Sydney Airport Community Forum

Long Term Operating Plan

REVIEW OF LTOP PERFORMANCE

Report

March 2005

AIRWAYS INTERNATIONAL

AIRPLAN

CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

INTRODUCTION

The terms of reference required the consultant to:

1. Determine the level of noise sharing being achieved in separate noise sharing periods;
2. Determine the usage of the modes used in noise sharing periods and ascertain the operational constraints;
3. Assess what can be done to overcome or mitigate the above constraints;
4. Assess likely future trends; and
5. Assess the potential for increasing noise sharing in the core periods.

CONSULTATIONS AND DATA SOURCES

Consultation meetings and in-depth discussions were held with industry, SACF representatives and community members. The consultants were available throughout the study for consultation with all parties.

Extensive data was sought and supplied, including from Airservices and submissions by industry, SACF and community representatives. The cooperation and assistance of all parties is acknowledged.

CONSULTANT PERSPECTIVE

The multi-disciplinary consultant team concentrated on the technical issues and examinations to address the Terms of Reference. The consultant, being independent from any direct association with the development, implementation and ongoing monitoring of LTOP, brought to this review a wide perspective of LTOP, in the context of noise mitigation initiatives at Sydney and other airports with significant aircraft noise issues.

Data was analysed at a macro level to try and ascertain trends and link them to systemic procedural or infrastructure deficiencies. Experts in air traffic management undertook an audit of Airservices Australia operations in Sydney relating to the operation of LTOP. This included observations of operations and discussions with management and operators.

SPECIFICS OF SYDNEY AIRPORT

Even when compared to other high volume airports in Europe and North America (such as Heathrow or Chicago), Sydney Airport is a complex operating environment due to:

- Non-uniform mix of aircraft types and sizes
- Multi-role – regional hub, domestic hub, premier international gateway with long-haul and short-haul operations
- Small airport footprint in relation to air traffic, relative location of terminals, requiring multiple active runway crossing events
- Proximity to large conurbation, with limit to proportion of tracks over water or away from residential areas
- Nine different Runway Modes of Operation for use at different periods of the day to facilitate noise sharing, when traffic, wind velocity and other circumstances so determines or allows.

LTOP is one plank in a raft of noise mitigation strategies which include: limitation of aircraft (based on noise certification); limit on hours of operation (curfew); capacity cap and slot controls; airspace design to achieve noise sharing; preferential runways (LTOP); noise monitoring and land use planning (insulation program).

SUMMARY OF PRELIMINARY FINDINGS

There are three pillars on which LTOP is based, in order of priority

1) Safety – of aircraft operations

2) Capacity – within the 80 movement cap

3) Environment – noise sharing through use of noise sharing modes.

Changing these objectives, or their priority, would most likely lead to an operating plan for the airport with different characteristics.

1. Level of noise sharing achieved in separate noise sharing periods

Noise sharing statistics are reported monthly by Airservices Australia in terms of hours and movements by mode and runway end for all periods. There are no separate reports for noise sharing periods (6am-7am, 11am-3pm, 8pm-11pm).

The monthly reports indicate that the noise sharing goals in terms of runway end impacts have not been achieved for all runway ends. Based on implementation of all practicable LTOP recommendations and 7 years of operation, the disparity for the northern and western "targets" may indicate that they were unrealistic and require review.

2. Mode usage in noise sharing periods and operational constraints

Runway mode selection is based on a combination of:

- Demand (needs to be below runway mode capacity)
- Weather (wind, speed, direction, cloud/visibility, runway condition)
- Other causes – facility availability, pilot requests and staffing.

On an individual basis demand versus capacity was analysed, and mode utilisation by month gives a picture of the variation of mode usage with weather.

An audit of mode usage and mode selection criteria for a number of days for each season was undertaken.

The audit of actual Airservices Australia conduct of air traffic management operations relevant to LTOP, which included observation of operations and consultations with operational and management staff, did not identify any specific deficiencies which would have significant impact on the operation of LTOP as specified in reports and operational documents.

3. Overcoming or mitigating constraints

The constraints identified and examined for potential mitigation included:

- Technology
- Weather criteria for runway mode selection (consistent with safety of aircraft operations)
- Pilot runway requests
- Education of pilots and controllers
- Air traffic management organisational structure and staffing.

No significant initiatives that would dramatically and immediately overcome the constraints were identified in the mode usage analysis, analysis of mode selection or the audit of actual operations. Observations were made of trends and refinements that could assist in maintaining a management and operational focus on continuous improvement.

Nothing can be done about prevailing weather, which does not change significantly other than seasonal aberrations. However there are some issues which might be addressed that could reinforce with industry organisations the primacy of safety considerations:

- Crosswind component

  Harmonise LTOP requirement with ICAO parameters regarding maximum crosswind components acceptable in relation to runway selection for noise abatement reasons (15 knots). Such action would eliminate potential conflict between two parameters and enhance LTOP credibility.

- Downwind component

  Undertake further research regarding the maximum downwind allowable for noise abatement operations (component maximum 5 knots at surface) particularly:

  - on Runway 34R requiring an early right turn after takeoff, when downwind at height (above the surface) might be substantially higher, during a period when an aircraft may be reconfiguring and manoeuvring
  - on final approach while configuring for landing, where a higher prevailing downwind component at height can result in a higher aircraft ground speed than desired when downwind decays near the surface, with potential safety implications.

- Consult with meteorological, airline, safety and industrial organisations to afford greater credibility to subsequent LTOP operations by those who apply or use it.
- Ongoing education to controllers and pilots regarding the unique legal framework governing Sydney Airport noise sharing operations will afford balance to conventional institutional doctrine that is a foundation of ATC training and operational environments of 'safe, orderly and expeditious flow of air traffic'.
- More consultation and greater involvement of controller and pilot industrial organisations might result in increased ‘ownership’ of noise sharing solutions for viable continued operations at Australia’s premier international airport, rather than a situation of entrenched positions of stakeholders constraining enthusiastic adoption of reasonable strategies and applications that parties can all live with.

There were no direct observations during the study where staffing shortfalls precluded mode availability. The availability of adequate staffing is essential in the complex operating environment with noise sharing modes, especially in relation to taxiing aircraft crossing active runways. Because of the high level of local sensitivity to LTOP issues, the special awareness of and familiarity with such issues by senior management, line management and operational staff must be maintained and be the subject of continuous improvement strategies.

4. Likely Future Trends

The following items were considered in terms of future trends:

- Weather
- Traffic
- Demand
- Technology.

Trends were assessed in terms of influence on LTOP noise sharing targets.

Meteorological conditions affecting Sydney Airport operations will not significantly change in terms of wind velocity, cloud, visibility and hazardous weather. Enhanced automated sensing, processing, storage and distribution systems for meteorological data together with improved forecasting techniques will contribute to more effective prediction of conditions affecting optimum mode selections.

Traffic mix experienced at Sydney will continue to feature long, medium and short haul types because of the airport's geographical position in Australia and the region – for destination and interlining reasons. Aircraft will feature similar performances, particularly on the final approach segment. A more homogeneous mix of traffic (aircraft types) would simplify air traffic procedures and has the potential to increase achievable mode capacities.

The Sydney Airport Master Plan 20 year forecast projects traffic 80% above current levels. The busy day distribution of demand, as forecast by Sydney Airport, shows demand in core hours at the 80 movement per hour cap. However, during most noise sharing hours the forecast demand is well below the cap and usually within the nominal capacity of currently used noise sharing modes.

No dramatic short term technological innovations were identified that would assist in noise sharing. However, continuous improvements in technology and decision support systems will assist air traffic service providers in optimising the mode change decisions and processes which ultimately determine the cumulative mode and runway usages achieved.

5. Potential for Increasing Noise Sharing in Core Periods

Based on a macro analysis of traffic demand in 2003 on an hourly basis versus nominal noise sharing runway mode capacity, a potential increase in noise sharing in core periods was identified. Sensitivity analysis indicated that the potential rapidly disappears as traffic grows (or returns to levels experienced in 1999/2000). The added dimension of weather constraints also reduces the potential.

The latest data of mode usage for May 2004 indicated that there was significant noise sharing achieved during core periods with reduced traffic demand. Comparison with mode usage reports for January and February 2004, when noise sharing was limited even during noise sharing periods, seems to indicate that seasonal weather patterns (wind) may be an overriding influence.

1. INTRODUCTION

1.1 PROLOGUE

This is a report to assist SACF[1] in reviewing the performance of LTOP. It is therefore not considered necessary to provide a long and detailed introduction on the history and events that resulted in the adoption of a policy of "noise sharing", implemented through the LTOP procedures.

The history and background is well documented elsewhere and most of the members of SACF will be well versed in the details.

The terms of reference for the Consultant were very specific, and were referred to continuously throughout the preparation of this report so that the team remained focused on the issues that the Consultant was asked to address. Sydney Airport noise issues are complex and multi-faceted, and it is acknowledged that the Review of the Performance of LTOP necessarily only touches on a limited number of issues.

1.2 TERMS OF REFERENCE

1.2.1 Basic Principles of LTOP

Since 1996, runways and flight paths at Sydney Airport have operated under the principles of the Long Term Operating Plan (LTOP) for Sydney Airport.

The four basic principles under which LTOP has been developed are:

1. All three runways at the Airport, including the full length of the east-west runway, are to be available for use by jet and propeller aircraft
2. Maximum use is to be made of flightpaths over water and non-residential areas
3. The capacity of the Airport is to be maintained to the maximum practicable extent but the programmed movement rate is not to exceed 80 movements per hour
4. The safety of aviation operations is not to be compromised.

The Sydney Airport Community Forum (SACF) requested that *"an appropriately independent external consultant … support its work to investigate and report on each of the basic elements of LTOP, with the aim of contributing to an assessment of the LTOP performance to date"*.

This investigation identifies reasons for the "noise sharing modes" not being used more often and whether the constraints can be overcome.

The brief specifically states that the **principles of LTOP** as described below are *"fixed and are not negotiable"*.

---

[1] A list of Abbreviations and Acronyms is attached as Appendix A

1.2.2 Study Objectives

The Terms of Reference (ToR) as approved by the Minister for Transport and Regional Services (the Minister) and SACF are attached as Appendix B. The ToR states five objectives for the study:

1. Determine the level of noise sharing being achieved in separate noise sharing periods;
2. Examine the modes that are being used in these periods to ascertain the constraints;
3. Assess what can be done to overcome the constraints;
4. Ascertain likely future trends; and
5. Examine the potential for increasing noise sharing in the core periods.

1.3 BACKGROUND

1.3.1 LTOP Development

The foundations for LTOP are based on a comprehensive process, including consultation, carried out between from March 1996 by Airservices Australia under the direction of the Australian Government (referred to as the LTOP study).

In March 1996, the newly elected Federal Coalition Government, in accordance with a stated policy of 'Putting People First', directed that Airservices Australia review current operating procedures and associated airspace and develop a Long Term Operating Plan (LTOP) for Sydney Airport.

Under the Air Services Act, the Minister issued the directive and then, in the letter of transmittal to the Airservices Board Chairman, provided ToR to undertake a review of Sydney airspace and to report to him by 16th December 1996 with recommendations for a LTOP for Sydney Airport and associated airspace.

The Sydney Air Traffic Management Task Force was established with representatives from the community, environmental groups, industry, military and government. More than 1,500 submissions were received after an extensive advertising campaign.

Airservices determined that changes would need to be made to runway configurations and how and when these changes would be used to meet the ToR and provide the foundations of the LTOP. These were expressed by way of 31 recommendations. These recommendations were then presented to the community as part of a consultation process in order to obtain feedback from the community.

The principal reference document is that published by Airservices Australia in 1996 which describes the review and development of LTOP and describes in detail the 31 recommendations of the LTOP study. These included definition of the ten modes of operation that should be available for use at Sydney airport, the runway selection criteria, transitional arrangements, improvements to air traffic control equipment and additional taxiways, establishment of an Implementation Monitoring Committee (IMC), organisational arrangements for Air Traffic Services, additional studies and initiatives (such as cluster scheduling, an ILS on Runway 25), noise abatement climb procedures etc.

It is understood that SACF accepts that all but 2 of the recommendations have now been implemented. The recommendations that have not been implemented are No. 17 – “the Trident Concept” and No. 2 – “High and Wide” flight paths associated with the modes of operation.

1.3.2 LTOP is Part of a Noise Mitigation Strategy

Sydney's busy airport is conveniently located relative to the city. This has the potential to create noise impacts on the surrounding communities from airport operations. It is not unique in this aspect, which is typical of city airports. In these circumstances, noise mitigation is a high priority.

There are a wide range of initiatives for noise mitigation and abatement at airports around the world. Generically these can be grouped as:

- controlling noise at the source
- limiting aircraft (limit by airport and airlines)
- limiting population in noise impacted areas (land use planning)
- minimising exposure to residences that are already in impacted areas.

The range of initiatives at Sydney includes many of these, which are complementary in their goal of reducing the impacts of jet aircraft operations at a busy airport in proximity to a highly urbanised residential environment under arrival and departure tracks.

There are a range of agencies which have a variety of roles and responsibilities in relation to the control of aircraft noise and its impacts, particularly on communities in proximity to major commercial airports. Key agencies involved include:

a) Federal and State Government – in implementation of international, federal and state legislation, and regulatory functions including civil aviation (including safety) and planning controls

b) Airlines in terms of aircraft maintenance, scheduling and flight operations

c) Airservices Australia as the provider of air traffic management services include planning and implementation of airspace design, flight paths and navigation aids, and air traffic operational responsibilities

d) Sydney Airport in the provision of airside infrastructure (runway, taxiways and aprons)

e) Airport Coordination Australia (ACA) being responsible for schedule and slot controls.

The aircraft noise controls and mitigation measure pertaining to Sydney can be broadly summarised as:

Aircraft types	Noise certification to ICAO Chapter 3
Hours of operation	Curfew from 11pm to 6am
Capacity cap	Maximum scheduled 80 hourly movements (slot control)
Airspace design	Avoid overflight of residential areas (where possible) to achieve respite and noise sharing
Preferential runways	LTOP specifies variation in modes to achieve noise sharing (and respite)
Noise monitoring	Noise and flight path monitoring with extensive reporting capability
Land use planning	Difficult with inner city airport, noise insulation programme

LTOP is therefore, but one initiative in the range of controls and procedures at Sydney Airport which are in place to mitigate aircraft noise impacts.

1.3.3 Noise Sharing

The impacts of noise and the "success" of LTOP in "sharing the noise" is monitored by a range of cumulative measures. By definition these "cumulative" measures are determined by the discrete events - the individual arrivals and departures, the hourly, daily and monthly operations of aircraft at Sydney Airport. The nature of traffic at an airport is dynamic and the mode in operation at any single point in time is dependant on prevailing conditions, particularly traffic (number, sequence, origin and destination of flights), and weather (wind direction/speed and visibility). These individual choices at every hour of every day are independent. However, the monitoring of LTOP performance must necessarily focus on the "cumulative" outcome - whether it is measured in terms of runway end usage, track density plots, respite or noise contours (N70 or ANEF).

1.3.4 The Report Structure and Study Scope

The scope of the study, as stated in the brief from SACF, was *"to undertake relevant inquiries and prepare a report for SACF dealing with the operation of LTOP in respect of:*

1. *The level of noise sharing being achieved in separate noise sharing periods;*

2. *The usage of the modes that are utilised in noise sharing periods and ascertaining the operational constraints;*

3. *Assessing what can be done to overcome or mitigate the above constraints;*

4. *Assessing likely future trends; and*

5. *Assessing the potential for increasing noise sharing in the core periods."*

This report has been structured such that a separate chapter is devoted to each of the five items in the above scope.

1.3.5 Additional Issues and Tasks

Five issues, recommending potential ways to overcome constraints to LTOP, were referred from the SACF Implementation Monitoring Committee (IMC) to the LTOP Review Sub-Committee. While not specifically part of the original Terms of Reference for the consultants study, they were provided to the consultant as part of community consultations. These were considered under item 4 of the ToR.

Subsequent to the commencement of the study, the (2003) Master Plan for Sydney Airport was approved by the Minister. The consultant was asked to also take into account the SACF submission to the Master Plan. Additionally the consultant was asked to consider data in the Sydney Airport Master Plan, especially the forecasts.

Additionally SACF, through the Department of Transport and Regional Services (DOTARS) required that community input, through community representatives on SACF be part of the study process. A list of consultations and submissions is attached as Appendix D.

The issues and opinions raised by stakeholders were of benefit to the team in understanding the various perspectives of the stakeholders. The consultant team's focus was a technical, independent and objective assessment of the performance, to best meet the terms of reference framed by SACF within the allocated budget and timeframe.

1.4 ACKNOWLEDGEMENTS

The consultant acknowledges the assistance and cooperation of stakeholders during the course of this study, in making themselves available for consultations, providing information and views.

2. ASSESSMENT OF THE LEVEL OF NOISE SHARING

2.1 INTRODUCTION

2.1.1 Noise Sharing

LTOP is predicated on the principle of "sharing the noise" from aircraft operations at Sydney Airport.

The sharing of noise is implemented through the air traffic services provider (Airservices Australia) operating a preferred runway selection system, which depending on weather and traffic demand, uses the ten[2] different Runway Modes of Operation (RMO) on specified days and times.

2.1.2 Preferred Runway Selection

The ten modes can be generally grouped into four categories:

1.	Overwater operations	SODPROPS and Mode 1
2.	Noise sharing	Modes 5, 7, 14a
3.	The parallel runway modes	Modes 9 and 10
4.	Single runway modes	Modes12 and 13

Hours of the day are grouped into the following periods:

Noise sharing	Period of lower demand should permit use of "noise sharing modes"
Core period	High traffic demand may preclude use of "noise sharing modes"
Curfew	Use of SODPROPS unless weather does not permit

The grouping of the hours of the day (weekdays) are:

Time			Period
6am	-	7am	Noise sharing (early morning)
7am	-	11am	Core period (morning)
11am	-	3pm	Noise sharing (afternoon)
3pm	-	8pm	Core period (afternoon)
8pm	-	11pm	Noise sharing (evening)
11pm	-	6am	Curfew

During the various periods the preferred runway selection is as summarised in Appendix C, extracted from the Sydney Airport Operational Statistics (Airservices Australia, April 2004)[3].

---

[2] Mode 8 is no longer used (due to the complexity and risk associated with multiple runway crossings).

[3] Monthly reports are available on the internet at www.airservicesaustralia.com click on "Newsroom & Information" then "Public Information" then "Sydney Airport Operational Statistics".

