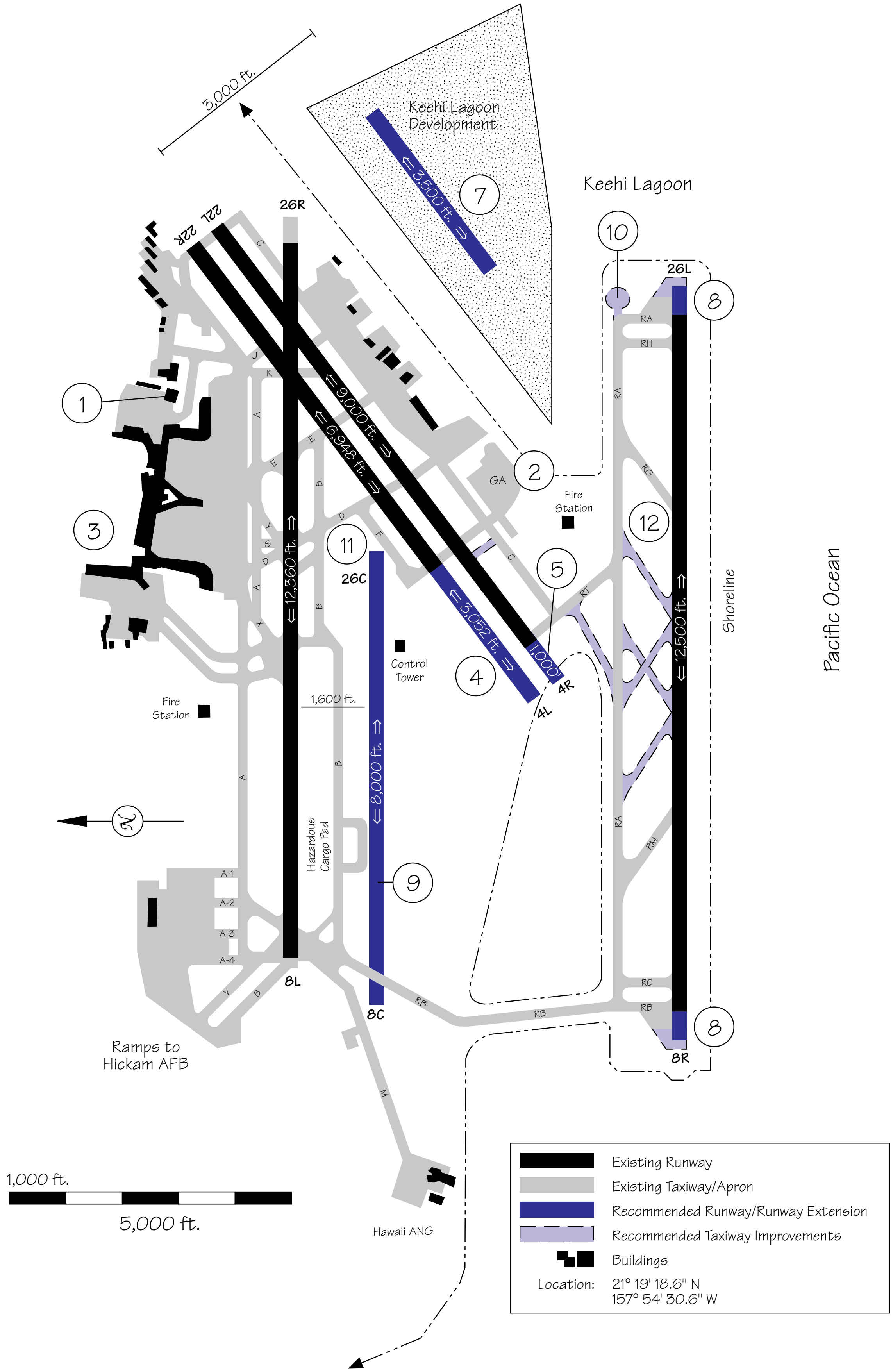
Model simulations included present and future air traffic control procedures, various airfield improvements, and traffic demands for different times. To assess the benefits of proposed airfield improvements, the FAA used different airfield configurations derived from present and projected airport layouts. The projected implementation time for air traffic control procedures and system improvements determined the aircraft separations used for IFR and VFR weather simulations.

For the delay analysis, agency specialists developed traffic demands based on the *Official Airline Guide,* historical data, and various forecasts. Aircraft volume, mix and peaking characteristics were developed for three demand periods (Baseline, Future 1, and Future 2). The estimated annual delays for the proposed improvement options were calculated from the experimental results. These estimates took into account the yearly variations in runway configurations, weather, and demand based on historical data.

The potential delay reductions for each improvement were assessed by comparing the annual delay estimates with the Do Nothing case.

The RDSIM model, in its capacity mode, was used to perform the capacity analysis for HNL. ❧

Figure 1 Honolulu International Airport



Appendix C — Glossary

ADSIM	Airfield Delay Simulation Model
ANG	Air National Guard
AOPA	Aircraft Owners and Pilots Association
ATA	Air Transport Association of America
ATC	Air Traffic Control
FAA	Federal Aviation Administration
GA	General Aviation
HNL	Honolulu International Airport
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
MLS	Microwave Landing System
nm	nautical miles
RDSIM	Runway Delay Simulation Model
RVR	Runway Visual Range
sm	statute miles
TCA	Terminal Control Area
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

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