THE WAY FORWARD FOR AIRCRAFT NOISE SHARING AT SYDNEY (Kingsford Smith) AIRPORT

-THE SACF Inc REVIEW OF LTOP 1997-2003

VOLUME 2 APPENDICES

SYDNEY AIRPORT COMMUNITY FORUM INC (C) 2003

<u>Convening Editor</u>: Philip S. Lingard

ISBN - 0-9751843-4-2 (pbk); 0-9751843-5-0 (pdf)

ANOTHER PAPER PRODUCED BY SACF Inc TO ASSIST WIDE-SPREAD COMMUNITY DEBATE ON THE PERFORMANCE OF THE GOVERNMENT'S "FAIR-SHARE" NOISE PLAN [LTOP] AND FLIGHT PATH AFFECTATION UNDER SYDNEY AIRPORT'S MASTER PLAN

SYDNEY AIRPORT COMMUNITY FORUM INC

Published by SYDNEY AIRPORT COMMUNITY FORUM INC
P.O. Box 104 Summer Hill NSW 2130, Australia

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Printed in Australia

[1] Contributors : See Appendix A

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APPENDIX A ABOUT SACF Inc

Sydney Airport Community Forum Inc (SACF Inc) was formed in 1998 as an open non-party-political forum representing airport community groups across the whole of greater Sydney from Randwick to the Blue Mountains, and from Hornsby to Sydney's south-west extremities. It was established as an alternative to the government-appointed committee of a similar name that is not representative of all the communities affected by aircraft noise and pollution.

In July 1999 SACF Inc produced a position paper on Sydneys' airports predicament entitled ***"The Way Forward from Sydney's Airports Quagmire"*** and has undertaken considerable lobbying of Government and opposition MPs to propose improvements to airport policy and flight path planning.

SACF Inc does not believe that a second airport at Badgerys Creek will significantly alleviate the suffering for inner city residents, because it will only further complicate the already tortuous flight paths over Sydney resulting in increased low altitude, hence noisy, flying. It has proposed that government reconsider sites in the near southern highlands as possible venues for a new primary or replacement Sydney Airport.

SACF Inc is lobbying Government to address the lack of Protective Legislation for people exposed to aircraft noise, and has suggested that a mandatory maximum noise level from overflying aircraft be prescribed, just as the noise from cars, trucks and industrial sites is regulated on the ground.

SACF Inc proposes that ***"noise minimisation"*** through aircraft altitude control could be more effective than ***"noise-sharing"*** in the armory of airport environmental policy. In October 2003 SACF Inc produced its "Submission on Sydney Airport Corporation Ltds Preliminary Draft Master Plan July 2003" . A technical working group of SACF Inc has been working on this review of the Long Term Operating Plan for Sydney (Kingsford Smith) Airport [The LTOP Review], which it is hoped will further influence government policy towards ameliorating the suffering of those subjected to aircraft noise.

The SACF Inc Forum now includes around 20 community groups across Sydney including the Coalition of Airport Action Groups."

Contributors to "The Way Forward for Aircraft Noise Sharing at Sydney (Kingsford Smith) Airport"

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Richard J. Tanner B.Sc (Ag) (Chair , SACF Inc) [AFALOS]

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Tim Bradley (NWRAG)
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Peter Cork (Fairfield - FRAAN)
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Alister Simington (Summer Hill - SOS)
Steve Summers (Dulwich Hill)