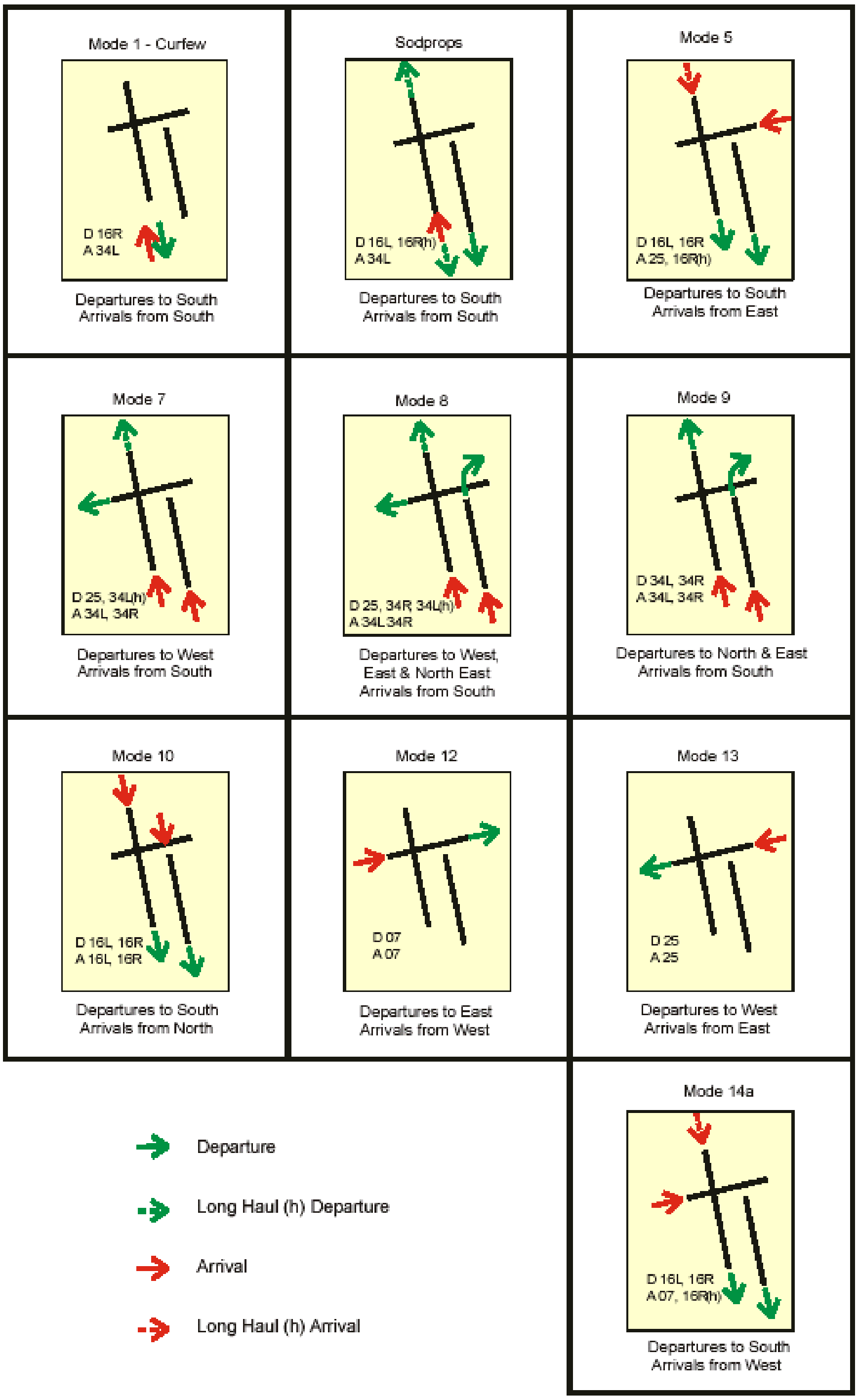


Figure 2.1 The LTOP Runway Modes[4]

[4] *Source – Airservices Australia*

It should be noted that SODPROPS and Shoulder Curfew operations are slightly different facets of the same method of operation, the difference being that SODPROPS has heavy departures off RWY 34L and Shoulder Curfew has them off 16R. Due to the nose to nose operation of shoulder curfew, it has less capacity than SODPROPS.

Airservices Australia also noted that if at all possible, even when SODPROPS is the nominated mode, that consideration is always given to the possibility of processing a departure off 16R, although it is often not possible due to the arrival sequence.

2.2 LEVEL OF NOISE SHARING

2.2.1 Noise Sharing Metrics

The 1996 LTOP study discusses a range of inputs and parameters that could be used to *"monitor the equidistribution of noise"*. It was clear that any reporting system had to be on the one hand comprehensive, transparent and engender confidence in the monitoring process, while on the other hand be accessible and easily understood.

There is no single metric that can clearly demonstrate if LTOP is achieving its objective of "sharing the noise".

The impacts of noise and the "success" of LTOP in "sharing the noise" is therefore monitored by a range of cumulative measures. By definition these "cumulative" measures are determined by the discrete events - the individual arrivals and departures, the hourly, daily and monthly operations of aircraft at Sydney Airport. The nature of traffic at an airport is dynamic and the mode in operation at any single point in time is dependent on prevailing conditions. The primary determinates are traffic (number, sequence, origin and destination of flights), and weather (wind direction/speed and visibility). These individual choices at every hour of every day are independent. However, the monitoring of LTOP performance must necessarily focus on the "cumulative" outcome - whether it is measured in terms of runway end usage, track density plots, respite, noise contours (N70 or ANEF).

There are a number of ways "noise sharing" can be measured. These include:

a) Mode usage – either in terms of proportion of time or movements

b) Runway end usage – either in terms of proportion of time or movements

c) Respite – proportion of time or movements that a runway or direction is not used

d) Cumulative noise exposure – as expressed in terms ANEC, N70.

These statistics can be reported on a daily, weekly, monthly, quarterly or annual basis. They can be reviewed in terms of absolute measures, against targets or can show comparative trends over time.

Since the introduction of LTOP, Airservices have provided publicly available monthly reports. The content of these reports has expanded over time in terms of breadth and depth. Our conclusion is that there has been considerable improvement over time in the presentation and detail of these reports.

The current reports (for example the May 2004 report) are approximately 30 pages in length, have extensive tables and graphics. The contents includes:

- An overview
- A description of the Sydney Airport runway system, the Runway Modes of Operation, the Preferred Runway Selection criteria
- Monthly Runway Movement Summaries – All Aircraft; Jet Aircraft only; Non Jet Aircraft only;
- Hourly Runway Movement Summary– All Movements; Arrivals; Departures

- Monthly Mode Utilisation Summary and Cumulative Mode Utilisation for year to date
- Runway End Impact (cumulative time or movements)
- A chart showing the Mode Usage over all hours of the days in the reported month
- Complaints – including statistics on Complaints vs Complainants, Complaints History / Top Complaint Suburbs; Complaint Density by Suburb; Recorded Complaints vs Complainants, by Suburb; Recorded Complaints vs Complainants, by Locations/Airports Other Than Sydney
- Graphical charts of traffic distribution by track for jet, non-jet, non-curfew respite for current month and rolling 12 month statistics
- Measured Daily N70[5] values at noise monitoring stations in the suburbs surrounding Sydney Airport.

The full set of reports is available for viewing or download on the Airservices Australia website.

The various measures included in the monthly reports each provide a different perspective of the noise impacts and level of noise sharing being achieved.

While time and scope of this study did not permit a comprehensive review of the time-history (since the implementation of LTOP in 1996) of all the measures, the runway end usage and daily mode usage and runway end impact were examined in some detail. Observations were also made on the various measures, their strengths, weaknesses and potential refinements.

2.2.2 LTOP Overall Performance – Runway Ends

The simplest, form of performance measure is ‘runway end usage’. Airservices report on runway activity for the period is aggregated by number of movements or by time, over four quadrants – N, S, E, W.

Movements are classified as either northerly, southerly, easterly or westerly. The community expectations from the LTOP study is that the proportion of movements will be:

North	South	East	West
17%	55%	13%	15%

Of course these “end usages” are the result of aggregation of all movements and the interaction of the different runway mode usage. The relationship between runway end usage and mode selection is implicit rather than explicit.

Parallel runway mode 10 usage will result in departures on runways 16L and 16R being aggregated in the southerly quadrant, and arrivals on these runways being aggregated in the northerly quadrant. However, the parallel runway mode 9 has

[5] The measured daily N70 value is the average daily number of aircraft noise events whose maximum noise level (LAmax) equals or exceeds 70dBA.

arrivals on runway 34L[6] and 34R aggregated in the southerly count, departures on runway 34L aggregated in the northerly quadrant, but departures on 34R in the easterly quadrant (they contribute to "noise sharing") because of the early turn procedure as departures track easterly, close to the runway 25/07 direction.

Airservices provided the runway end usage statistics from 1998 to 2004 which are plotted in Figure 2.2, and show the monthly "runway end usages" for each of the quadrants.

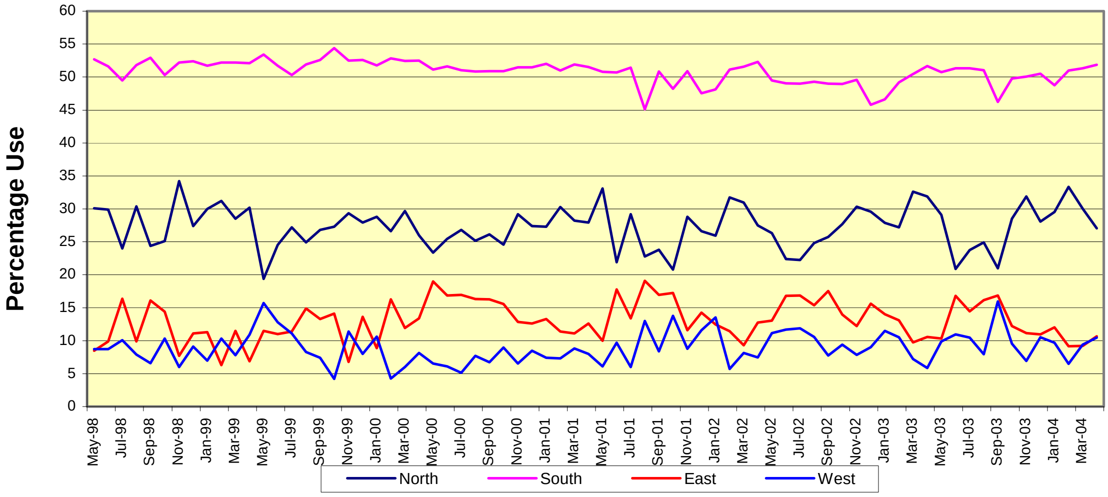


Figure 2.2 Runway End Usage by Quadrant 1998 - 2004

While there are strong fluctuations, possibly due to seasonal weather factors influencing runway selection or some secondary effects such as fluctuations in demand, the overall trends are for the usage to be of the order of :

North	South	East	West
27%	50%	13%	10%

From a community "noise sharing" perspective the underachievement to the north and overachievement to the west are of principle concern to the affected communities, who consider that they are receiving more than their "fair share" of noise. It must be noted, however, that the strength of this measure, its simplicity, is also its weakness, in that it does not represent all the factors that make up "noise sharing". Some of its weaknesses are – its high level of aggregation; the "granularity" of the use of quadrants[7]; it does not give an indication of "respite"; it does not give the level of detail if reporting were based on the usage of flight paths.

[6] There are significant non-jet departure tracks from 34L which track west, but are attributed as northerly movements, because the departure runway and initial heading is northerly. It is understood that Airservices Australia have presented to IMC some analysis of the effect of re-attribution of these movements to the west, and this may reduce the northerly percentages by up to 4% and increase the westerly percentages by a similar amount.

[7] It has been suggested that use of octas (8 segments) rather than quadrants (four compass points) would give a clearer picture of noise sharing.

This study investigated the possible operational constraints which may contribute to the discrepancies noted above. These are discussed in detail in Section 3.

The monthly Airservices report to SACF includes other summaries which do give more detail reports and other perspectives on the 'noise sharing'.

2.2.3 Annual Noise Sharing by Time and Movements

Figures 12 and 13 of the 1996 LTOP study provided *"an indication of the potential hours that suburbs to the east, north and west will experience aircraft noise with the same level of traffic assumed in the ANEC 2 contour."*

Based on the indicative Mode Usage for 270,000 movements a year in the LTOP study (based on a 17 hour day excluding the curfew period) the usage of parallel modes (RMOs 9 and 10) was assumed about 47% and the usage of the noise sharing modes (RMOs 5, 7 and 14a) was 29%. The statistics reported by Airservices Australia for the calendar year 2003 (about 250,000 annual movements) usage of parallel modes (RMOs 9 and 10) was 71% and the usage of the noise sharing modes (RMOs 5, 7 and 14a) was 22%.

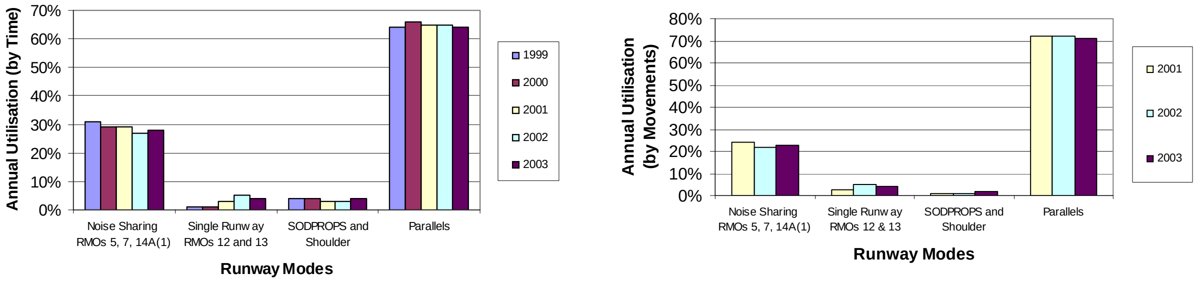
Similarly from Figure 10 of the LTOP report, the estimated percentage of time when the noise sharing modes would be used was between 35% and 50%, and parallel modes between 45% and 55%. This compared with that reported for the calendar year 2003 of noise sharing modes at 28% of the time, parallel runway modes at 64% of the time, and the remaining 8% of the time single runway and SODPROPS.

There is considerable debate about whether the examples of mode usage in the 1996 LTOP report were originally to be used at targets. However, there appear to be expectations from the community that there would be some correlation between those in the study and the actual mode usage, as a measure of noise sharing. These expectations are not being met.

This study investigated the possible operational constraints which may contribute to the discrepancies noted above. These are discussed in detail in Section 3.

Figure 2.3 indicates that noise sharing, in terms of use of noise sharing runway modes on an annual basis (in terms of both time and movements) appears reasonably consistent across time, despite a drop in traffic of about 20% between 2000 and 2003 (refer Figure 2.4).

There is a significant difference if sharing is measured by time (respite) or number of movements (biased toward core periods and parallel modes). This is obviously the result of the significantly greater number of movements in the busy periods compared to the non-busy periods, giving a strong weighting to these periods when "noise sharing" is measured by % of movements. During the busy periods demand is more likely to be above the capacity of the noise-sharing modes, and parallel runway modes will be required to be used.



Movements Time

Figure 2.3 Comparison of Annual Runway Mode Utilization

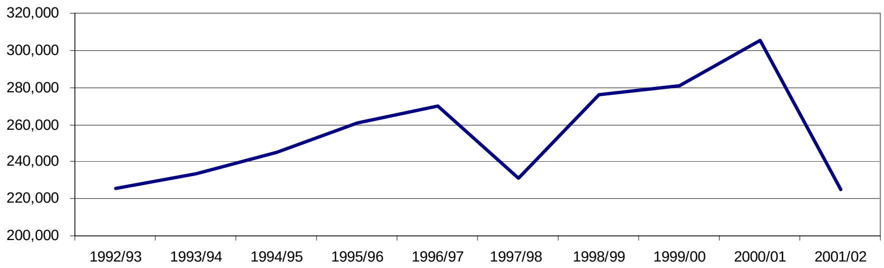
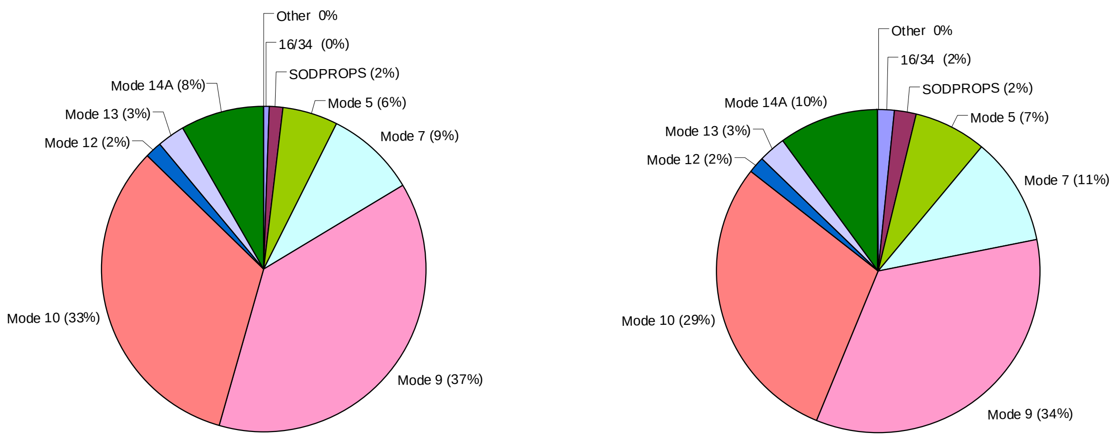


Figure 2.4 Sydney Airport Annual Aircraft Movements 1992 – 2002

The usage of all modes for the calendar year 2003, summarised from Airservices Australia reports to SACF and available on their web site, are shown in Figure 2.5.



Movements Time

Figure 2.5 Percentage Runway Mode Utilization by Movements and by Time 2003

2.3 CONCLUSIONS

The monthly reports indicate that the noise sharing goals in terms of runway end impacts have not been achieved for all runway ends. Based on implementation of all practicable LTOP recommendations and 7 years of operation, the disparity for the northern and western "targets" may indicate that they were unrealistic and require review.

3. MODES USED IN NOISE SHARING PERIODS

3.1 NOISE SHARING PERIODS

The second item in the terms of reference for this study was to determine the usage of the modes used in noise sharing periods and ascertain the operational constraints. The two terms requiring definition are “noise sharing modes” and “noise sharing periods”.

Noise sharing modes generally refer to Modes 5, 7 and 14a. They specifically exclude the “parallel runway modes” (Modes 9 and 10), even though departures on Runway 34L under RMO 9 are to the east and contribute to noise sharing.

The noise sharing periods are currently defined based on the operating premise that[8]:

> *Rwy 34 and Rwy 16 Parallel Runway operations should only be considered for use if required for traffic management purposes during the following hours:*
>
> *0700 to 1100 Monday to Saturday*
>
> *0800 to 1100 Sunday*
>
> *1500 to 2000 Sunday to Friday*
>
> *In order to take advantage of suitable traffic dispositions, variations to these times will occur.*

Runway mode selection is based on a combination of:

- Demand (needs to be below runway mode capacity)
- Weather (wind, speed, direction, cloud/visibility, runway condition)
- Other causes – facility availability, pilot requests and staffing

Demand versus capacity was analysed separately, including correlations of capacity limitations with mode utilisation. Monthly comparisons of mode utilisation were made to seek any causal relationships of noise sharing achievement with weather.

An audit of mode usage and mode selection criteria for a number of days for each season was undertaken.

3.2 NOISE SHARING MODE USAGE

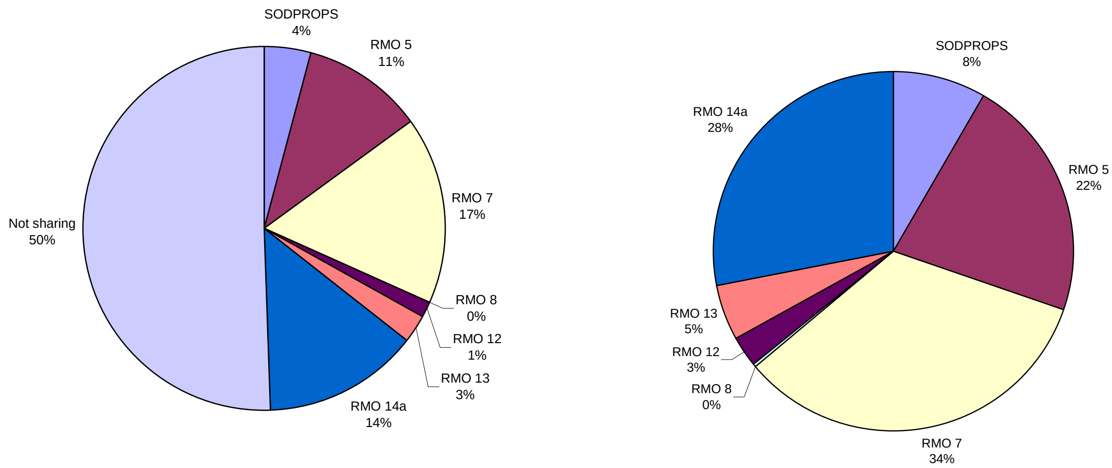
Analysis of daily, monthly and annual mode usage in the “noise sharing periods”[9] was undertaken for the calendar year 2003, using Airservices Australia statistics as provided to SACF in the monthly reports.

---

[8] *Source: Airservices Australia monthly reports Sydney Airport - Preferred Runway Selection, noted as effective from 28 November 2000*

[9] *To simplify analysis, Sundays were not analysed separately, and noise sharing hours were taken as 11am-3pm and 8pm – 11pm for all days in the year.*

Figure 3.1 clearly shows that in 2003, for whatever reason, parallel runway modes were used during 50% of the time during “noise sharing periods”, presumably required for traffic management purposes. The possible contributory operational reasons are discussed in Section 3.3. The pie on the right shows the “noise sharing modes” used during noise sharing hours in 2003.



All modes | Noise sharing modes

Figure 3.1 Usage of Noise Sharing Modes during Noise Sharing Periods – 2003

Month by month mode usage statistics in Figures 3.2 and 3.3 show clear seasonally patterns. These seasonal patterns would be expected to be repeated on an annual basis, so that aggregated annual noise sharing achievements would be expected to be consistent. Figure 3.2 also gives a picture of monthly noise sharing mode usage versus non-noise sharing mode (parallel runway operations). In summer, noise sharing modes usage is greater than in winter months.

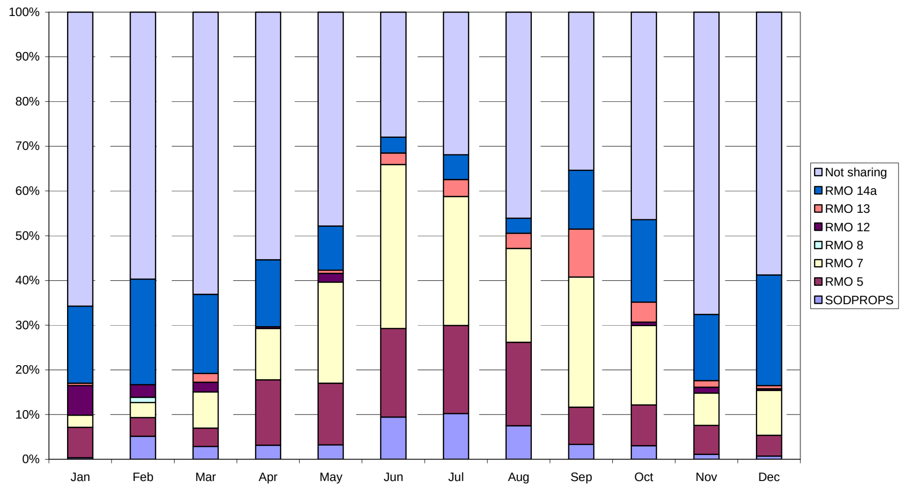


Figure 3.2 Monthly Modes during all Hours - 2003

Figure 3.3 shows details for each month of the usage of the various noise sharing modes, during noise sharing periods. It excludes parallel runway modes (RMO 9 and10) used during these hours.

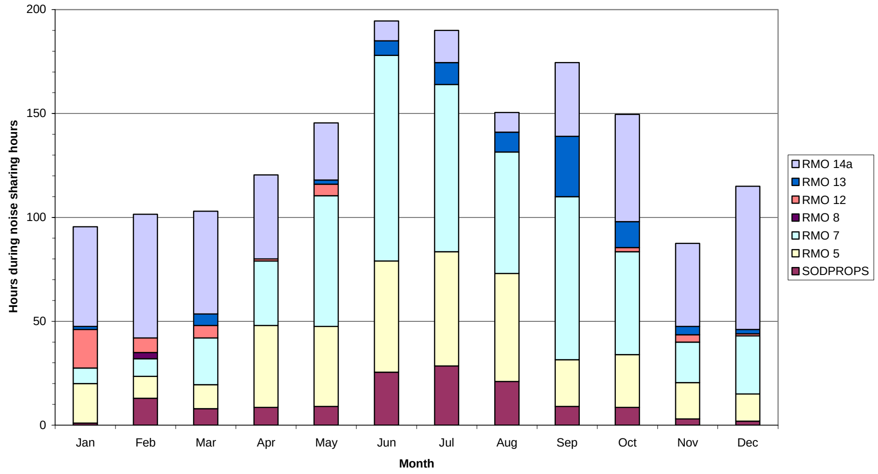


Figure 3.3 Monthly Noise Sharing Modes during Noise Sharing Periods 2003

3.3 CONSTRAINTS

The potential constraints to the use of noise sharing modes during noise sharing periods were identified and grouped as primary, secondary or other:

Primary Causes	Demand (vs Mode Capacity)
	Weather (wind speed, direction, cloud/visibility, wet runway)
	Facilities availability (maintenance, incident, airport works etc.)
Secondary Causes	Pilot request
Other Potential Causes	Staffing

Quantitative and qualitative assessments were made based on records of mode selection and usage during 2003 and early 2004 to assess the performance of Airservices Australia in optimal usage of noise sharing modes during noise sharing periods.

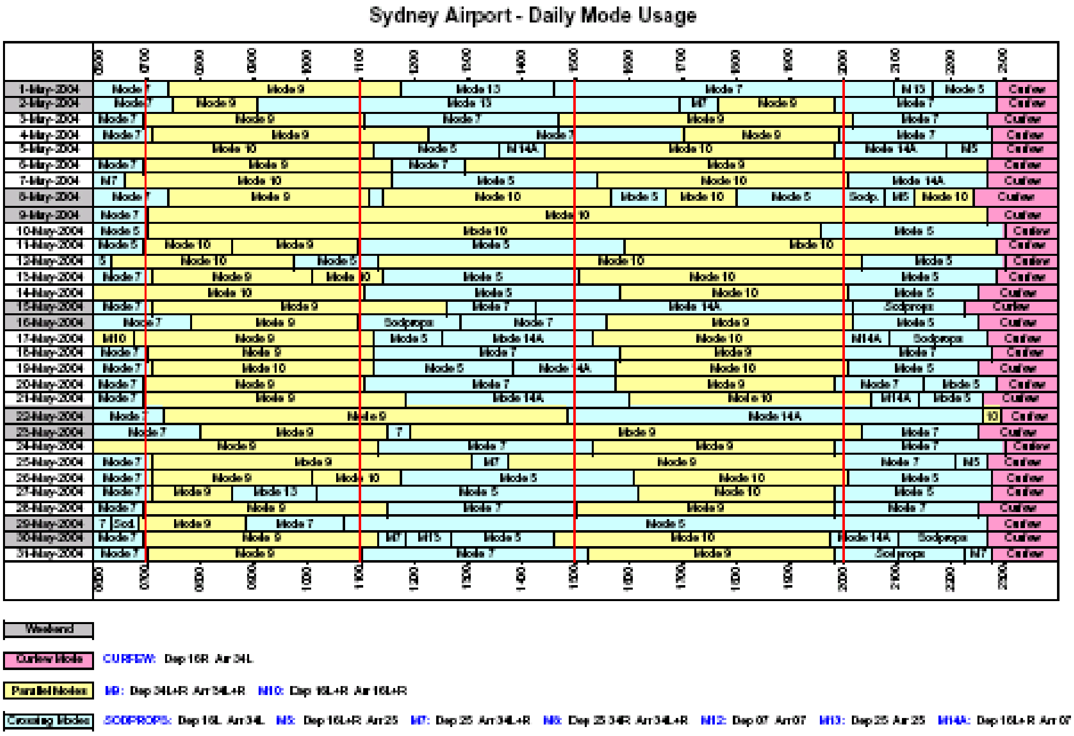


Figure 3.4 Daily Noise Sharing Mode Usage for May 2004

In their monthly reports to SACF, Airservices provide quite detailed data on daily mode usage, in a clear graphical format. An example of this is reproduced in Figure 3.4.

Figure 3.4 shows that, for Monday 3 May, Mode 7 was used in noise sharing hours, and the period of usage closely matched the target period (11am to 3pm and 8pm to 11pm). However, for 4 May, Mode 7 was in use from 6am, and the next changeover to “noise sharing mode” Mode 7 occurred late, after midday. It was, however, then maintained until 5pm.

What is missing from these daily mode usage charts, is the reason why noise sharing modes were not used during the noise sharing period. Recently Airservices Australia have started presenting a summary report that can be read in conjunction with the daily mode usage charts, and gives some indication of the reasons why noise sharing was not used – whether demand, weather or some other reason. An extract from a sample report for March 2004 is shown in Table 3.1.

Date	11:00 Parameter Actual Time:	Reason for delay	Explanation Wind & Weather - if LTOP not used at 11:00	Time Changed from LTOP Mode if <1600	Reason for Change from LTOP	General Comments
1-Mar-04	None	Wind	25kt southerly wind all day			
2-Mar-04	11:05		190/12 to 170/10			Changed to LTOP at required times had to use a combination of LTOP due to wind fluctuations
3-Mar-04	11:45	Traffic	Arrival delays at 11:00 - took 45 mins to manage			IF continued to use RWY07 - ILS required and delays above acceptable
4-Mar-04	None	Wind	040/18 to 020/20 all day			
5-Mar-04	None	Wind	020/10 to 040/15-20			
6-Mar-04	12:00	Traffic and WX	Showers in area - wind 070/15	12:40	LTOP not used in the evening due to WX	Holding fuel increased all day in the likelihood of single RWY ops due WX - also WX over BK determined complexity in SY ops combined with MED 1 traffic
7-Mar-04	None	WX and wind	Low cloud, wind 170/10			16L lighting U/S - diversions in place
8-Mar-04	None	Wind	NE up to 25kts			
9-Mar-04	1255	Wind	NE east of the field -340/15	15:15	Wind swing and heavy traffic	Wind continued to shift for the remainder of the day - several RWY changes made
10-Mar-04	None	Wind	160/20			Attempted to change to Mode 14A - wind increased before change was fully facilitated
11-Mar-04	None	Wind	100/10 to 030-070/10			DW and CW exceeding max allowable on LTOP combinations
12-Mar-04	None	Wind	030/12			Downwind on 07/25 RWY in the afternoon: RWY's wet

Table 3.1 Extract of Daily Mode Usage Report

The improvements in reporting are further discussed in Section 7.

3.3.1 Demand Vs Mode Capacity

The capacity of Sydney Airport is limited by the legislated cap of 80 scheduled aircraft movements per hour. The legislated slot allocation regime is operated by Airport Coordination Australia (ACA) at the planning level. Slots are allocated in 15 minute blocks. In addition to the maximum number of slots allowed to be allocated in any one hour of 80, a Slot Compliance Scheme also operates at Sydney Airport. The slots allocated by ACA have variable tolerances:

- If flight time is less than three hours tolerance is ± 15 minutes
- If flight time is greater than 3 hours tolerance is ± 30 minutes.

An airline is advised if it is operating outside the tolerance and is required to respond within 7 days. Acceptable reasons are that something has occurred outside the airline's control or for safety and security reasons. It is usually technical or consequential. Airlines are required to make every effort to arrive and depart as close to their slot times as possible.

The slot compliance scheme should smooth the demand within each hour and reduce delays due to clustering of flights.

At the "process" level there is a practical limit of 50 arrivals per hour, which is also considered when the slot allocation is done.

Due to elasticity in the system, it is possible for more than 80 movements to take place in any one hour, especially if there has been disruption due to weather resulting in planned movements surging into the subsequent hour. Air traffic services have recorded over 90 aircraft in any one hour during such an occurrence of clearing a backlog. Without the legislated cap, and with sufficient demand, the parallel runway modes of operation may be capable of processing 100 movements in a busy hour.

The estimated relative sustainable hourly capacities of the LTOP runway modes are summarised in Table 3.2[10]. Analysis of 2003 hourly movement statistics are also included which indicate the maximum and average hourly rates achieved (demand as well as capacity dependent).

Mode	**Capacity**			**2003**	
	Total	**Arr**	**Dep**	**av hr**	**max hr**
Curfew	23	12	10	3	14
4 (sodprops)	43	15	28	27	49
5[(2)]	53	25	28	30	60
7[(2)]	64	27	37	32	72
8	45	complex			
9 *(parallels)*	82[(1)]	44	38	43	64
10 *(parallels)*	87[(1)]	49	38	43	90
12	33	23	10	37	44
13	33	22	11	38	49
14a[(2)]	66	26	40	33	55

Notes

(1) *Unconstrained capacity, which is in effect limited by the legislated 80 hourly movement cap*

(2) Preferred modes during noise sharing periods

Table 3.2 LTOP RMO Nominal Hourly Capacities

[10] *LTOP capacities as reported in the 1996 studies. No better estimates of mode capacities were available from Airservices Australia or SACL. There has been no comparable in-depth study carried out on the capacities of all LTOP modes.*

It is understood that Airservices Australia has conducted basic modelling as part of a peak hour measurement process. Additional modelling was done on 16 and 34 parallel runway modes and single runway operations to develop targets for performance measurement in peak hours. The other LTOP modes, not being peak hour modes, were not modelled past the basic modelling.

It is understood that there has been no study conducted that compares actual modes usage to theoretical possibilities on a tactical basis. Airservices Australia continue to use historical peak rates achieved during operations both post and pre the commissioning of the parallel runway. This is also the case for parallel runway operations. In effect the actual maximum and sustained rates are set as the expected achievable rates both in CTMS and then operationally in Maestro. The Maestro rate is then adjusted on a dynamic basis as traffic disposition and other variables present during any given sequence.

Noise sharing periods are considered to be from: 0600 to 0700; 1100 to 1500; and from 2000 to 2300 (curfew). These periods are historically those when the demand at Sydney has fallen away to the extent that it is possible for a noise sharing mode to be utilised without causing excessive delays to the airlines. If the hourly demand is close to the capacity of the runway modes, then delays will become significant. A runway mode with a higher capacity will then be required to ensure smooth traffic flow for safety and efficiency.

Airservices Australia have a number of sophisticated support tools for strategic and tactical prediction and management of delay, and will transition to a higher capacity mode when the anticipated delays are above a predetermined threshold.[11]

Noise sharing hours are generally of lower demand than the "core period" (busy hours). It was anticipated that correlation between actual demand and mode capacity would provide some quantitative measures of the frequency of demand being above the nominal capacity of the noise sharing modes.

In trying to establish any correlation between mode selection/usage and demand, the patterns of demand at Sydney were examined. These are all based on detailed aircraft movement data supplied by Airservices Australia.

Figure 3.5 show the daily demand for 2003. The weekly fluctuations in demand (lower demand on weekends) are clearly visible. Average weekday and weekend demand statistics and busy day statistics were also generated for some simplified quantitative analysis.

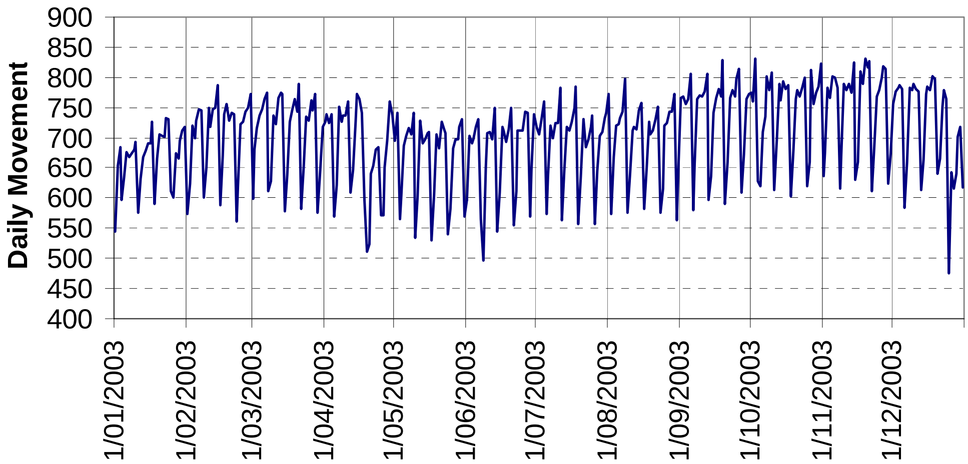
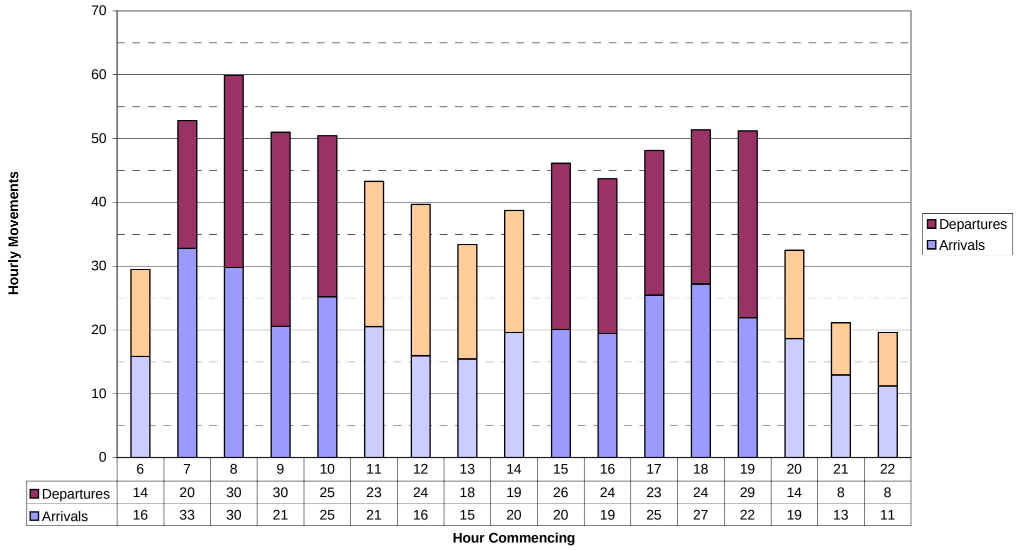


Figure 3.5 Daily Aircraft Movements - 2003

[11] *Refer the Airservices Australia website which describes some of the Flow Management Procedures and Tools used by Airservices Australia for air traffic management, including Central Traffic Management System (CTMS), MAESTRO and The Advanced Runway Decision Advisory System (TARDAS).*

Figure 3.6 shows the hourly demand profile for an average weekday in 2003.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Departures	14	20	30	30	25	23	24	18	19	26	24	23	24	29	14	8	8
Arrivals	16	33	30	21	25	21	16	15	20	20	19	25	27	22	19	13	11

Figure 3.6 2003 Average Weekday – Hourly Aircraft Movements

Runway mode capacity is very often expressed in terms of hourly arrivals or departures, so the hourly splits are also shown to indicate if there is a general bias towards arrivals or departures.

Generally there is no strong hourly bias between arrivals and departures, as show in Figure 3.7.