List of Member Community Groups of SACF Inc & SACF Inc Associates

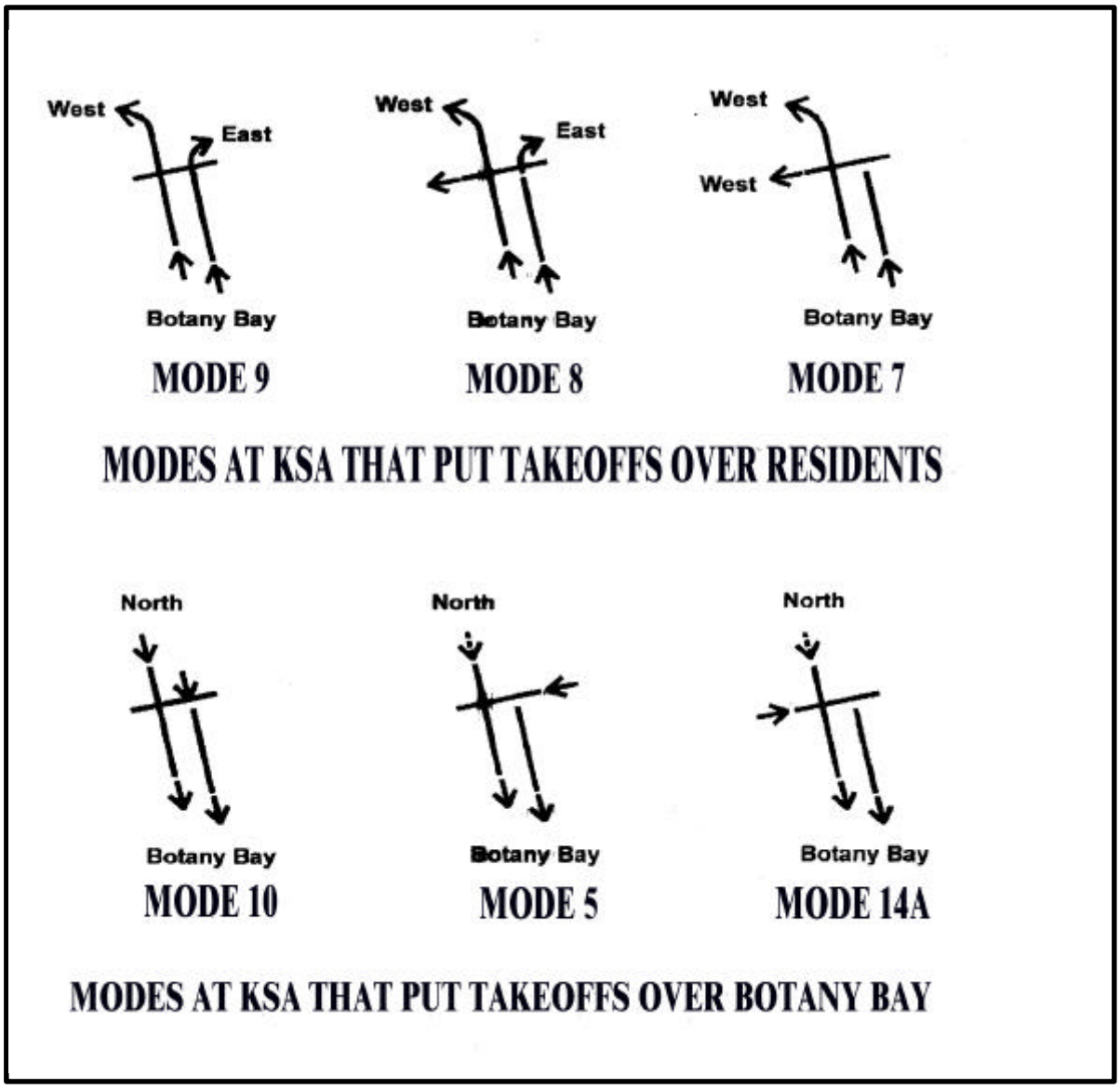
Member Community Groups
Association for an Airport Located Outside Sydney [AFALOS]
Coalition of Airport Action Groups [CAAG]
Community Advisory Committee [CAC]
Coogee Residents Against Aircraft Noise
Fairfield Residents Against Aircraft Noise [FRAAN]
Hornsby Residents Aircraft Noise Group [HRANG]
North West Residents Airport Group [NWRAG]
Parramatta Residents Against Airport Pollution [PRAAN]
Randwick Airport Action Forum [RAAF]
Save Our Skies [SOS]
Strathfield Residents Against Aircraft Noise

Associate Community Groups
Bligh Residents Airport Group
Bankstown Airport Community Environment Forum [BACEF[

APPENDIX B LTOP MODES:

B.1 CURRENTLY USED MODES

ksamod2.tif



APPENDIX B Cont'd:

B.2 CURRENTLY UNUSED SODPROPs MODES

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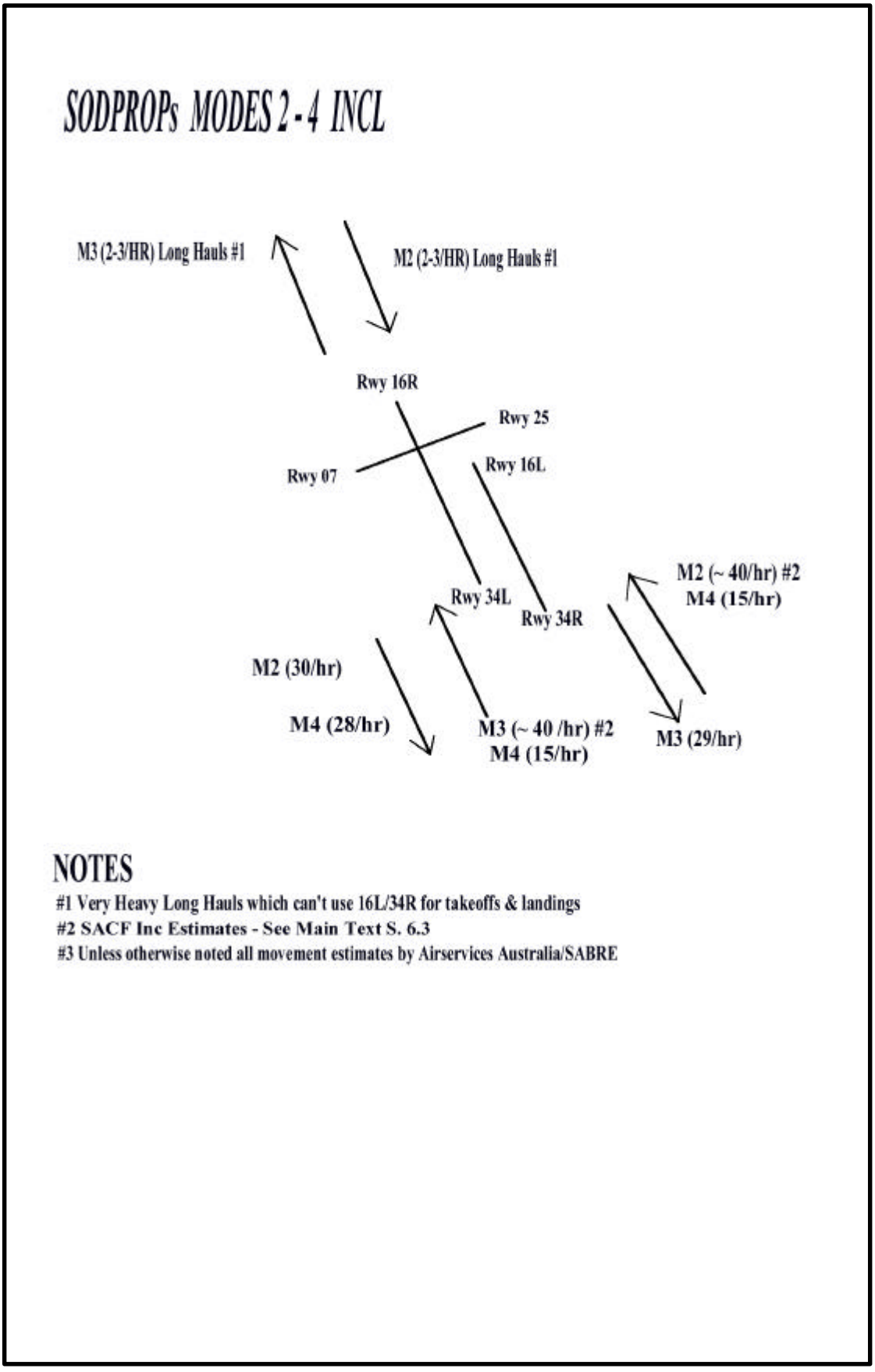

06-06-2003 11:11 FROM: TO:61 (2) 97989606 P:01

Marise Payne

Liberal Senator for New South Wales

22 AUG 2002

Mr George Church
22 Kelvin Close
Winston Hills NSW 2153

Dear Mr Church,

I write in response to your request to be granted membership of the Sydney Airport Community Forum (SACF) to represent the Winston Hills community.