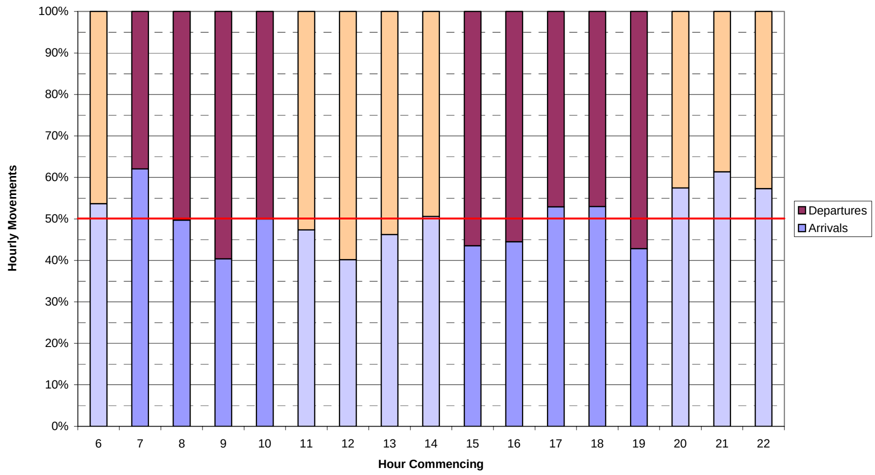
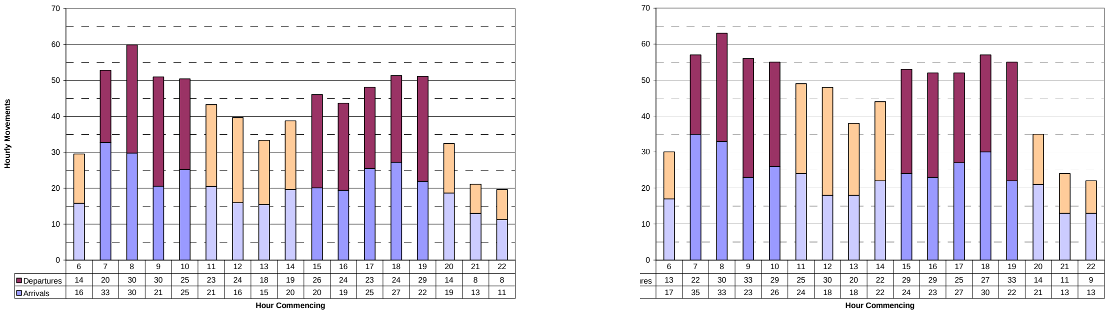


Figure 3.7 2003 Average Weekday – Hourly Split Arrivals vs Departures

For ease of identification, the "core hours" are highlighted in darker shades, and the "noise sharing hours" are in the lighter shades. It is interesting to note that during 2003, even during busy periods of the average day, the total hourly demand is well below the legislated 80 scheduled movement cap. As previously noted overall traffic levels in 2003 were well down on the peaks experienced in 2000.

A comparison between the hourly demand patterns for the 95% busy day, and the average weekday is shown in Figure 3.8.



Average Weekday **95% Busy Day**

Figure 3.8 Comparison of Hourly Movements Average Weekday vs Busy Day

Figure 3.8 shows that in certain hours the busy day movements are about 10% above average, the variability between average and peak is more pronounced in afternoon and the morning traffic appears more consistent.

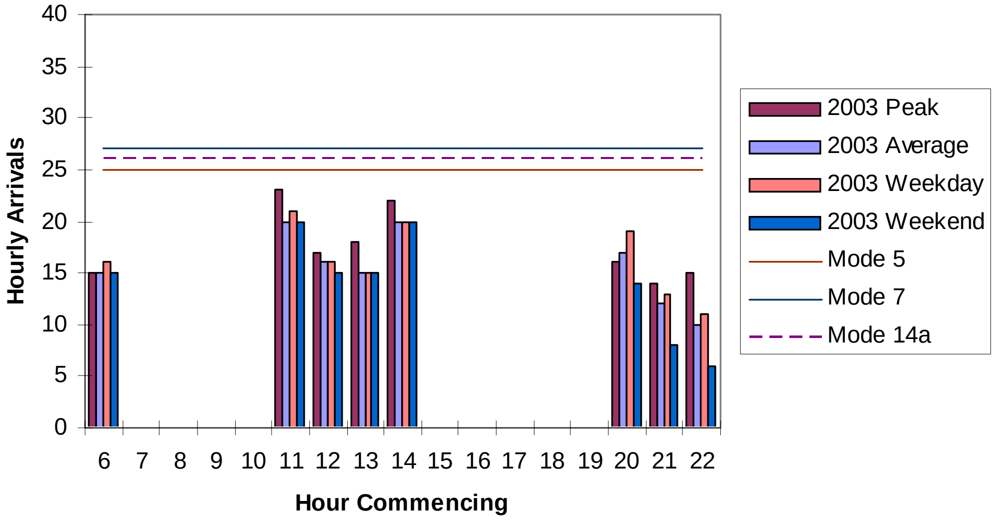


Figure 3.9 Busy Hour Arrivals vs Noise Sharing Mode Capacities

The limiting factor for usage of noise sharing modes, even in noise sharing periods, may be that demand approaches or exceeds capacity. It is not only the overall hourly demand that must be considered, but also separate arrival (or departure demand). Figure 3.9 compares the noise sharing modes (Modes 5, 7 and 14a) arrival capacities (from Table 3.3) and arrival demand during a range of demand levels for the noise sharing hours.

This shows that for 2003, demand during noise-sharing hours, should not have been a factor mitigating use of noise sharing modes. Based on this analysis, preclusion of the use of noise sharing modes during noise sharing hours would be expected to be due to others factors such as weather, or secondary effects.

3.3.2 Weather

Seasonal trends in mode usage were analysed to determine if there was a clear connection between weather and noise sharing[12].

Figure 3.2 showed that there are some clear seasonal (monthly) variations in mode usage. This would be expected with the seasonal changes in prevailing winds. Figure 3.10 shows that when mode usage is then translated into runway end usage (one of the simplest and primary reference points of the community for monitoring noise sharing), the variations between seasons are evident but definitely not as pronounced.

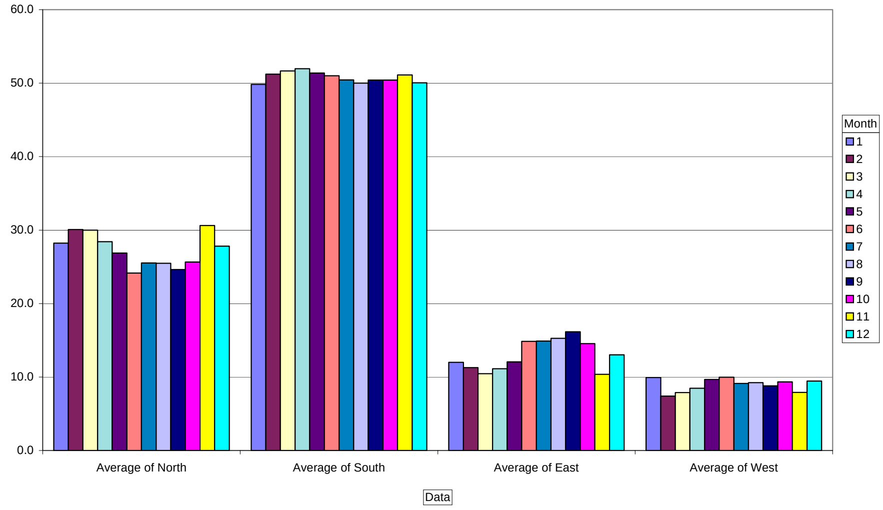


Figure 3.10 Runway End Usage by Month for 2003

Northerly movements varied from about 25% during June to October, rising to over 30% in summer months. Southerly movements were reasonably constant at 50%. Westerly movements peaked about 10% in January and May, and were at their lowest in February, March, April and November around 7%. Easterly movements varied between 10% during summer, and rose to about 15% during late winter and early spring. These trends on a longer term basis can also be picked up from Figure 2.2 which plots monthly runway end usage for the period 1998 to 2004.

The conclusion is that seasonal weather patterns may generally account for a variation of some 5% in runway end usage, particularly between northerly and easterly impacts. From this type of macro analysis, weather does not appear to be a major contributor in any discrepancy between "targets" and long term trends for the southerly or westerly directions. There could be some seasonally driven relationship between northerly and easterly noise sharing. It of interest to note that the "easterly target" is being met, indicating that the evident seasonal factors cancel when converted to annual statistics. Similarly the relative seasonal stability of southerly and westerly runway end usage, do not correlate or explain the approximate 5% "gap" between the "targets" and long term end usage trends.

---

[12] This macro analysis was undertaken for seasonal trends, and did not look at daily weather patterns that might affect runway mode choice on an hourly basis.

3.3.3 Other Factors

The macro analysis of potential primary factors constraining noise sharing mode selection in noise sharing hours did not yield statistically significant correlations as a dominant determinate.

Other potential factors were considered which could be influencing the discrete mode selection (hour by hour) and on a cumulative basis result in the overall trends in noise sharing. The secondary constraints considered included procedures and human factors.

The very nature of objective analysis means that little account be made of the human factors which are very much a subjective factor in the decision making process – for the purposes of this report as applied to runway mode selections.

There are many variable factors that must be brought into consideration when managing air traffic operations. This is still very much a discipline which requires human input to take account of the numerous variables contributing to determination of a decision which is the most appropriate for the circumstances.

It is a natural human instinct when faced with immediate problems to take a line of least resistance. This observation is not meant in a derogatory sense; more so it illustrates that where one has a choice of two options and one option carries less risk than the other option and both provide the same result, then most people, and in particular air traffic controllers who are by training very risk-adverse, will choose the option which carries the least risk.

Controllers at Sydney Airport have three overarching priorities that are applied when determining how air traffic situations will be addressed:

1. Safety
2. Operational Performance
3. Environment

These are outlined below. There is some mutually exclusive conflict that must be resolved in each instance.

<u>Safety</u>

The raison d'etre for air traffic control is safe air navigation; to prevent collisions between aircraft in the air, and on the ground at controlled aerodromes. The ATC function is a 'service' one – ATC is not a policeman of the air or enforcer of rules as the regulator is. The service nature of ATC is well described in ICAO documents and philosophy and well understood by the signatories to the Convention, international and domestic aviation communities, and industrial organisations. The service and safety ethics are incultured into air traffic controllers from the day they choose to enter the profession.

Controllers quickly learn that things rarely proceed exactly as planned and thus apply a modest buffer of separation over that than is legally required. For example, if 3 NM radar separation is the required standard, and therefore <3 NM constitutes a separation breakdown, then all controllers whether at Sydney or elsewhere will keep aircraft say 3.5 NM apart thus allowing for variable factors that can conspire to reduce this. Where an air safety incident investigation reveals loss of separation, the inevitable tendency is to be more conservative in the future to ensure that such an event does not occur again; or at least that the risk of separation breakdown is minimised.

Operational Performance

In context, operational performance can be deemed to be the ability to process traffic demand in a safe, orderly and expeditious manner. The ATC service provider's direct customers are airspace users, predominately the airlines. The airlines have certain expectations that controllers will process a specified number of aircraft in given conditions on a specific mode.

If an anticipated movement rate is not achieved then the ATC provider must respond to a 'please explain' from its customer. It is not reasonable to invite large numbers of such complaints to demonstrate customer dissatisfaction for perceived poor service in an attempt to show a case for mitigating circumstances.

Environment

Noise sharing requirements (LTOP) are another priority for the controllers at Sydney. While safety as first priority is a given, it can be a matter of degree, however. While one course of action might be deemed to 'be safe' it may not be 'as safe' as perhaps another course of action. Humans faced with a requirement for a decision with a number of variables will tend to opt for the safest option. This could suggest that an LTOP noise sharing mode might not be adopted when analysis of the raw data indicates that it could have been.

Priorities of capacity and noise sharing can be mutually exclusive. The move to a noise sharing mode will often result in extra costs to the airlines and delays to flights that would not have occurred if a parallel mode had been maintained. The controller has direct communication with the pilots; the controller's natural instinct is to assist the person he/she is speaking to and provide the best service he or she can. To delay aircraft by 15 minutes or more to implement a noise sharing mode while un-natural to a controller's extensive training in expedition is never the less accepted by ATC staff.

Other Factors Affecting Mode Selections

A number of factors which do not necessarily appear in the data that will influence the Traffic Manager's decision will include:

Weather

- Variable inconsistent surface wind velocity
- Upper wind
- Forecast conditions
- Inclement weather in only one sector
- Violent weather; for example thunderstorms

Pilot Requests

- Pilot requests for an into-wind runway or parallel runway mode

Civil Works

- Work on the airport
    - Taxiway or runway closures
    - Cranes or other obstructions

Staffing levels

Traffic Surges

- Bunching of traffic - surges
- Unbalanced demand between arrivals and departures

Emergencies

- Aircraft emergencies

Apron Issues

- Apron congestion.

3.4 DEMAND-WEATHER-MODE ANALYSIS AND METHODOLOGY

An "audit" of Airservices Australia's Sydney Airport operations was undertaken, which included two aspects:

1. Detailed examination of sample daily mode selection charts (such as shown in Figure 3.4) in conjunction with weather information and traffic demand.

2. Observation of air traffic operations by a qualified independent senior air traffic manager, and an associated review of procedures and consultations with Airservices Australia's managers, airline operators and industrial and community representatives.

Much of this was qualitative in nature, to assess whether there were any obvious technical deficiencies in Airservices Australia's operations which were a constraint on the LTOP implementation of noise sharing.

Available weather data was captured and referenced to known mode allocations for a sample period, to provide an objective basis for analysis in relation to possible alternative mode use considering known capacity-demand data. This basis applied to both preferred modes in LTOP periods and relief modes otherwise.

Data was used for the first week respectively in an autumn, winter, summer and spring month for 2003-2004.

To determine demand at Sydney during any one hour, the actual movements for that hour were recorded. However, demand and actual movements are not always the same measurement, as demand often occurs in surges at different periods during that hour. This means that despite flow control measures, at times while the hourly rate may be below the actual capacity of that runway mode, aircraft can still be experiencing significant delays due to their being bunched rather than evenly spread during the nominal hour period.

For the purpose of this analysis, demand exceeding 60 movements per hour was deemed reasonable to consider that parallel modes of operation be used.

Where demand dropped below 60 movements for less than a one hour period, this was not considered to be sufficiently long enough to change modes, given that traffic would be unlikely to be evenly spaced and that by the time the mode change was affected, only a short period would remain before further mode change was required to accommodate the pending surge for the next 'hour'. Mode change is a considerable exercise to implement and is not done on an ad-hoc basis. To do so would introduce adverse human factors issues and significant disruption to traffic flow with consequent possible flight safety implications, as discussed elsewhere in this study.

3.4.1 Mode Usage

To ascertain the actual mode in use at any time, data from the Sydney Airport Daily Mode Usage Chart produced by Airservices Australia was referenced. However this is a coarse measurement and does not fall exactly into one-hour bites as may be otherwise assumed from the way the data is recorded. However every effort was made to ensure that the analysis reflected the actual mode usage.

The viable mode options considered as alternatives to the actual modes that were utilised were Modes 4 (SODPROPS), 5, 7, and 14A. Mode 8 is not used in practice and was not applied due to the large numbers of runway crossings that are required for it to function. Modes 12 and 13 were not considered for the purpose of this exercise as they contravene the primary LTOP objective of keeping operations over water to the greatest extent possible.

3.4.2 Weather Considerations

Hourly Meteorological Aviation Reports (METARs) were referenced to ascertain the relevant weather conditions at the airport during any specific one-hour period.

However these are indicative and do not necessarily provide a completely accurate picture of the actual conditions existing during most of that hour – they are a ‘snapshot’. As such the METAR does not reflect the changes between observations unless significant changes warrant a ‘special’ observation (such as passing storms).

Automatic Terminal Information Service (ATIS) broadcasts recorded by ATC are much more comprehensive, however analysis would be an exhaustive exercise, as many of these might feature in a one-hour period and even gathering the information might not be feasible.

The weather in a given final approach sector, while not necessarily featuring significantly in a specific METAR, may never the less have major influence on airport operations and thus mode selected.

Sydney Airport features a large area and much infrastructure. It is situated on the coast and is likely to experience different wind effects at thresholds of its runways due to local effect, while the METAR reflects wind velocity at one nominated sensor. ATC will refer to both automated displayed meteorological information as well as visual observations (and are trained as aviation meteorological observers) in determining ATIS content (and runway selections).

No consideration was afforded for possible turbulence that might exist and be reported but might not have been recorded in the METARs.

When calculating whether or not observed wind velocity indicated that a certain runway mode might be used, the wind and gust reported was applied (during the hour the actual winds may have been stronger, or less, than reported in the METAR).

3.4.3 Methodology

An analysis of aircraft operations at Sydney Airport was undertaken on an hourly basis for sample periods and featuring movements (take-off and landing numbers), mode use, wind velocity, meteorological conditions.

Twenty-four hour data was utilised for the first week (Sunday to Saturday) of four representative months; for autumn (May), winter (August) and spring (November) of 2003 and summer (February) of 2004.

Furthermore, the METAR information referenced for each hour period represents a 'snapshot' rather than actual conditions that might have prevailed throughout most of the hour.

For the purpose of this report, noise sharing operations are deemed to be those whereby aircraft operations on a runway or runways orientated in one direction are simultaneously supplemented by aircraft operations using a runway or runways in a different direction. For example, operations applying Modes 5, 7 and 14A.

Movement data, mode capacity figures and meteorological information were used to suggest at least whether alternative modes might have been feasible for periods of an hour or longer. The purpose was to try and determine whether cross runway rather than continued parallel runway use could prospectively increase noise sharing during the LTOP periods.

A similar exercise was also undertaken to indicate whether noise sharing modes might also have been feasible during some core hour periods for noise relief purposes - when a combination of wind velocity, visual or other weather, demand and mode capacity circumstances suggested so. (However it is recognised that the first LTOP requirement is to route flights over water to the extent possible. Accordingly reducing northern sector movements in some instances, has an effect of reducing southern sector movements as well with a consequential increase in over land movements and thus increased overall noise to some sensitive suburban areas).

3.4.4 Limitations

Sampling although indicative is not exhaustive and absolute conclusions should not be drawn.

Nominal capacity figures determined by Airservices' LTOP Sabre modelling in 1996 were applied except that for SODPROPS applications, a more conservative figure of 30 movements an hour was applied, as a higher figure will likely only be possible in ideal conditions of calm wind, clear skies and excellent visibility, ideal aircraft mix and spacing and efficient arrival and departure streams.

Mode 8 was not applied, as this is not used in practice. To do so requires about as many runway crossing events as there are aircraft movements with corresponding significantly increased risk of incidents occurring. Safety is a major element of LTOP activity.

3.4.5 Data Summary

Sampling as described above showed the following results, noting that these sample months may give results higher or lower than annual averages for particular mode usage.

Total Movements

May, week 1, 2003	4,692
August, week 1, 2003	4,959
November, week 1, 2003	5,222
February, week 1, 2004	4,839
Total	19,712
Average weekly	4,928
Annualised extrapolated	256,256

SODPROPS use (not curfew period)

	Movements	Percent
May, week 1, 2003	305	6.5%
August, week 1, 2003	370	7.5%
November, week 1, 2003	28	0.5%
February, week 1, 2004	29	0.6%
Average	183	3.7%
Annualised extrapolated	9,516	

Curfew movements

May, week 1, 2003	143	3.0%
August, week 1, 2003	147	3.0%
November, week 1, 2003	156	3.0%
February, week 1, 2004	154	3.2%
Average	150	3.1%
Annualised extrapolated	7,800	

Potential for increased cross-runway LTOP use (in noise sharing hours)

May, week 1, 2003	245	5.2%
August, week 1, 2003	92	1.9%
November, week 1, 2003	264	5.1%
February, week 1, 2004	315	6.5%
Average	229	4.7%
Annualised extrapolated	11,908	

Potential for core period cross runway use for noise relief from parallel mode

May, week 1, 2003	1,693	36.1%
August, week 1, 2003	1,247	25.1%
November, week 1, 2003	1,484	28.4%
February, week 1, 2004	1,507	31.1%
Average	1,483	30.2%
Annualised extrapolated	77,116	

Potential for increased SODPROPS use (up to 30 movements per hour applied)

May, week 1, 2003	65	1.4%
August, week 1, 2003	0	0.0%
November, week 1, 2003	24	0.5%
February, week 1, 2004	13	0.3%
Average	26	0.6%
Annualised extrapolated	1,352	

3.4.6 Results

The consultant well understands the dynamics of safe orderly and efficient air traffic control service, and also the sometimes conflicting mutually exclusive requirements that must be accommodated. Furthermore, safety is indoctrinated into an air traffic controllers psyche from career inception. These industry paradigms cannot be overlooked either – from both ATC and pilot union perspectives.

The analysis of sample data used showed the following.

SODPROPS (Mode 4) was used for 3.7% of movements. Data analysis indicated that a marginal increase in SODPROPS use (0.5%) was feasible (say total 4.2% of movements).

Potential for increased noise sharing mode use in LTOP operations (with a view to reducing northern sector parallel runway operations, increasing noise sharing and affording relief) exists. Data suggests that 4.7% of traffic could have been assigned an alternative LTOP mode. Short term periods of less than one hour were not deemed to be feasible for these purposes.

During core periods, increased noise sharing mode use operations of up to 30% might be feasible for noise relief purposes, however while reducing northern sector operations, substantial numbers of current over water flights would be routed in eastern and western sectors with attendant increase in overall noise. Accordingly such an arrangement is not a solution.

Curfew movements totalled 3.1% of traffic, recorded here as a matter of record.

3.5 CONCLUSIONS

The audit of actual Airservices conduct of air traffic management operations relevant to LTOP, which included observation of operations and consultations with operational and management staff, did not identify any specific deficiencies which would have significant impact on the operation of LTOP as specified in reports and operational documents.

4. OVERCOMING CONSTRAINTS

This study, as discussed in the Introduction, was a review of the performance of LTOP.

There are three pillars on which LTOP is based, in order of priority:

- Safety – of aircraft operations
- Capacity – within the 80 movement cap
- Environment – noise sharing through use of noise sharing modes.

Consideration of any changes to these objectives, or their priority, and development of an alternative operating plan for the airport were outside the scope of this review.

The study focussed on the understanding of what constitutes the technical elements of LTOP, the resultant noise sharing performance under a range of measures, and identification of constraints that could improve performance within the overall LTOP parameters. Primary and secondary constraints considered included runway demand/capacity, weather, procedures and other factors.

The detailed macro analysis of potential primary constraints – demand and weather, did not yield significant correlations that would indicate that they were dominant determinants.

Similarly the audit of actual Airservices' conduct of air traffic management operations relevant to LTOP, which included observation of operations and consultations with operational and management staff, did not identify any specific deficiencies which would have significant impact on the operation of LTOP as specified in reports and operational documents.

It is acknowledged that over time refinements have been introduced to procedures and organisation roles. Technological tools to assist traffic management have been introduced. As could be expected a cultural acclimatisation of an air traffic control organisation to the addition of accountability for efficiency and noise sharing outcomes has taken place, in addition to the traditional and primary role to ensure operational safety.

In contrast to this observation, there is no trend evident to a measurable narrowing of the gap between runway end usage "targets" and achievements. However, this review was unable to identify any single significant constraint to the performance of LTOP.

In summary, based on the review, it is the Consultant's opinion that there are no obvious or simple solutions to increase noise sharing within the acknowledged constraints of:

- Priorities of safety, capacity and noise sharing
- Airport and flight path locations relative to city
- Layout of airport
- International, domestic and regional role of the airport
- Demand and mode capacities
- Weather patterns
- Differing stakeholder issues and requirements.

The industry and the community through the various mechanisms in place should continue to seek marginal improvements in all aspects.

At the operator level, there may be a case to investigate the potential use and success of incentives based systems in similar environments where safety cannot be compromised.

The overall impression of this review, within its terms of reference, is that the implementation process has been reasonable considering the complexity of LTOP in all its aspects.

Future trends, the potential to increase noise sharing in core periods, and other issues and findings are discussed in subsequent sections of this report.

5. FUTURE TRENDS

Future trends which may affect LTOP performance were considered in the following areas:

- Traffic Demand
- Capacity
- Weather
- Procedures
- Technology.

5.1 IMPACTS OF GROWTH IN TRAFFIC DEMAND

The Sydney Airport Master Plan was the main public reference document for consideration of growth scenarios and assessments were made on the impacts of projected traffic growth on LTOP performance.

The performance of LTOP is primarily influenced by the hourly traffic profiles, rather than annual aircraft movements.

The Sydney Airport Master Plan (2003) includes a range of forecast hourly movement profiles. These are shown in Figures 5.1[13] and 5.2, with the addition of a line representing the nominal capacity of RMO5, one of the noise sharing modes at 53 hourly movements. This is likely to be the limiting factor for noise sharing. The other noise sharing modes (RMO 7 and 14a) have higher capacities at 64 and 66 hourly movements, respectively. The 2001 hourly profile is included as a point of reference.

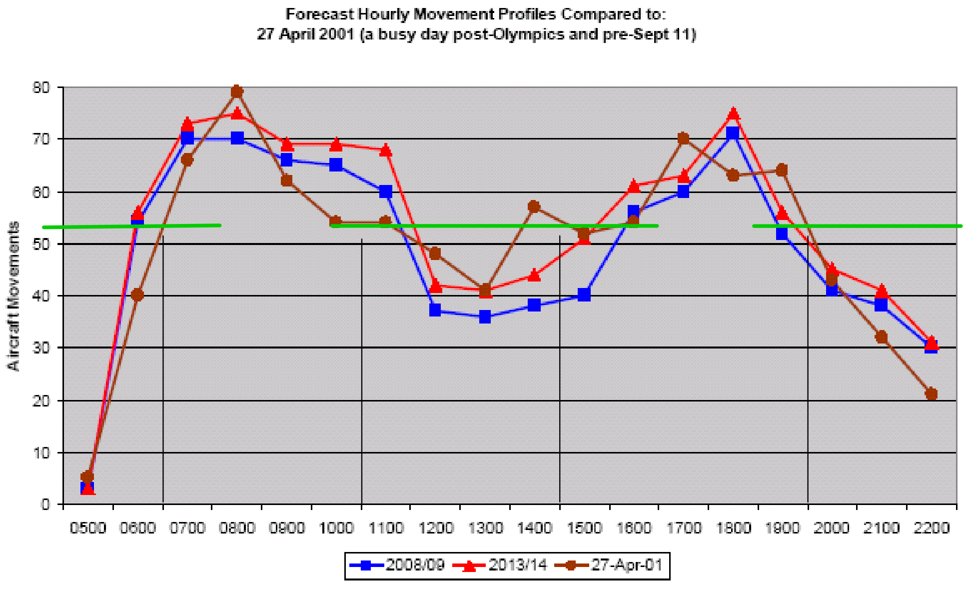


Figure 5.1 Medium Term Traffic Demand and Noise Sharing Capacity

---

[13] From SACF website - SACL presentation to SACF – Reference SACF 310703.ppt

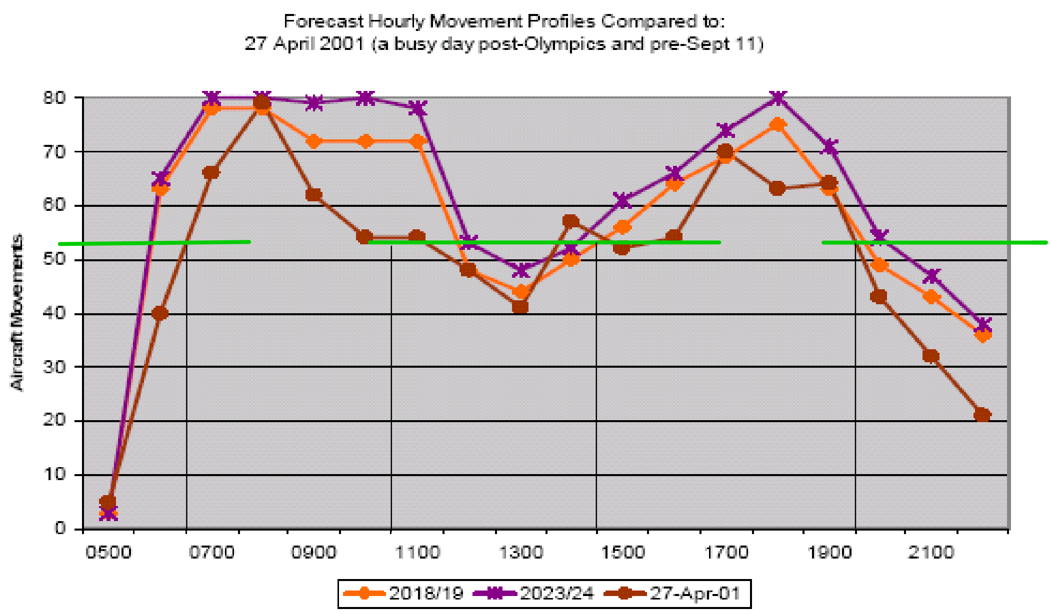


Figure 5.2 Longer Term Traffic Demand and Noise Sharing Capacity

The Sydney Airport Master Plan traffic growth assumes an increase in proportion of larger aircraft, and that government policy retains access for regionals. It retains the scope for noise sharing and retains the 80 movement cap.

However, as seen in Figure 5.2, capacity of noise sharing in the 11am to 12 noon period is likely to be exceeded in the longer term on busy days.

The above plots compare busy hour demand (hourly arrivals) with capacity for RMO 5. Independent modelling was undertaken to analyse the potential changes to mode usage based on projected demand and RMO capacities of the noise sharing modes, in the noise sharing hours now and in the future.

The characteristics of current daily traffic demand profiles, for the average day, the average weekday, the average weekend and the busy day (95%)[14] were considered. The 95% busy day demand for 2003 was about 800 daily movements. The variation in daily movements in 2003 was shown in Figure 3.5. It showed that the busy day traffic levels were biased to the months of September, October and November. The weekly traffic patters are also clearly illustrated with weekend daily movements typically 20% below that for the weekdays. The "bias" between arrivals and departures change, generally with the time of day, as illustrated in Figures 3.6 and 3.7.

For the average day, during noise-sharing hours, the split between arrivals and departures is slightly departures biased during the mid-morning noise sharing period, and slightly departures biased in the evening noise sharing periods, but these biases are not strong (less than 60/40).

The Sydney Airport Master Plan shows a typical busy day hourly movements profile, which we assume was for the 95% day. Because the capacity of the runway modes of operation are more likely to be limited by arrival demand, than

[14] The 95% concept as representing a typical busy day (5% of 365 days) relates to this level of traffic being exceeded on 18 days of the year (less than twice per month)

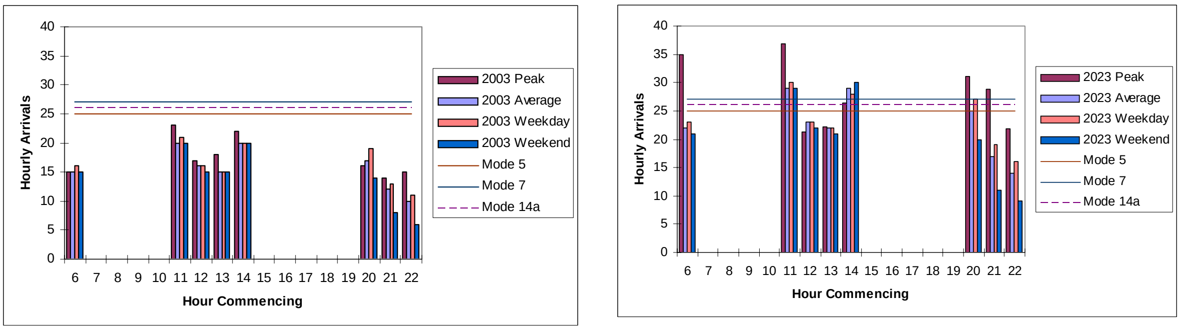
overall or departure demand, the hourly overall demand was multiplied by the arrival/departure biases in the 2003 data, to give the arrival demand.

The arrival capacity for the noise-sharing modes (from the 1996 LTOP report) based on Sabre's modelling is summarised in Table 5.1.

Table 5.1 Noise Sharing Mode Arrival Capacities

RMO	Capacity	
Mode 5	25	Arrivals/hour
Mode 7	27	Arrivals/hour
Mode 14a	26	Arrivals/hour

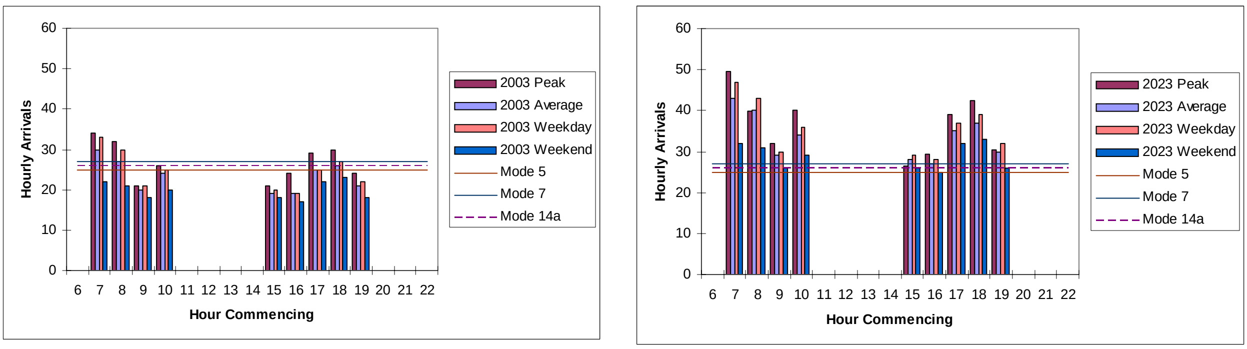
The outcomes of the modelling comparing mode capacities and current and projected 2023 demand[15] for the peak, the average, the weekday average and the weekend average daily demand profiles are shown in Figure 5.3.



2003 2023 projection

Figure 5.3 Future Trends – Demand/Capacity Noise Sharing Periods

A similar analysis, as illustrated in Figure 5.4, was done to ascertain the future potential for increasing the use of noise sharing modes during the "core periods" (7am to 11am and 3pm to 7pm). The potential for increasing "noise sharing" in the core periods is further discussed in Section 6.



2003 2023 projection

Figure 5.4 Future Trends – Demand/Capacity Core Periods

---

[15] Sources:
SACL 2003 daily curve (arrivals) growth at average annual growth to 2023
SABRE: capacities
Arrival demand would in fact be reduced to cap, the proportion of arrivals in total 80 movement cap.

Figure 5.3 shows that there will continue to be opportunities for noise sharing during noise sharing hours for 2023 projected demand. The exceptions are the 11am to 12 noon period even during average days, the 6am, 7pm and 8pm hours on (95%) busy days.

5.2 NEW AIRCRAFT

Many jet airliners, in terms of their size and passenger loadings, have not changed significantly since the advent of the Boeing 707, introduced to scheduled services some 50 years ago, and this size of aircraft remains in demand.

The Boeing 747, unique in its class, introduced long haul wide body operations in 1969, and newer versions continue to be produced for service in the immediate future.

Smaller twin-engined types like the Boeing 737 continue to be developed in newer versions and serve both short and medium haul markets (although extended range versions and very reliable engines allow increasingly longer international sectors over water).

New technology airliners recently introduced such as the Airbus A330 and Boeing 777 offer performance and efficiencies perhaps not thought feasible only a generation ago. The Boeing 7E7, currently under development, will offer even greater enhancements and the ultra-large Airbus A380 will soon enter service - including with Qantas - in a couple of years time. Sectors of 18 hours or more will become routine (Singapore Airlines is about to commence its Singapore-Los Angeles service using Airbus A340 aircraft for the 18-hour sector).

Accordingly a mix of aircraft types, weights and configurations will continue to operate.

However within terminal airspace at least, aircraft arrival, approach and landing speeds will remain more or less the same as they have for the last 50 years. (Indicatively, for airline jets, these might approximate 300-250 knots airspeed inside 50 NM reducing to around 210 knots by 15 NM, 180 knots at 10 NM, 160 knots at 5 NM, 145-150 knots at 3NM and landing at around 135-140 knots.)

5.3 AIRCRAFT ENGINE PERFORMANCE

More powerful, fuel-efficient and quieter turbo-fan jet engines continue to be developed, in responses to technological developments, commercial requirements and environmental demands. For example, the new Boeing 7E7 airliner is anticipated to be much more efficient than airliner types in current operation and with a very small noise footprint projected.

International certification standards for noise continue to require quieter aircraft operations. Noise regulation will continue to develop, given technological advances and anticipated future technologies as has historically occurred over the 50 years of jet air transportation.

5.4 AERONAUTICAL TELECOMMUNICATIONS

Aeronautical telecommunications increasingly uses satellite facilitation for communication, navigation and surveillance, airborne systems and infrastructure, coupled with high levels of automation. This technology reduces (and may eventually eliminate some) conventional terrestrial facilities used for these purposes. Previously termed Future Air Navigation Systems (FANS), the new systems are termed CNS/ATM (communication, navigation, surveillance / air traffic management). CNS/ATM is the foundation of International Civil Aviation Organization (ICAO[16]) Global Air Navigation Plan.

Historic reliance on fixed position radio-navigation aids has determined that aircraft flight routes were conventionally anchored by such aids thus requiring that aircraft fly directly overhead them. However satellite facilitated navigation featuring Global Positioning System (GPS) technology and complementary equipage and procedures potentially offers alternative tracks to aircraft. ICAO allows GPS use for 'prime means' navigation (but must be supported by alternative/conventional navigation facilities).

Data linking between airliners and air traffic control (ATC) facilities allows near real-time exchange of efficient message traffic rather than reliance on broadcast voice communications, interfacing with respective flight management systems and air traffic management systems.

Such technologies complemented with a variety of surveillance infrastructure either in-service or already planned for, will allow advanced surface movement guidance and control of aircraft on the movement and manoeuvring areas in low visibility conditions. This will be essential to match airspace management capacity and ability of precision landing systems to process scheduled flights efficiently and expeditiously in such conditions.

Regarding precision landing systems, conventional Category (Cat) I ILS facilities used throughout Australia and most of the world, with complementary lighting and other infrastructure, allow aircraft to land in conditions of 800m visibility / 550m Runway Visual Range (RVR) and 200 ft decision height. Existing systems are understood to be upgradeable to Cat II at least, although new replacement facilities are planned for around three year's time which will satisfy Cat II/III requirements in any event. Enhanced (centreline) lighting is already implemented.

Accordingly Cat II operations at Sydney in future can be anticipated featuring meteorological minima of 350m RVR and 100ft ceiling. This will allow less missed approaches due to poor weather and afford safer operations in conditions of low visibility.

Cat III operation, featuring 200m-zero visibility and 0ft ceiling is a future possibility and is provided at airports like Heathrow and Frankfurt. Approved aircraft arriving at Cat III airports may carry minimal fuel reserves when holding or alternate (diversion) meteorological conditions exist or are forecast, as they are assured of landing, on time. This allows the airline to carry more passengers and freight instead of additional fuel.