The Minister for Transport and Regional Services (who approves membersip of the Forum) has been consulted in relation to your request and I must inform you that a position is not available at present for you to take part as a member. When the former Minister (the Hon John Sharp MP) established SACF in March 1996 he said in his media statement that:

> *"Membership of the new body will streamline the cumbersome and unwieldy arrangements put in place by the previous government. He said that it would have about half the number of members of the previous committee but would achieve a proper breadth of representation. ... The new body will include elected parliamentary representatives of both Liberal and Labor parties and selected range of mayors. The aviation industry will also be included. For the first time the body will also include members drawn directly from the community."*

That same commitment remains today under Minister Anderson. Most of the community members were nominated by the Local Members but not all nominees were selected.

However, you are welcome to attend SACF meetings as an observer and I have asked the Secretariat to contact you before meetings to inform you of meeting dates, times and venue. To assist you in your future correspondence to SACF, and to assist you in understanding the whole-of-Sydney policy which is the focus of SACF, I have obtained for you information on how various runway modes affect Winston Hills, including:

- names of the runways;
- the various modes employed;
- the preferred runway selection;
- a movement summary (with Winston Hills-relevant columns highlighted); and
- maps indicating the movements affecting your suburb.

Level 3, 2-12 Macquarie Street Room S1-94

06-06-2003 11:12 FROM: TO:61 (2) 97989606 P:02

You will see from this information what share of noise Winston Hills receives in relation to other Sydney suburbs. Departures off runway 25 are such that approximately only half of these departures pass over or near Winston Hills. Additionally, of those that do, a large majority are at 8000 feet or more in height (see map 1). Of the departures off runway 34 left, only about half track over or near Winston Hills (see map 2). Percentages of flights over or near Winston Hills for June 2002 are 18.9% considering the above.

I should mention the flights arriving for Runway 16 Right on descent are using reduced power setting, though I know your past complaints to the Noise Enquiry Unit and to my office have been in relation to jets taking off from Sydney Airport.

I do appreciate your sensitivity to aircraft noise but must stress my commitment to the policy of all areas of Sydney sharing the burden of aircraft noise as fairly as possible. I would appreciate if future correspondence to me on noise issues affecting you can be sent to the following address:

SACF Chair
PO Box A301
Sydney South NSW 1235

If sent to the above address, your correspondence can be copied to other SACF members and can be discussed when the Forum meets.

Yours sincerely,

Marise Payne

MARISE PAYNE
Senator for New South Wales

cc: Members of the Sydney Airport Community Forum
The Hon John Anderson MP, Minister for Transport and Regional Services

APPENDIX D LETTER FROM RICHARD TANNER TO WEEKLIES APRIL 2000:

[*Dear Editor:*

"Now that the Civil Aviation Safety Authority appears to have successfully cracked the whip over lack of proper maintenance programs for Ansett's aircraft fleet it should raise its sights over the far more important issues at Sydney's Kingsford Smith Airport.

Since 1996 the present Government has concentrated the noise of departing flights over Labor held electorates under the aegis of the so-called "Fair Share Noise Plan" aka "The Long Term Operating Plan" or LTOP. Prior to 1996 the Labor Party concentrated flight paths over Liberal -held electorates.

Not only does the LTOP involve criss-crossing of arrival and departure flight paths with artificial height ceilings, but careful examination of the Sydney Airport Operating Statistics since 1995 reveals an alarming situation which should shock even the most hardened politicians and leave no excuse for CASA to do nothing.

The 1995/2000 figures show that takeoffs to the north over residents [LTOP modes 7, 8 & 9] have almost doubled from 29 to 53% of all departures. In the same period takeoffs over Botany Bay to the sea which affect fewer residents [LTOP Modes 5,10 & 14A] have decreased from 65% to 44%. The perverse effect of LTOP has thus been to increase the number of heavily laden jet departures from KSA over populated areas to the north east and west; when an ostensible aim was to maximise movements over the water.

Statistically world wide there is a chance of an aircraft crash on take off of about one in three million, but it is now deliberate Government Policy to transfer this risk over heavily populated areas. A big jet such as a B747 will take off with approximately 100 tonnes of highly flammable aviation fuel - equivalent to about four road tankers full.