Regarding implementation of new technologies, Airservices Australia has produced an Air Navigation Plan detailing systems and schedules otherwise

[16] Australia, like most United Nations members, is a signatory to the Convention on International Civil Aviation, and thus adopts its standards and recommended practices (SARPS) – these are published as Annexes to the Convention.

outlined in the ICAO Regional Air Navigation Plan (Asia-Pacific), itself reflecting concepts from the ICAO Global Air Navigation Plan. Capital expenditure programmes implement the plan.

5.5 AIR TRAFFIC MANAGEMENT

On-board flight management systems (FMS) allow new and emerging technology and complementary procedures to be exploited by aircraft operators where circumstances allow, for more efficient and safer operations, such as long haul direct-tracking using optimum cruising levels and climb/cruise procedures.

Automation and new systems allow reduction in traditional tactical ATC intervention. Aircraft were historically radar vectored, held, or adjustments to airspeed made on ATC instruction.

With the advent of CNS/ATM including required navigation performance (RNP) from aircraft systems, tactical ATC is reduced, with aircraft arrivals planned from their departure, though air traffic flow management (ATFM) measures, determining routing, descent point, speeds, arrival-approach selection and processing and landing on long determined runways at a preassigned estimated landing time slot.

Automation allows increasing traffic demands to be accommodated more readily than conventional historic processes (flow controller with a clipboard).

While air traffic management contributes to greater flexibility in enroute ATC applications, it does not readily extend to ad-hoc operation of an airport's runway operations where movements exceed a certain threshold, such as that which quickly applies on a daily basis at Sydney – air traffic management removes the relative randomness and places more order into systemic measures that provide overall greater efficiency of operations, reduces scope for human factor errors and enhances safer air navigation.

Regarding radar separations, standard separation is 5 NM, reducing to 3 NM in airport environs where high definition radar with fast scan rates (for target updates) is implemented (such as facilitating Sydney). In the United States, longitudinal separation for aircraft on final approach can be further reduced to 2.5 NM in certain circumstances, allowing 3 NM separation to be realised without infringements. At closer separations, runway occupancy becomes the constraining factor, so further reduction again is not feasible at typical jet speeds.

In future, 'reduced' longitudinal spacing between consecutive aircraft on final approach as described above could marginally enhance capacity to better meet demand requirements. If such separation was used in parallel runway arrival mode in instrument conditions, precision approach runway monitor operations (currently implemented, with some restrictions on use) would be required – to allow the runways to be used independently.

5.6 AIRSPACE MANAGEMENT

RNP results in reduced tracking tolerances placed on air navigation and thus routes can be spaced closer together, with potential for alternative routings to be implemented where they might not have been previously possible due to overlap conflictions. Furthermore, longitudinal separations between flights can be safely reduced and with RVSM (reduced vertical separation minima) already being introduced internationally, a significantly greater number of flights can be accommodated in a given volume of airspace than was hitherto possible.

Philosophical changes in airspace management have also resulted in large volumes of airspace previously reserved for military activity being released for short or long terms to civilian ATC sectors when such airspace is not in use, allowing more flexibility in routings or holding etc. (in peacetime / non-hostile operations, military authorities require that their aircraft operate within the ATC system, although they are exempted from doing so as 'state' aircraft under the Chicago Convention[17]).

So the capacity of the airspace has increased or is increasing (although this capacity is not significantly matched by similar capacity gains at airports already featuring high demand without additional runways and movement areas being implemented). The airspace capacity can not be fully exploited in terminal airspace though where aircraft tracking is governed by a single arrival track (such as a Localizer course) and limitations on departure tracks (due to say noise abatement requirements or obstacles).

5.7 FLIGHT PROCEDURES - DEPARTURES

Aircraft performance has already been discussed.

In relation to aircraft taking off, despite more powerful, fuel-efficient and quieter engines, the takeoff and after-takeoff period remains a critical phase of flight due to high aircraft weight, low aircraft speed and low height conspiring to impact adversely on safe operation options. Premature manoeuvring affects both speed and lift, until the aircraft is at an airspeed where landing gear and flaps etc can be raised (termed reconfiguring) where after normal climb continues at higher and thus safer airspeeds also enabling manoeuvring to occur.

The above situation is exacerbated where there is a downwind component (tailwind). Surface downwind component will be less than any downwind component at height (due to surface friction). Wind velocity as displayed to ATC towers is measured from a sensor sited on the aerodrome (surface). So very soon after takeoff, any downwind component thought to be say 5 knots might actually be say 20 knots or so at a few hundred feet of height, with potential serious consequences to aircraft performance, especially if early manoeuvring was attempted.

This means that airliners cannot readily manoeuvre immediately after takeoff especially if there is downwind. This situation is fundamental to aerodynamics of conventional airliners and will not change under existing design criteria.

ICAO Document 8168 Procedures for Air Navigation Services – Operations (PANS-OPS) limits downwind component operations to 5 knots and crosswind component operations to 15 knots for utilising preferential runway selections for

---

[17] The Convention on International Civil Aviation from which ICAO, a United Nations agency, was established in 1944, is termed the Chicago Convention. Annexes to the Convention contain standards and recommended practices that contracting states are obliged to adopt (except where impossible to do so).

noise abatement purposes. ATC and pilot unions are very aware of this limitation. However after a certain speed and height, aircraft can track more or less wherever the Standard Instrument Departure (SID) prescribes as programmed into the FMS, or where intervening tactical ATC instructions determine.

Greater potential thus exists for varying departure routes – except in the vicinity of the immediate upwind end of the departure runway – provided that any conflict with arrival routes is avoided in the process.

5.8 FLIGHT PROCEDURES – ARRIVALS

While departing aircraft are out of the way relatively quickly with short noise footprints due to good climb performance, arriving aircraft in the approach phase of flight are more of a problem, as they are at a lower level for a longer period of time along more or less a fixed course, as explained here.

Satellite facilitated technology, automation and data linking has been discussed. The foregoing, together with published Standard Instrument Arrivals (STARs), allows very efficient flow of arriving aircraft on 'continuous descent' leading into an instrument approach final approach segment for eventual landing.

Irrespective of weather conditions, airliners conventionally operate under Instrument Flight Rules (and have done so in Europe since the early 1960s), with aircraft systems using the appropriate radio navigation aids, even when executing a 'visual' final approach.

The final approach segment flight path is prescribed by an Instrument Landing System (ILS). Tracking guidance is provided by a Localiser (LLZ) component - the azimuth component of the ILS. This aligns an approaching aircraft up precisely on the runway extended centreline. The elevation component of an ILS is facilitated by a Glide Path unit.

The final approach segment, and certainly flight from 5 NM, must be aligned with the runway centreline and a precise 3º glideslope (5%, or 1:20) maintained, in accordance with international standards and recommended practices, published procedures and aircraft manufacturer and airline operating manuals, in order to execute a safe approach and landing.

Airliners require a 'stabilised' final approach segment, usually from at least 5 NM-8 NM, to configure the aircraft and maintain the correct glideslope and centreline course while correct airspeed is maintained until reduced to execute a safe landing at the precise airspeed required. Changes to course, level, airspeed and power all have a dynamic effect on each other and large aircraft at low speed are not very manoeuvrable.

The above situation will not change in the foreseeable future (and thus the 'high and wide' concept is not deemed to be feasible).

However LLZ capture at excessive distances to touchdown and levelling off at a prescribed altitude waiting for Glide Path capture are no longer essential. In particular, developments allow some alternative intermediate approach segment routing leading up to the final approach segment.

Firstly, GPS navigation allows a suitably equipped aircraft (most airliners) to intercept the LLZ course at an acute angle at say 8 NM, thereby providing an alternative intermediate approach segment to the extended centreline final approach course.

The Microwave Landing System (MLS) has not been the success initially conceptually envisaged, due to the 'curved approach' being unsuitable for airliner configuration and operation (unlike perhaps for say military fast jet operations). Pilots and airline companies are not prepared to entertain such manoeuvres, unless internationally agreed standards and procedures for civil aviation applications were to be developed and adopted. MLS can otherwise be used in the same manner described for GPS above, if aircraft are equipped and ground infrastructure provided.

Smaller commuter type aircraft are somewhat more flexible than airliners but even so, a straight-in final approach segment of about 5 NM will remain necessary. Accordingly initiatives such as TARDAS might have some limited potential for noise share relief beyond this distance where terrain and obstructions allows routing.

Where circumstances determine that a straight-in final approach segment precisely aligned with the centreline course is not feasible (usually due to terrain or other obstructions), ICAO allows an 'offset' final approach course of up to 5º to be implemented and still satisfy ILS definition. This involves locating the LLZ along the side of the runway somewhere; however siting requirements are stringent and extraordinarily difficult, if not impossible, to satisfy at a congested built up airport. The LLZ course in such instances intercepts the landing runway extended centreline at about ½ NM to touchdown at a very shallow angle requiring only minor directional change to land.

At Hong Kong's former Kai Tak airport, a mountain precluded a conventional ILS approach to Runway 13 situated in the harbour. Accordingly the LLZ (and complementary Glide Path) was offset 50º from the runway extended centreline and implemented, to allow an ILS-like approach to be flown, but to a much higher minima and with significant manoeuvring at the minima, to either land or commence a missed approach – a challenging procedure requiring significant skill, training and experience. This system was termed IGS for Instrument Guidance System, as it did not satisfy ILS definition or comply with ICAO standards and recommended practices for a runway precision approach.

Accordingly IGS is not considered to be suitable for Sydney for noise relief purposes.

ICAO does not allow GPS for sole means precision navigation and thus ILS (or MLS) backup at least remains required.

Thus straight-in approaches along existing centreline courses and glideslope angles will remain, at least from around 8 NM to touchdown.

5.9 OBSTRUCTIONS

Not withstanding previous comments, should technology and procedures allow other than existing straight-in final approach segments to the Sydney runways, another constraining issue emerges in any event.

Approach paths to runways require that there be no obstructions penetrating a corridor underneath the flight path above an angle of 1:50 or 2% above the horizontal as measured from the end of the runway. This is an international requirement with obligatory compliance.

Building and mast construction along the approaches to the Sydney runways has been limited in the above manner by regulation and terrain has been suitable, as happens for other airports around the world. However no such constraints have been applied - nor have they needed to be - on similar developments in other sectors in the Sydney environs.

Accordingly it is unlikely that an unobstructed approach path would exist in other sectors, as high rise developments, communications towers and similar have been occurring there for at least the last 50 years. It is not feasible to pull buildings down and it is not acceptable to accommodate penetrations in the approach surface and still accommodate the instrument approach and its minima.

5.10 SHORT TAKE OFF AND LANDING OPERATIONS

Short take off and landing (STOL) landing operations are approved at some places, involving a steep Glide Path angle of up to 5.5º – twice as steep as conventional operations are required to be. London City Airport is an example where such operations occur.

However special aircraft only may execute steep approaches. These include types such as the Boeing (De Havilland) Dash-8 and British Aerospace 146. STOL operations and their steep approach profiles are neither feasible nor approved for conventional airliner operation.

Accordingly ‘high and wide’ operations are not deemed to be feasible for the majority of aircraft movements at Sydney in the context of items 5.8-5.10; however a small number of aircraft could theoretically operate ‘high’, with suitable facilitation and procedures, as described above.

5.11 METEOROLOGICAL CONSIDERATIONS

Meteorological conditions are not anticipated to vary greatly in the foreseeable future. Climatic changes are gradual and take place over millennia. However some periodic weather cycles are known to occur, such as the El Niño effect every three to seven years.

El Niño is the name given to climatic disarray caused by effects of warm ocean currents that periodically occur in the eastern Pacific Ocean. Atmospheric conditions are globally affected, causing unusual weather patterns resulting in droughts, floods, jet streams, storms and other variations in seasonal conditions including temperatures and winds.

Airservices Australia staff interviewed at Sydney remarked that meteorological conditions over the recent summer (2003-2004) had been ‘unusual’.

Long range weather forecasting at Sydney International Airport is obviously outside the scope of this study. It is reasonable to assume though that conditions for the next 50 years will average more or less what they have been for the last 50 years so. Global warming or a possible future ice age is not likely to have discernable affects over this time scale.

However improved precision approach systems, airfield lighting, surface movement guidance and control, instrumented runway visual range reporting, storm tracking, forecasting and weather observation, all automated and linked, will afford levels of information exchange and safety not enjoyed previously. In other than extreme conditions, aircraft will be unlikely to miss approaches due to low visibility and the like.

Local wind directions and speeds will likely average to what they have always been, although significant industrial developments such as coal-fired furnaces (not envisaged) can have a local effect on wind and turbulence.

Jet airliner takeoff, approach and landing speeds will remain about the same as they currently are and have been for fifty years. Aircraft will be similarly affected by crosswind and downwind as they are today. New ultra-large heavy aircraft types such as the Airbus A380 are designed to cope with similar meteorological conditions to other airliners (although wider runways and taxiways and larger gates may be required).

5.12 ENVIRONMENTAL FACTORS

Airlines, airport operators, air navigation service providers (ANSPs) and aviation regulators will all recognise that environmental considerations at Sydney International Airport have been legislated into Federal law and aircraft noise is a most serious issue affecting large numbers of residents in the suburban area. The consequence is that noise abatement can no longer be accommodated simply to the extent otherwise deemed practical.

Accordingly increasingly proactive measures must continue to be applied to implement LTOP, in particular during the noise sharing periods, but at other times as well, when possible – within regulated capacity, meteorological conditions and wind velocity allow, and safety is not compromised. Noise respite must be a consideration at all times.

Airservices Australia, the ANSP, has implemented certain structural, process, procedural, monitoring and reporting measures, to better manage LTOP compliance. In future, this could be further developed and enhanced with the expectation that some increase in LTOP compliance and noise sharing is possible; and in circumstances where this is not possible or at least self evident (for example say thunderstorms over the airport and demand of 70 movements an hour), then comprehensive journal entry and reporting be undertaken to explain why. Likewise, when a mode change can be implemented even if only for say an hour, for respite purposes, then journal entries similarly need to be more comprehensive, to assist subsequent analysis as appropriate.

6. POTENTIAL FOR INCREASING NOISE SHARING IN CORE PERIODS

6.1 INTRODUCTION

The “Core Periods” are between 7am - 11am, and 3pm – 8pm. During these hours the operating premise is that[18]:

> *Rwy 34 and Rwy 16 Parallel Runway operations should only be considered for use if required for traffic management purposes during the following hours:*
>
> *0700 to 1100 Monday to Saturday*
>
> *0800 to 1100 Sunday*
>
> *1500 to 2000 Sunday to Friday*
>
> *In order to take advantage of suitable traffic dispositions, variations to these times will occur.*

The expectation is that because these periods are those parts of the day with the higher demand (refer Figures 3.6 and 3.8) there will often be a “traffic management” requirement to use parallel runway modes, rather than noise sharing modes.

Based on 2003 traffic levels, a sample audit of detailed mode usage, correlated with demand and meteorological data indicated that (in the short term) there is potential for further use of noise sharing modes (RMO 5, 7, 14a) during the “core periods”, when demand is below the mode capacity.

The conclusions were based on relatively small samples covering each “season”, further detailed investigation is recommended based on larger samples.

A standard report with (sustained) hourly demand could facilitate monitoring of opportunities for increased noise sharing in core periods.

Similarly standard reports of (sustained) hourly capacity achieved in the noise sharing modes could be initiated to track actual performance versus theoretical capacity and opportunities to use these modes when demand is below achievable capacities.

6.2 ANALYSIS

RMO arrival capacity of noise sharing modes limits their use during the core periods, when hourly demand is generally at its highest.

Year 2003 arrival movements were summed for each hour on each day.

Arrival capacities for noise sharing modes 5, 7 and 14a are about 25, 27 and 26 arrivals per hour, respectively.

---

[18] Airservices Australia monthly reports Sydney Airport - Preferred Runway Selection, noted as effective from 28 November 2000

Figure 6.1 shows that for the core hour 7am to 8am, on some 20% of the days in 2003 the demand was less than the Mode 5 arrival capacity. If weather and other conditions were favourable, and it was judged that the mode could be sustained for a reasonable period, it may have been possible to use Mode 5 for say 60 days of the year. Mode 7, having a higher capacity than Mode 5, could have been used for almost 30% of the days during the core hour 7am to 8am if other conditions were conducive.

The overall average hourly arrival demand was below lowest noise sharing mode capacity (Mode 5 – 25 hourly arrivals) for 61% of core hours. For the morning core period this was 50% and for the afternoon core period this was 75%.

This analysis does NOT include consideration of meteorological conditions or other factors, which could significantly reduce the actual opportunities.

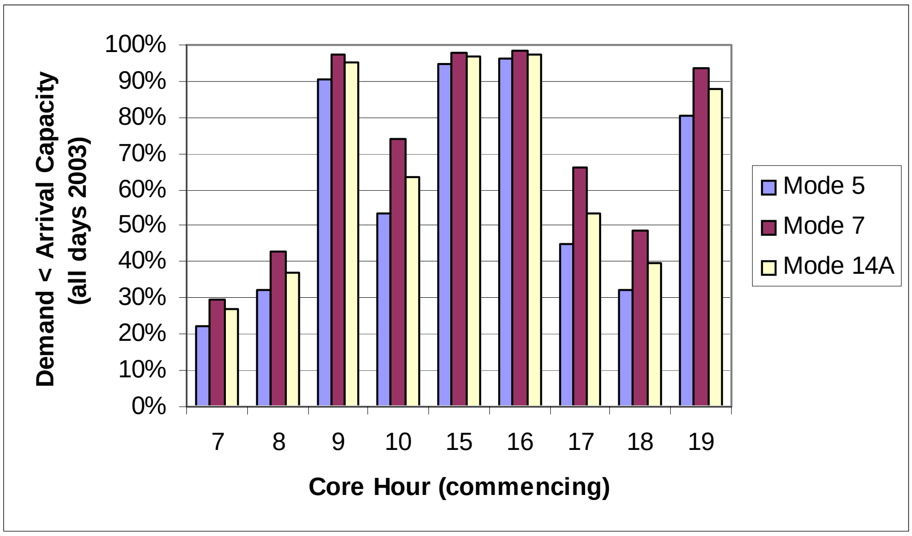


Figure 6.1 Hourly Arrivals and Departures – 2003 All Days

Sensitivity analyses shown in Figures 6.2 and 6.3 were carried out for the following cases:

- Capacities 15% less than Sabre
- 2003 Traffic +30%

These show that for 2003 traffic, if the actual noise sharing mode capacities achievable are 15% less than Sabre's original modelling then the average hourly arrival demand was below lowest noise sharing mode capacity (Mode 5 – 25 hourly arrivals) for 41% of core hours. For the morning core period this was 32% and for the afternoon core period this was 48%.