The conflagration from a crash on take off is now more likely to be spread over heavily populated areas rather than the sea when this unfortunate but inevitable statistic occurs over Sydney. This is aviation Russian Roulette being played out in the skies over the residents of Sydney.

In addition both out and in-bound aircraft are remorselessly vectored across as many Sydney suburbs as possible at low levels for what in most cases appears to be no good reason. This creates even lower artificial ceilings for departing aircraft which as the figures show fly mainly over populated land areas.

Thus the LTOP just doesn't work and is outright dangerous. The Sydney airspace management plan is a fiasco, an operational "joke" sponsored by buck-passing politicians and implemented by over-stressed and under-funded bureaucrats in Airservices Australia who are unfortunately the hands-tied servants of their masters - the government of the day.

In the present chaos in the skies over Sydney there is an excellent opportunity for CASA to show its real worth by forthwith closing Sydney's KSA until all political parties sign a binding agreement that they will cause the operations at KSA to be conducted in a manner which has at its core the real safety interests of air traffic and the people of Sydney. Whilst the issues surrounding the present Ansett imbroglio are serious, they are mere bagatelle compared with the air safety issues at KSA . It remains to be seen whether CASA would be prepared to bite their political masters over this issue, or are they mere toy watchdogs who don't bite and are not worth feeding!"

Yours Faithfully
Richard J. Tanner
Chair, Sydney Airport Community Forum Inc]

CIVIL AVIATION
SAFETY AUTHORITY
AUSTRALIA

Office of Legal Counsel
Telephone: (02) 6217 1600
Facsimile: (02) 6217 1607

Our ref: 02/6392
Your ref: r/sacf0210.sacfinc

Philip S Lingard
Sydney Airport Community Forum Inc
PO Box 104
SUMMER HILL NSW 2130

Dear Mr Lingard

ACCESS TO DOCUMENTS UNDER THE *FREEDOM OF INFORMATION ACT 1982*

I refer to your request seeking access under the Freedom of Information Act 1982 (the 'Act') to documents held by the Civil Aviation Safety Authority (CASA).

I am the decision maker for your request.

A decision has been made to release all relevant documents held by CASA. Please find enclosed requested documents.

Due to the small number of documents, I have decided to waive all charges under section 29(5) of the Act that may have been imposed.

Please do not hesitate to contact me on telephone (02) 6217 1606 or facsimile (02) 6217 1607 if you have any questions in relation to your request.

Yours sincerely

Bronwen Urban
Office of Legal Counsel

3 July 2002

CIVIL AVIATION
SAFETY AUTHORITY
AUSTRALIA

Minute

Ref: *C02/10235*

TO: Bronwen Urban
OLC

DATE: 14 May 2002

Re: Request for CASA documents

Bronwen

I attach a letter sent to Aviation Safety Standards from the Sydney Airport Community Forum Inc requesting that documents on File 99/8037 (also attached) be made available.

The letter also requested a list of any other studies carried out by the Authority which relate to the approval of LTOP operations. CASA has not carried out any such studies and this request would have been better directed to DOTARS.

I am writing to request that OLC respond direct or, alternatively, advise me whether it would be appropriate to forward the file contents (consisting of two letters, one from the Sydney Airport Community Forum) as requested.

Regards

Lorraine

Lorraine Browitt
Executive Coordinator
Aviation Safety Standards

P.S. I've phoned Mr King and to acknowledge his request & to inform him we will respond in the near future. LB

URBAN, BRONWEN

From: URBAN, BRONWEN
Sent: Wednesday, 15 May 2002 11:36 AM
To: BROWITT, LORRAINE
Subject: LTOP Sydney Airport

Lorraine

I received you minute today regarding a request for documents by the Sydney Airport Community Forum Inc relating to LTOPP (Sydney Airport).

I spoke with the Chairman of SACF today and advised that the document SACF are seeking is a CASA file and is not publicly available. I advised that should they still require a copy, they would need to apply under the *Freedom of Information Act 1982*. I also informed them that CASA had not conducted any other studies relating to the approval of LTOP operations and suggested they may wish to contact DOTRS.