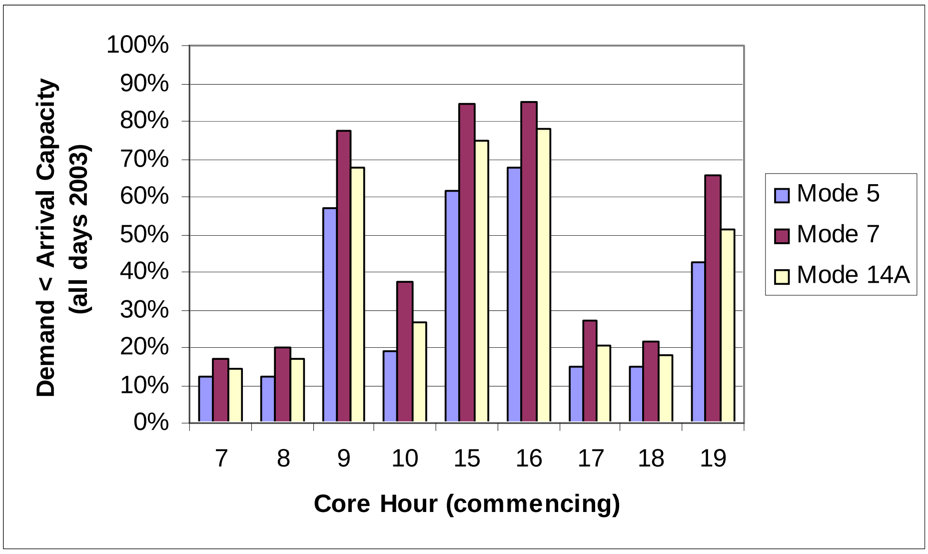


Figure 6.2 Lower Noise Sharing Capacities – 2003 All Days

On the other hand, for the assumed Sabre noise sharing mode capacities, if the demand increases by 30%, moving above the demand seen in the year 2000, then the average hourly arrival demand was below lowest noise sharing mode capacity (Mode 5 – 25 hourly arrivals) for 20% of core hours. For the morning core period this was 13% and for the afternoon core period this was 26%.

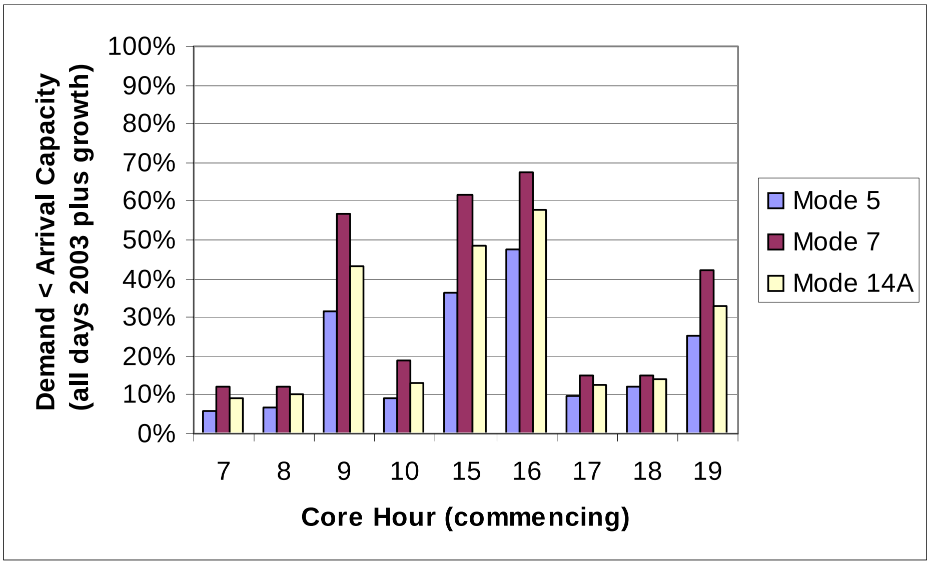


Figure 6.3 30% Higher Demand than 2003 All Days

The potential constraints to increasing the use of noise sharing modes during core periods include:

- Consideration of transitioning between modes[19] means that the analysis is potentially optimistic
- Actual capacities achievable /achieved in Modes 5, 7,14A need checking
- The weather dimension needs to be added to the analysis (accurate continuous readings of wind speed and direction and visibility).

It is suggested that this first cut in analysis should be used as a basis and future reporting should look at hours when noise sharing modes seemed an option, and identify systemic causes that mitigate – weather, capacity, other.

6.3 CONCLUSIONS

This simplistic analysis based on 2003 demand, indicated some potential scope in the short term, for further use of noise sharing in core periods, depending on the ease with which mode changes can be made, without causing undue delay.

Analysis at a more refined level could be warranted, including improved reporting and confirmation of actually achieved noise sharing mode capacities.

It is important to note, as shown in Figure 6.3, that the potential for further noise sharing in core hours, rapidly disappears as traffic grows, unless noise sharing mode capacities can be increased. It should be noted that 2003 demand was lower than that experienced in 2000 and may only indicate a temporary downturn due to the coincidence of a number of events depressing base demand, and traditional longer term growth. In such a case the further more refined analysis is not justified.

---

[19] It is understood that in periods of average to high demand it may take 20 minutes to set up the conditions to achieve a transition from one mode to another. This includes rerouting both ground traffic – taxiing departing aircraft to new operation runways in time for the proposed transition, and allocation of airborne aircraft to the approach paths for the arrival runways of the new runway mode of operation. Inevitably this will result in a temporary "loss of capacity", compared to remaining on the same mode. Frequent transitioning will also increase the controller workload and safety and human factors issues will determine what is a "reasonable" number of transitions between modes that should be made over any particular period. A decision to transition to a new mode is not made just on the immediate traffic that is presenting in the next 15 minutes, and the prevailing weather that is conducive to the proposed noise sharing mode, but the forward projection of demand over the subsequent period, and any uncertainty of the continued weather suitability of the proposed noise sharing mode.

7. OTHER ISSUES AND FINDINGS

It is understood that SACF accepts that all but two of the recommendations have now been implemented. The recommendations that have not been implemented are No. 17 – “the Trident Concept” and No. 2 – “High and Wide” flight paths associated with the modes of operation.

The consultant agrees that the Trident concept is not supported by present technology, and should remain under review for the longer term.

The consultant understands that the “High and Wide” flight tracks were studied extensively by IMC Task Force 2, and determined that there was no justification identified for a revisit of this (see also Sections 5.8 and 5.9).

In terms of the proposal put to IMC in relation to Fuel Advisory, the consultant comments that our understanding of the ATC responsibility is for advisory of possible delays (flight information service), but operational control is not. We agree that timely delay reporting from/to airlines could improve pilot decisions on contingency fuel.

The Consultant suggests that there is potential for some enhancements that Airservices Australia may consider in the following areas:

1. Mode Sharing Guidelines

   Development of more comprehensive guidelines on noise sharing parameters and reasons, rather than simply mode priorities.

2. Justification

   Guidelines could include parameters that warranted mode change for noise relief purposes. For example, where demand and conditions allowed, a change to another suitable mode that could be sustained for at least one hour might justify the exercise.

3. Controller Acquaintance

   Ongoing controller acquaintance regarding the changed legal environment governing operations at Sydney airport and the imperative to tailor conventional practices to accommodate increased noise sharing solutions.

4. Journal Entries

   Some journal entries are comprehensive, and need no further explanation while some other entries are less so, for example; “Reason for Delay: Wind” and “Explanation Wind and Weather if LTOP is not used at 11.00: 030/12” in one entry. These conditions may well affect operations but do not sufficiently explain why an LTOP mode could not otherwise be used.

   Improved journal recording, including comprehensive reasons for/not implementing mode change, for either noise sharing or relief, in core hours or LTOP hours is appropriate. Entries such as ‘due traffic’, or ‘due weather’ may not constitute an adequate level of information for third parties to review and monitor.

The use of codes (similar to those used for on-time performance monitoring by airlines) could make it easier to spot trends and further investigate and correlate with potential underlying causes.

5. Assistant to Traffic Manager

   If the Traffic Manager position is unable to exercise more comprehensive attention to noise sharing reporting issues (perhaps not unreasonably, due to other importing watch keeping duties) then consideration should be afforded to assignment of an administrative assistant for such purposes.

8. CONCLUSIONS

The overall implementation as reviewed in this study and within the terms of reference was considered reasonable considering process complexity

There are no simple solutions to improve LTOP noise sharing within the constraints of:

- Priorities of safety, capacity and noise sharing
- Airport and flight path locations relative to city
- Layout of airport
- International, domestic and regional role of the airport
- Demand and mode capacities
- Weather patterns
- Differing stakeholder issues and requirements.

Many service organisations with performance goals will use incentive systems for operational staff to meet continuous improvement targets. It is considered that there may be significant difficulties in applying this to air traffic controllers (and pilots) in relation to LTOP targets. Appropriate precedents of successful implementation in comparable industries where the primary service provided is safety (in the case of air traffic control – the adequate separation of aircraft at all times during all processes) in a potentially hazardous environment and the performance goals may increase risk.

On the other hand it is considered that there is always room for improvement in the information provided to the Implementation Monitoring Committee (IMC) to assist it in fulfilling its role.

There is clear evidence of this occurring since the initial implementation of LTOP. Recent improvements include the introduction of the daily mode usage charts, and the addition of the journal entries providing an indication of the reasons noise sharing modes could not be used or sustained over specific periods.

There must remain a balance between micro and macro reports and monitoring, including a range of exception reports and trend (long-term) analysis, codes for noise sharing modes not used.

If these are maintained in a standard format and there is clearer correlation of movement data and short interval meteorological data, this could be of assistance in understanding daily mode usage, and seasonal and annual trends.

Scrutiny of these reports by the Airservices Australia management with direct LTOP implementation responsibilities, the SACF IMC and its technical support staff, will permit them to form a view on achieved and achievable noise sharing mode capacities and monitor demand and usage against these.

Future trends in terms of increased demand, without any clear technical or operation opportunities for noise sharing mode capacity increases will likely reduce the opportunities for increased noise sharing in core periods.

Other issues and findings are:

- The Trident concept is not supported by present technology, but may remain under review for the longer the term.
- The High and Wide concept was rejected by IMC Task Force 2, and it is agreed that there is no justification identified for revisit.
- Advisory of possible delays (flight information service) is considered an ATC responsibility, but operational control is not. However, timely delay reporting from/to airlines could improve pilot decisions on contingency fuel.
- There is still scope for improved reporting, including more comprehensive journal entry explanations for non-use of LTOP mode that would be of benefit to Airservices Australia and the IMC.

APPENDIX A
ABBREVIATIONS AND ACRONYMS

APPENDIX A – ABBREVIATIONS AND ACRONYMS

Acronym	Term
ANEC	Australian Noise Exposure Concept
ANEF	Australian Noise Exposure Forecast
ANSP	Air Navigation Service Provider
AsA	Airservices Australia
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
BARA	Board of Airline Representatives of Australia
CASA	Civil Aviation Safety Authority
CTMS	Central Traffic Management System
DOTARS	Department of Transport and Regional Services
FANS	Future Air Navigation Systems
FMS	Flight Management System (on board an aircraft)
GPS	Global Positioning System (satellite based navigation aids)
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
IMC	Implementation Monitoring Committee
LLZ	Localiser (ground based navigation aid)
LTOP	Long Term Operating Plan (for Sydney Airport and associated airspace)
MAESTRO	A software based sequencing tool
METARs	Meteorological Aviation Reports
MLS	Microwave Landing System (ground based navigation allowing curved approach)
N70	Noise metric of number of movements above 70 dBA at a point
PANS-OPS	Procedures for Air Navigation Services – Operations
RNP	Required Navigation Performance
RVSM	Reduced Vertical Separation Minima
SACF	Sydney Airport Community Forum
SID	Standard Instrument Departure (flight track)
SODPROPS	Simultaneous Opposite Direction Parallel Runway Operations
STAR	Standard Terminal Arrival (track)
STAR	Standard Instrument Arrival (flight track)
STOL	Short Take-off and Landing (aircraft capability)
TARDAS	The Advanced Runway Decision Advisory System:

APPENDIX B
TERMS OF REFERNCE

<u>Tender Brief/Specification</u>

Assessment of the performance of the Sydney Airport Long Term Operating Plan (LTOP)

1. <u>Introduction</u>

1.1 The LTOP Review Subcommittee of the Sydney Airport Community Forum (SACF) is seeking tenders for the provision of advice on the performance of the Sydney Airport LTOP.

1.2 Following the commencement of operations on the third runway at Sydney Airport, the then Minister for Transport and Regional Development issued a Ministerial Direction on 20 March 1996 to Airservices Australia which provided the principles under which LTOP would be developed and operate.

1.3 The basic principles under which LTOP has been developed are:

- all three runways at the Airport, including the full length of the east-west runway, are to be available for use by jet and propeller aircraft
- maximum use is to be made of flightpaths over water and non-residential areas
- the capacity of the Airport is to be maintained to the maximum practicable extent but the programmed movement rate is not to exceed 80 movements per hour
- the safety of aviation operations is not to be compromised.

2. <u>Background</u>

2.1 The LTOP Review Subcommittee established by the Sydney Airport Community Forum (SACF) is conducting a review of the LTOP. SACF requested that an appropriately independent external consultant be employed to support its work to investigate and report on each of the basic elements of LTOP, with the aim of contributing to an assessment of the LTOP performance to date. The investigation is to identify reasons for the "noise sharing modes" not being used more often and to identify whether the constraints can be overcome.

2.2 Terms of Reference have been developed to ensure that the review is focussed and will deliver an effective outcome. The Terms of Reference were submitted by the SACF Chair to the Minister for Transport and Regional Services. The Minister has agreed to the proposed Terms of Reference. It should be noted that the principles of LTOP as described above are fixed and are not negotiable.

2.3 In accordance with the Terms of Reference agreed to by the Minister, the objectives of this review are to:

- Determine the level of noise sharing being achieved in separate noise sharing periods;
- Examine the modes that are being used in these periods to ascertain the constraints;
- Assess what can be done to overcome the constraints;
- Ascertain likely future trends; and
- Examine the potential for increasing noise sharing in the core periods.

2.4 Also, in accordance with the agreed Terms of Reference, the review of LTOP will focus, in the first instance, on the nominated 'noise sharing hours' to identify the potential to increase the use of noise sharing modes during these periods, before a subsequent review of 'peak periods' is undertaken. Constraints on the use of noise sharing modes may include environmental and safety factors, as well as current technology used by airlines and Airservices Australia.

3. Scope of the Requirement

3.1 The review will focus on examining the basic elements (such as noise sharing periods, the modes, constraints, and ascertaining future trends), how they can be optimised and if any constraints can be reasonably overcome. The review seeks to identify the actual reasons for the current use of noise sharing modes.

4. Statement of Objectives

4.1 The fundamental objective of the Consultant is to assess and advise the LTOP Review Subcommittee on the operation of LTOP as described in the scope of work.

5. Scope of Work

5.1 The Consultant will undertake relevant inquiries and prepare a report for SACF dealing with the operation of LTOP in respect of:

- the level of noise sharing being achieved in separate noise sharing periods;
- the usage of the modes that are utilised in noise sharing periods and ascertaining the operational constraints;
- assessing what can be done to overcome or mitigate the above constraints;
- assessing likely future trends; and
- assessing the potential for increasing noise sharing in the core periods.

5.2 The Consultant will prepare the report described above in a timely manner for consideration by the LTOP Review Subcommittee of SACF.

APPENDIX C
PREFERRED RUNWAY SELECTION

Sydney Airport
Preferred Runway Selection

Effective from 28 November 2000

Monday to Friday		
2300 to 0600	**1.**	**Curfew – Departures 16R/Arrivals 34L (Mode 1)**
0600 to 0700	**1.**	**SODPROPS** - Departures **16L** / Arrivals **34L**
	2.	Departures **34R, 25 & 34L** / Arrivals **34L&R** *(Mode 8)*, ***or*** Departures **25** / Arrivals **34L&R** *(Mode 7)*, ***or*** Departures **16L&R** / Arrivals **25** *(Mode 5)*, ***or*** Departures **16L&R** / Arrivals **07** *(Mode 14A)*
	3.	**34** *(Mode 9)* or **16** *(Mode 10)*
	4.	**07** *(Mode 12)* or **25** *(Mode 13)*
0700 to 2245 / 2300	**1.**	**SODPROPS** - Departures **16L** / Arrivals **34L**
	2.	Departures **16L&R** / Arrivals **07** *(Mode 14A)*, ***or*** Departures **34R, 25 & 34L** / Arrivals **34L&R** *(Mode 8)*, ***or*** Departures **25** / Arrivals **34L&R** *(Mode 7)*, ***or*** Departures **16L&R** / Arrivals **25** *(Mode 5)*
	3.	**34** *(Mode 9)* or **16** *(Mode 10)*
	4.	**07** *(Mode 12)* or **25** *(Mode 13)*
2245 to 2300	**1.**	**SODPROPS** - Departures **16L&R (Mandatory)** / Arrivals **34L**
	2.	Departures **16L&R** (Mandatory) / Arrivals **34L** *(Mode 4)* ***unless*** there would be significant delays to either departing or arriving aircraft ***or*** traffic complexity requires a variation ***or*** weather conditions preclude the use of 34L.
	3.	Departures **16L&R** / Arrivals **25** *(Mode 5)*, ***or*** Departures **16L&R** / Arrivals **07** *(Mode 14A)*
	4.	**16** *(Mode 10)*

Rwy 34 and Rwy 16 Parallel Runway operations should only be considered for use if required for traffic management purposes during the following hours:

0700 to 1100 Monday to Saturday

0800 to 1100 Sunday

1500 to 2000 Sunday to Friday

In order to take advantage of suitable traffic dispositions, variations to these times will occur.

20 knot crosswind and 5 knot downwind criteria apply to all dry runway conditions

This is not an operational document. It has been prepared for information purposes only and is subject to change without notice.

Saturday and Sunday		
2300 to 0600	**1.**	**Curfew – Departures 16R/Arrivals 34L (Mode 1)**
0600 to 0700 Saturday *0600 to 0800 Sunday*	**1.**	**SODPROPS** - Departures **16L** / Arrivals **34L**
	2.	**Curfew Act -** Departures **16L&R**/Arrivals **34L***(Mode 4)* ***unless*** there would be significant delays to either departing or arriving aircraft ***or*** traffic complexity requires a variation ***or*** weather conditions are not suitable
	3.	Departures **16L&R** / Arrivals **25** *(Mode 5)*, ***or*** Departures **16L&R** / Arrivals **07** *(Mode 14A)*, ***or*** Departures **34R, 25 & 34L** / Arrivals **34L&R** *(Mode 8)*, ***or*** Departures **25** / Arrivals **34L&R** *(Mode 7)*
	4.	**34** *(Mode 9)* or **16** *(Mode 10)*
	5.	**07** *(Mode 12)* or **25** *(Mode 13)*
0700 to 2200 Saturday *0800 to 2200 Sunday*	***1.***	**SODPROPS** - Departures **16L** / Arrivals **34L**
	2.	Departures **16L&R** / Arrivals **07** *(Mode 14A)*, ***or*** Departures **34R, 25 & 34L** / Arrivals **34L&R** *(Mode 8)*, ***or*** Departures **25** / Arrivals **34L&R** *(Mode 7)* ***or*** Departures **16L&R** / Arrivals **25** *(Mode 5)*
	3.	**34** *(Mode 9)* or **16** *(Mode 10)*
	4.	**07** *(Mode 12)* or **25** *(Mode 13)*
2200 to 2245	***1.***	**SODPROPS** - Departures **16L** / Arrivals **34L**
	2.	Departures **16L&R** / Arrivals **34L** *(Mode 4)* ***unless*** there would be significant delays to either departing or arriving aircraft ***or*** traffic complexity requires a variation ***or*** weather conditions are not suitable
	3.	Departures **16L&R** / Arrivals **25** *(Mode 5)*
	4.	Departures **16L&R** / Arrivals **07** *(Mode 14A)*
	5.	Departures **34R, 25 & 34L** / Arrivals **34L&R** *(Mode 8)*
	6.	Departures **25** / Arrivals **34L&R** *(Mode 7)*
	7.	**34** *(Mode 9)* or **16** *(Mode 10)*
	8.	**07** *(Mode 12)* or **25** *(Mode 13)*
2245 to 2300	***1.***	**SODPROPS** - Departures **16L&R (Mandatory)** / Arrivals **34L**
	2.	Departures **16L&R** (Mandatory) / Arrivals **34L** *(Mode 4).* The arrivals runway (34L) may be varied if there would be significant delays to either departing or arriving aircraft ***or*** traffic complexity requires a variation ***or*** weather conditions preclude the use of 34L. Departures **16L&R** / Arrivals **25** *(Mode 5)*, ***or***
	3.	Departures **16L&R** / Arrivals **07** *(Mode 14A)*
	4.	**16** *(Mode 10)*

APPENDIX D
SUMMARY OF CONSULTATIONS

APPENDIX D – SUMMARY OF CONSULTATIONS

SACF, through the Department of Transport and Regional Services (DOTARS) required that community input, through community representatives on SACF be part of the study process. These consultations are summarised in Table D1 below.