Regards

Bronwen Urban
Freedom of Information
Office of Legal Counsel

APPENDIX F MILITARY "PROHIBITED, RESTRICTED AND DANGER" ZONES [PRDs]

PRD's are "***Prohibited, Restricted or Danger"*** Zones. They are usually associated with military airport operations. In the near vicinity of KSA these are Richmond and Williamtown (Newcastle). PRD's are divided into "24 hour" and "NOTAM " zones . "NOTAM" refers to the fact that these zones are activated and deactivated by Airservices Australia "Notices to Airmen" , ie NOTAMs, presumably in response to Military directions.

It is stated in the AIP [ENR1.4] that clearance will only be withheld when activities hazardous to Aircraft taking place or when military activities requires it [#2] , and also that when compliance with Air Traffic Control requires flight through into or out of restricted airspace the pilot in command may assume that ATC[#3] has obtained approval for the flight [Para 3.3.3]. However, the flight path must comply with prescribed controlled airspace procedures.

What this means in practice would require more expert analysis, but it is illuminating to consider the theoretical possibilities.

We shall deal with the implications of the Richmond Tracks and the Offshore (East-North-Eastern) Tracks in turn:

(a) North Western (Richmond Track) PRDs:

Tables F.1 and F.2 show the "NOTAM"- and 24 hour- affected PRDs, respectively, for flight tracks to- and -from KSA to the North West. Although from 4 December 1997 Airservices was said to have taken over management of the Richmond Military Airspace [#4] , a recent AIP Supplement [H27/02] dated 13/6/2002 warns of the effects of "Operation Pitch Black" [15/7/02 - 2/8/02] , a Military Exercise involving Richmond and Williamtown Airspace with effects on H76/H78, H66/Q166 H76/B587 & H66 and Q94 indicating temporary revised route designations and the activation of the following PRD's : R542, R641, R583A, R587A, R587B and R595. Further "temporary PRD's" [subject to 8 hour NOTAMs] were allocated for the exercise for which the administering authority is stated to be the Department of Defence (Air Force).

(a1) <u>"NOTAM" -Implemented PRDS</u> [See Table F.1]:
All the northwestern tracks are affected by the NOTAM -implemented PRD, R541 which is a roughly trapezoidal zone from 4000- 28000 feet, approximately centred on the Richmond Radial [310 °]. R541 begins 32 km from KSA -Centre and extends to 80 km, with a commencing width of 15 km and a final width of 63 km.

R541 is no mean volume of airspace, and if implemented frequently, it would likely prevent aircraft travelling out from KSA above 4000 feet until they get well beyond Richmond airspace.

Further out from Richmond in an extension of the R541 radiating trapezoidal zone, are various other NOTAM implementable PRD "Restricted" zones (R543, R586A, B & C) affecting Tracks H202 & V316 at altitudes above 6500 feet [as high as 60,000 feet in places], having distances out from 84 km to as far as 270 km from KSA-Centre [See Table F.1].

A NOTAM-implementable "Danger Zone" (D558) affecting Track V316 may apply at altitudes up to 7500 feet at from 165 - 277 km from KSA-Centre of commencing width 76 km and final width 105 km. .