Table D.1 Summary of Consultations

INDUSTRY	
Airservices Australia	Initial extensive briefing Detailed technical consultations over 1 week Requests for data and replies Telecon Tom Grant
Airlines/BARA	Meeting with airlines in Sydney Position paper provided by airlines Phone call with BARA – W Bennett Phone message left with Rex Written submissions by airlines
Sydney Airport	Discussion with Ken Alcott Review of Master Plan and SACF submission Request for data – demand and capacity, supplied demand data, runway capacity referred to Airservices
Airline Coordination Australia	Meeting with E Krolke on slot allocation
COMMUNITY	
SACF Reps	Email sent to all members (addresses provided by DOTARS) Long meeting with J Clarke Telecon with M Patrinos (to provide written notes) Telecon with K Hill (to provide written notes) Technical meeting with advisor J Ludlow (including 3 reports) Response from Minister S Nori Brief Submission by Mayor Cr P Blight, with request to contact Council's Environmental Scientist Telecon with R Balzola representing J Murphy MP
Community Groups and individuals	Letter sent to all names on list provided by DOTARS. Replies: P Lingard (SACF Inc) – CD-Rom with 300 page document Letter from R and C Patton Letter from G Craig Letter from A Albanese MP Letter from J Barros (Leichhardt Airport & Urban Environment Research Group) Letter from G Church Submission from Mr D Shrubb

All SACF community representatives were contacted by the consultant by email early in the study, inviting them to provide input. Meetings were held with Mr Clarke and Mr Ludlow (as a technical adviser to the community); and telephone consultations with Ms Patrinos, Mr K Hill, Mr R Balzola (on behalf of J Murphy MP). Material was received from SACF Inc.

Subsequent to the presentation to SACF of the preliminary finding additional submissions were received from the airlines and from Mr D Shrubb.

A summary of the key technical issues of direct relevance to this study from these consultations are summarised below (direct reference to who provided the comment was not considered necessary). The consultant considered these issues, where appropriate, during the course of investigations and analysis. Some initial relevant comments are also added below. Findings are contained in the body of the report.

- The targets to the North in terms of Runway End Usage have never been met.

  This is addressed in Sections 2 and 3 of this report.

- Concern was expressed about the time taken for implementation of changes (improvements).

  While we have not specifically addressed this issue, our opinion is that complex operating procedures for a major international airport will always require a long lead time for implementation, from a political, organisational and technical perspective. Our observation is that, within the well defined parameters of LTOP, there are demonstrable steps that have been taken to improve and refine the operational implementation, even if there is difficulty in measuring demonstrable outcomes.

- It was suggested that there could be improvements to the reports prepared by Airservices Australia, making it easier to understand the cause and effect in terms of runway mode usage reporting (eg a graphic correlating wind, hourly demand, and mode usage).

  We agree that there should be a process of continuous improvement to reporting, including some experimentation with format and content, to facilitate ease of understanding of a very complex issue.

- There was interest in using technology to increase the range of arrival tracks available (particularly for Runway 34R) to further spread aircraft and share noise.

  It is understood that this issue is being examined by IMC Task Force 3.

- There was interest in increasing the "granularity" of runway end usage reporting. Rather than using four quadrants (North, South, East, West), it was thought that using 8 sectors (eg N, NE, E, SE, S, SW, W and NW) would provide a better picture of the extent of noise sharing. As a case in point the departure track from runway 16L which immediately turns to the west is reported in the statistics as a Northern movement, even though the flight tracks are predominantly over the western suburbs, not those on the approach to runway 34R which are of most concern to these communities.

It is understood that Airservices Australia have recently provided a sample monthly report to IMC demonstrating the magnitude of change if these tracks were reported in the Western quadrant not in the Northern quadrant.

- A view was expressed that more information should be provided on the noise insulation programme, including financial accounting of moneys collected, expended, forward programme and when the insulation programme will be reviewed.

  Consideration of the noise insulation programme is considered to be outside the direct scope of this study and has not been commented on further. There could, of course, be implications if significant changes were made to flight paths or route densities in terms of eligibility for noise insulation.

- One community group submitted that the long term sustainability of LTOP with higher movement rates, the 80 cap is set too low, the long term solution is relocating to an alternative site (eg Wilton)

  The setting of the 80 cap and the issue of airport relocation is outside the scope of this review. The opportunities for noise sharing in the future are addressed in Section 5 of this report.

- The airlines industry submissions related to:

  "The inability to meet specific runway end targets, has led to broader questions surrounding how LTOP is managed, both at the strategic and tactical levels."

  "The industry remains committed to its responsibilities surrounding LTOP and has clearly suffered the direct economic consequences of the adoption of LTOP and other government directives surrounding the use of Sydney (e.g. Movement Cap, Runway use, Flight Path Design). As such, the industry does not support any measures to expand LTOP by way of mandating runway mode changes at specific times of the day and its consequences for carriage of fuel and scheduling."

  The significance of the draft findings as presented by the Consultant to SACF, especially the efficacy of the processes used by Airservices in mode selection in accordance with LTOP principles, that there is no single panacea that would address the conflicting issues inherent within LTOP and industry opposition to a variable cap as a mechanism for inclusion in LTOP due to the immense impact it would on the commercial viability of the industry.

APPENDIX E
LTOP RECOMMENDATIONS (1996) AND IMPLEMENTATION

APPENDIX E – LTOP IMPLEMENTATION SCHEDULE

Source - IMC - February 2003 as provided by Airservices Australia

No	Recommendation	Ministers Response	Implementation Progress
1	Proposed Runway Modes of Operation 1,4,5,7,8,9,10,12,13,14A Modes 9,10,12,13 – should continue under LTOP because of the requirements dictated by weather conditions. Curfew legislation requires that Mode 1 continue to be used during 2300 to 600 daily Modes 4,5,7,8 and 14A should be included in LTOP to maximise flights over water and fairly share unavoidable noise over residential areas.	The available modes of operation be available for use as described in Airservices report.	Implemented. Modes 1,4,5,7,9,10,12,13,14A introduced in 1996/97. Mode 8 introduced in 1999 although complexity of operation has resulted in limited use. Mode 6A safety and environmental assessment has been completed and considered by the IMC. The IMC agreed that mode 6A delivered no additional benefit over the other modes available and due to its inherent complexity should not be progressed. The SACF considered this mode at it September 2002 meeting and agreed “That Mode 6A be held in abeyance at the present time”.
2	Flight paths associated with the recommended modes of operation and shown in maps accompanying each mode be adopted as the flight paths to be used in the SY TMA (within 45Nm of SY APT) for the period of LTOP.	The general structure and layout of the flight paths shown in the maps in the Airservices report be adopted with the amendments indicated in the paper entitled ‘Flight path maps and notes’.	Departure flight paths implemented by December 1997. Extensive simulation and design work undertaken between March to August 1997 indicated arrival flight paths for high and wide would mitigate against flexible mode operation. High and wide was further investigated by an IMC Task Force that reported to the IMC in Feb 03. The findings of the report were unanimously endorsed by the IMC, being, inter alia, that the community and industry do not support the introduction of the high and wide flight paths as documented in LTOP.
3	Discontinue those current noise abatement requirements which mandate changing to, or continuing the use of, runways 16L & R for arrivals and departures when there is up to 5 kts downwind.	Recommendation be adopted	Implemented. New runway selection criteria introduced in 1997 - since modified by post implementation review to ensure as far as practical equal preference for 16 and 34 directions in parallel and mixed mode operations.
4	Adopt new runway selection criteria to: Give preference to over the water operations, mode 4, to minimise residential overflights Restrict the dedicated use of the east west runway, modes 12, 13, to circumstances when weather requires the use of these modes. Interchange use of the other modes to ensure a fair sharing of unavoidable aircraft noise subject to weather and traffic demands.	Recommendation to be adopted	Implemented. New runway selection criteria introduced in August 1997 and single east west runway operations to last preference. Implemented the preference table in LTOP. Safety case for use of mode 4 outside of curfew hours completed in February 1998 Revised mode priority list implemented in April 1998 with mode 4 highest preference in non curfew hours. SODPROPS safety case prepared and reviewed by BASI (Dec 1998). An independent review of the use of SODPROPS being conducted by Airservices during early 2003 for report to the IMC in June 2003.

No	Recommendation	Ministers Response	Implementation Progress
5	Modes of operation should be changed throughout each day when traffic and weather conditions permit, to provide respite from noise affecting residents in different areas. Changes should not be more frequent than every 4 hours unless required for operational or weather reasons. The preferred times for mode changes are 1030, 1600 and 2000. Other times when mode changes could occur are: End of curfew mode Around 7.30 on weekdays to enable parallel operations to handle peak traffic demands When weather changes dictate As traffic delays increase and a change of mode will better sustain projected traffic levels In preparation for curfew.	The system of runway rotation proposed by Airservices be adopted to provide periods of respite and to assist in the equitable sharing of noise and this system be refined as necessary to assist in the achievement of noise sharing goals.	Implemented. New runway selection criteria introduced August 1997. Change period parameter of 2 hours retained to improve flexibility. Actual change times are later due to traffic demand and profile. Revised management instructions issued to ATC Jan 1998 as a result of experience with crossing runways including: Removal of specific traffic demand limits on the use of modes Removal of the 2 hour rule Reinstatement of standard AIP cross wind and down wind criteria for runway selection. Additional measures to decouple BK and KSA traffic for greater use of modes 5 and 14A.
6	Because of the complexity of the proposed changes and the time needed to optimise the capacity of the over water mode and the modes using 3 runways, initial operations under LTOP should not include mode 8. Mode 8 should be included in LTOP if experience indicates that it would contribute to the plans objectives. While it is desirable that mode 8 not be used in the initial stages, documentation covering its operations, requirements and flight paths would be included in the implementation plan. This would allow its use late if monitoring and operational experience indicated that adjustments were required to modes and such adjustments could not be achieved satisfactorily with only the other 9 modes.	Recommendation be adopted	Implemented. Mode 8 introduced in December 1999. Use of mode 8 limited due to complexity of on ground movements and adverse impacts on movements to the east. In practice, mode 8 does not produce any benefits over mode 7 which is a less complex mode of operation. The expected capacity increase for mode 8 (over mode 7) was not realised due to the complexity of mode 8 operations.
7	A runway selection procedure be in introduced to facilitate fair sharing of impact of aircraft noise. The procedures for runway use to achieve this objective are detailed in chapter 6.	Recommendation be adopted	Implemented. Chapter 6 recommendation implemented in August 1997 except for mode 4 in other than immediate post curfew hours – April 1998. Revised mode management procedures introduced in Jan 1998 reduced the need for demand response mode changes.
8	Improvements to ATC equipment as identified in this report or during implementation should be carried out as a matter of priority so that the projected short term capacities of each mode can be realised.	The necessary infrastructure enhancements, including rapid exit taxiways and the relocation of the landing threshold of R16L be progressed to ensure that achievement of the gaol of the plan is not compromised.	Implemented. Tower communications modified to provide support for an aerodrome control co-ordinator to help alleviate the complexity of on ground movements. Central traffic flow management tool introduced – CTMS. Taxiway infrastructure completed. Threshold of 16L extended Movement of R25 threshold completed and ILS installed and commissioned in Sep 01.

No	Recommendation	Ministers Response	Implementation Progress
9	Implementation and Monitoring Committee be established to oversight implementation of LTOP and report on its effectiveness.	IMC be established.	Implemented. IMC established and meetings ongoing.
10	Flight corridors to the south should be repealed to allow alternative departure tracks from runway 16R which would enhance the capacity of simultaneous opposite direction parallel operations over Botany Bay by allowing left turns through the Heads from runway 16R to achieve separation with traffic approaching to land on runway 34L. The current Air Navigation regulations require jet aircraft to fly within, and not deviate from, the appropriate designated flight corridor for a specified runway. This means jet aircraft departing from runway 16R with a left turn through the Heads would breach the current regulations.	A decision to be deferred pending the provision by Airservices of information supporting the need for the proposal.	No action by Airservices
11	It is recommended that on shift management of procedures and staff resources be enhanced to satisfy the objectives of the Noise Management Plan, focussing authority and accountability of Air Traffic Services staff to a core position. It is intended that the new function will result in improved overall coordination and responsibility for interaction between Tower and TCU.	Recommendation supported	Implemented. Traffic Manager position created with responsibility for improved co-ordination between the TCU and Tower and for taking a stronger managerial view of traffic management objectives and LTOP.
12	Consideration be given to allowing aircraft departing 16R during the curfew to turn left and track over water through Botany Bay Heads to provide separation assurance with arriving traffic and enhance safety of operations.	Recommendation not accepted.	
13	That a study be undertaken to assess when aircraft require to operate on the long runway to provide the IMC with accurate data to adjust the plan in the interest of maximising respite periods.	The IMC be requested to oversee a study into the patterns of runway use of long haul aircraft.	Off mode operations recorded and discussed extensively at IMC and SACF during 2000/01. Discussions with operators on off mode operations and an off mode report is prepared and provided to IMC as required.
14	That DoTRS consider the impact of cluster scheduling on the availability of LTOP modes.	This issue has already been addressed by the 1 April 1997 announcement on proposals for a slot system for the airport.	No action required of Airservices.
15	That where traffic levels and disposition allow, Runway 34L be the preferred runway for arriving traffic when runways in that direction are in use.	This recommendation be supported in principle subject to it assisting and not detracting from attainment of noise sharing goals.	Use of 34L to 34R is currently around 2:1. 34L only arrivals (mode 9A) implemented on Saturday afternoons and during other low traffic periods. Use of 34L only operations reported to each meeting of the IMC.
16	Following concerns expressed during the public consultation process it is recommended the West Pymble locater beacon be removed from service.	The West Pymble beacon be removed from service at the earliest possible time.	Implemented. Removed Sept 1997.
17	That arrival flight paths to the north of the airport (known as the trident – refer chapter 4,5) be further refined during the implementation phase to reduce the	The recommendation be accepted in principle and that the proposal be referred to the IMC.	Revised noise abatement procedures designed to diversify arrival flight paths to runway 16R in visual conditions. Considerable amount of work on the

No	Recommendation	Ministers Response	Implementation Progress
	concentration of air traffic on R16 localiser tracks.		trident concept undertaken by the IMC and LTOP technical group. Conclusions were that procedure could only be carried out in VMC and would require the significant majority of flights to be equipped with FMS operated equipment for it to be viable. Introduction of trident was investigated as part of the IMC Task Force study. It concluded that technology required to spread arrival flight paths to runway 16 has not been certified for precision approaches and is not likely to be for some time.
18.	That consideration be given to the provision of an ILS on R25 to enhance the availability of the preferred operation modes.	No decision be made on this recommendation until the costs and benefits of this proposal have been fully evaluated.	Implemented. Study demonstrated that the use of mode 5 would be sensitive to small changes in the acceptability of R25. ILS installation complete. Glide slope commissioned in Sept 2001.
19	Noise abatement climb procedures be standardised for all runways and that an assessment be made to determine whether the ICAO A or B be mandated for all jet operations.	An assessment into the noise exposure benefits of the two ICAO departure procedures be undertaken by the IMC	Implemented. Use of ICAO A departure procedures mandated for departures from 34L & R, 07 and 25.
20.	That as part of the implementation process consideration be given to the proposal that propeller aircraft departures on R34L be commenced no further north than taxiway B10.	Recommendation 20 be deferred for IMC discussion.	This is essentially current practice for most propeller aircraft.
21	That following the implementation of new arrangements ANEI contours be produced on a quarterly and 12 monthly basis.	The recommendation be accepted and that the first quarterly ANEI be produced for the quarter immediately following the introduction of the stage 1 procedures	Implemented.
22	That after 12 months of stable operations an ANEF be produced in order to provide business and the community with appropriate data on long term land use planning.	An ANEF be produced for the airport as soon as possible to provide robust forecasts on further traffic movement patterns, but in any case ANECs be updated on a 6 monthly basis.	SACL is currently developing a Master Plan for Sydney Airport. This will contain an ANEF.
23	That the IMC further progress equitable noise sharing refining an agreed set of criteria and target values developing a practical and publicly accountable monitoring process establishing an agreed mechanism for informing ATC on current outcomes in relation to targets.	The IMC monitor runway use, distribution of noise and periods of respite on an ongoing basis in order to provide information which will enable the community to assess the impacts of the airport.	Implemented. IMC review statistics at each meeting including data showing respite across noise affected areas.
24	That there be an appropriate process established for keeping the community informed on the distribution of noise.	The public will have access to the IMC. A key task for the committee will be to examine and advise on viable systems for the dissemination of monitoring information.	Implemented. Monthly statistical report prepared.
25	That the location of 12 permanent noise monitoring terminals be reviewed for their appropriateness in light of the new LTOP arrangements.	Recommendation supported.	Implemented. Location of noise monitors are reviewed by IMC and SACF.
26	A program of short term deployment of portable noise monitors be developed to provide data to residents in areas where	Recommendation supported	Monitoring program developed by SACF. Airservices undertook a hand held noise monitoring program of locations

No	Recommendation	Ministers Response	Implementation Progress
	significant problems are identified.		suggested by SACF, from Sept to Dec 2001 and a second program during the early part of 2002. The position of noise monitors is regularly discussed by IMC.
27.	That a formal safety analysis of the proposals for the LTOP be undertaken prior to implementation and that an independent review of safety issues by an independent third party with international expertise be undertaken.	Recommendation supported.	Implemented. Formal safety case prepared. Separate safety case for SODPROPS done. PRAXIS Critical Systems of UK engaged to review safety case and provide recommendations that were implemented. Further report and recommendations by BASI in 1998 following incidents. Recommendations implemented.
28.	Detailed simulation and evaluation of alternatives to be undertaken to the departure track to the south of the 163 VOR radial to determine the benefits of a change to Cronulla residents. To include: Initial departure tracks between runway heading and the 163 VOR radial Departure on the 163 VOR radial with a left turn at 5 DME to intercept 150 VOR radial Southern jets departing from R16L and tracking on 126 VOR radial through BBH.	Recommendation is accepted	Complex departure procedure not supported by CASA. Other alternatives adversely affect Kurnell. IMC developed a modification to the DEENA SID that provides benefits to Kurnell and Cronulla residents.
29	Aircraft tracking from Sydney to Bankstown during the curfew period 2300 to 0600 be tracked at 3,000ft via non populous areas of the Royal National Park and Holsworthy military areas to reduce noise over suburbs.	Recommendation accepted	Implemented.
30	Further simulation and development of practical departure tracks to the east of R07 and 34R be undertaken to establish a track that is not the reciprocal of R25 arrival track.	A new flight path be introduced to the south of Coogee so that areas under the arrival flight path for R25 are not, as far as practicable, overflown by operations to the east.	Implemented.
31	Airservices and military forces enable implementation of the in principle agreements for changes to military airspace surrounding Sydney through the Air Coordinating Committee.	Recommendation accepted.	Implemented. Airservices took responsibility for ATC services for Richmond and associated restricted areas in 1997. Navy firing areas East of Sydney were abolished. Transit of the Williamtown restricted airspace is now facilitated by a Civil Jet Corridor services to new ATS routes to the north.