---

2 AIP ENR1.4-7 PARA 3.4
3 ATC = Air Traffic Control
4 Govt SACF Minutes 19/9/1997

TABLE F.1 RICHMOND TRACK NOTAM RESTRICTED & DANGER ZONES

ZONE DISTANCE	**km**	**n. mi**	**ALTITUDE EXTENT feet**	**BEARING LIMITS degrees**	**DURATION**	**AFFECTED TRACKS**
R541-NEAREST POINT	**32**	**17**	4000- 28000	295-325	NOTAM	**H202,V316, V295,W144**
R541-EXTENT	**80**	**43**	4000- 28000	279-328	NOTAM	**H202,V316, V295,W144**
R541-MAX WIDTH	**63**	**34**	4000- 28000	279-328	NOTAM	**H202,V316, V295,W144**
R541-MIN WIDTH	**15**	**8**	4000- 28000	295-325	NOTAM	**H202,V316, V295,W144**
R543 - START	**84**	**46**	6500-NOTAM	280-306	NOTAM	**H202**
R543 - FINISH	**166**	**90**	6500-NOTAM	300-306	NOTAM	**H202**
R543 - START	**84**	**46**	6500-NOTAM	280-306	NOTAM	**V295**
R543 - FINISH	**125**	**68**	6500-NOTAM	300-306	NOTAM	**V295**
R586A -START	**166**	**90**	7500- 28000	308 - 335	NOTAM	**V316**
R586A -END	**202**	**110**	7500- 28000	308 - 335	NOTAM	**V316**
R586B -START	**202**	**110**	28000-60000	308-331	NOTAM	**V316**
R586B -END	**244**	**133**	28000-60000	308-331	NOTAM	**V316**
R586C -START	**244**	**133**	10000-60000	308 - 322	NOTAM	**V316**
R586C -END	**270**	**147**	10000-60000	308 - 322	NOTAM	**V316**
D558 - START	**165**	**90**	SFC-7500	305-335	NOTAM	**V316**
D558 - EXTENT	**277**	**151**	SFC-7500	305-335	NOTAM	**V316**
D558-MIN WIDTH	**76**	**42**	SFC-7500	305-335	NOTAM	**V316**
D558-MAX WIDTH	**105**	**57**	SFC-7500	305-335	NOTAM	**V316**

(a2) <u>24 Hour -Implemented PRDS</u> [See Table F.2]:
The first of these (R542) affect outward Track V316, only, being contiguous with the NOTAM-implemented PRD R541 (See (a1) above). R542 extends from 6500- 28000 feet at from 80 to 166 km from KSA-Centre.

Beneath this the 24 Hour "Danger Zone" PRD D554 affects tracks V316, V395 & H202 at altitudes from the Surface (SFC) to 6500 feet and distances from 82 to a maximum of 165 km from KSA-Centre. The horizontal transverse width of this zone across the flightpaths increases from 62 to 95 km.

The 24 Hr danger Zone D600 only potentially affects *<u>incoming</u>* northwestern Tracks H39 & W180 and restricts them to altitudes above 8500 feet until they reach 82 km (45n. mi) from KSA-Centre.

TABLE F.2 RICHMOND TRACK 24 HOUR PRDs - RESTRICTED & DANGER ZONES

ZONE DISTANCE	**km**	**n. mi**	**ALTITUDE EXTENT feet**	**BEARING LIMITS degrees**	**DURATION**	**AFFECTED TRACKS**
R542 - START	**80**	**43**	6500-FL280	306 - 335	24 HRS	**H76**
R542 - FINISH	**166**	**90**	**6500-FL280**	**306 - 335**	24 HRS	**H76**
R542 - START WIDTH2	**22**	**12**	**6500-FL280**	**306 - 335**	24 HRS	**H76**
R542 - FINISH WIDTH	**76**	**41**	**6500-FL280**	**306 - 335**	24 HRS	**H76**
D554 - START	**82**	**45**	SFC-6500	258-306	24 HRS	**V316**
D554 - EXTENT	**165**	**90**	SFC-6500	258-306	24 HRS	**V316**
D554-MIN WIDTH	**62**	**33**	SFC-6500	258-306	24 HRS	**V316**
D554-MAX WIDTH	**95**	**51**	SFC-6500	258-306	24 HRS	**V316**
D554-START	**82**	**45**	SFC-6500	258-306	24 HRS	**V295**
D554-MIN WIDTH	**35**	**19**	SFC-6500	258-306	24 HRS	**V295**
D554-MIN END	**125**	**68**	SFC-6500	258-306	24 HRS	**V295**
D554 - START	**82**	**45**	SFC-6500	258-306	24 HRS	**H202**
D554 - EXTENT	**165**	**90**	SFC-6500	258-306	24 HRS	**H202**
D554-MIN WIDTH	**62**	**33**	SFC-6500	258-306	24 HRS	**H202**
D600 -START	**82**	**45**	SFC-8500	226-345 AVE	24 HRS	**NIL EXIST FROM KSA**
D600 -END	**254**	**138**	SFC-8500	226-345 AVE	24 HRS	**NIL EXIST FROM KSA**

(a3) Richmond Track Discussion:

The effect of the above-described PRD's on the Richmond Track flight paths is shown in Figures F.1 - 3, for Tracks V295, H202 & V316, respectively:

FIGURE F.1 PRD AFFECTATION OF FLIGHT PATH V295
fpv295xf~1.tif

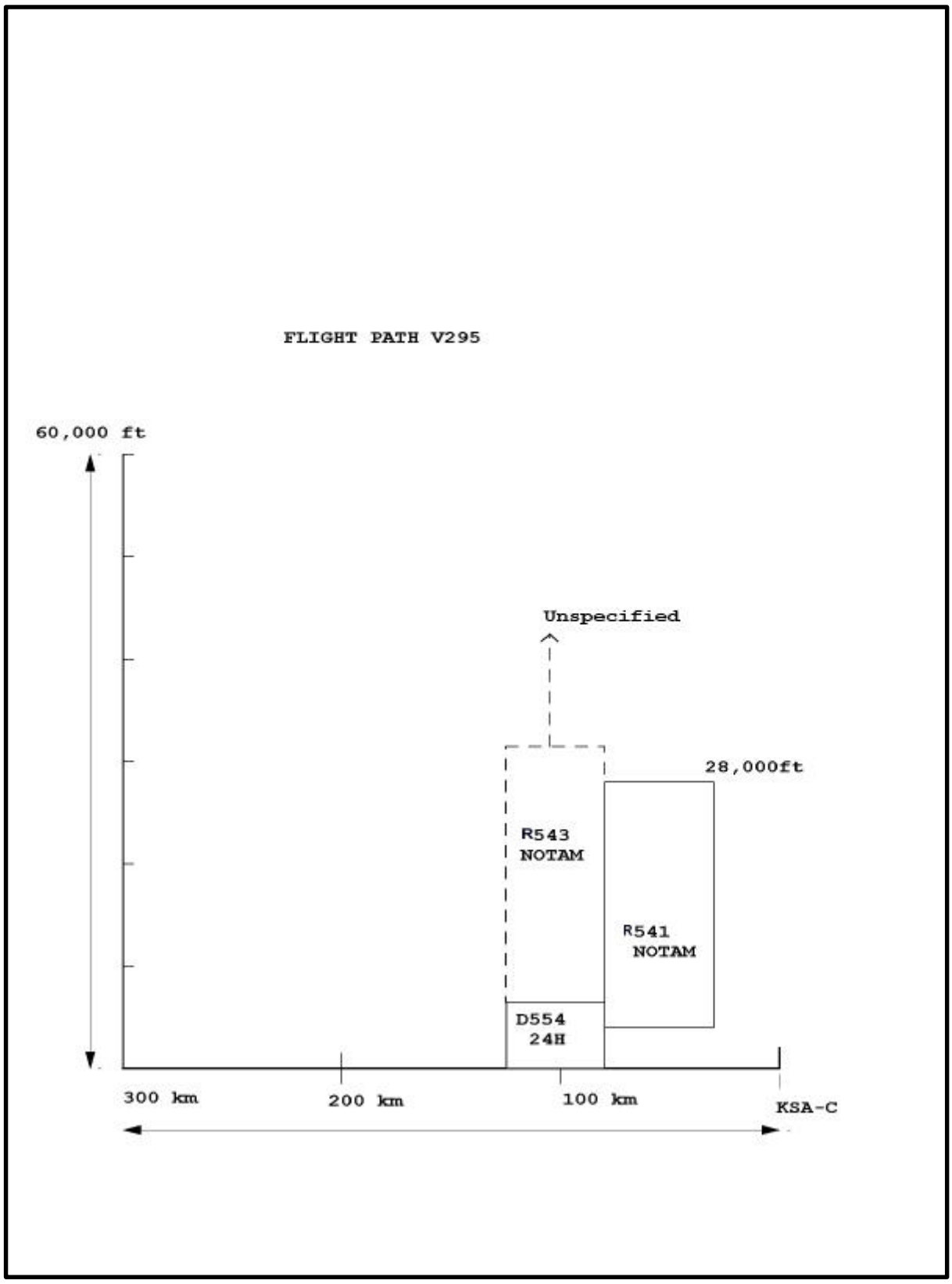

FIGURE F.2 PRD AFFECTATION OF FLIGHT PATH V316
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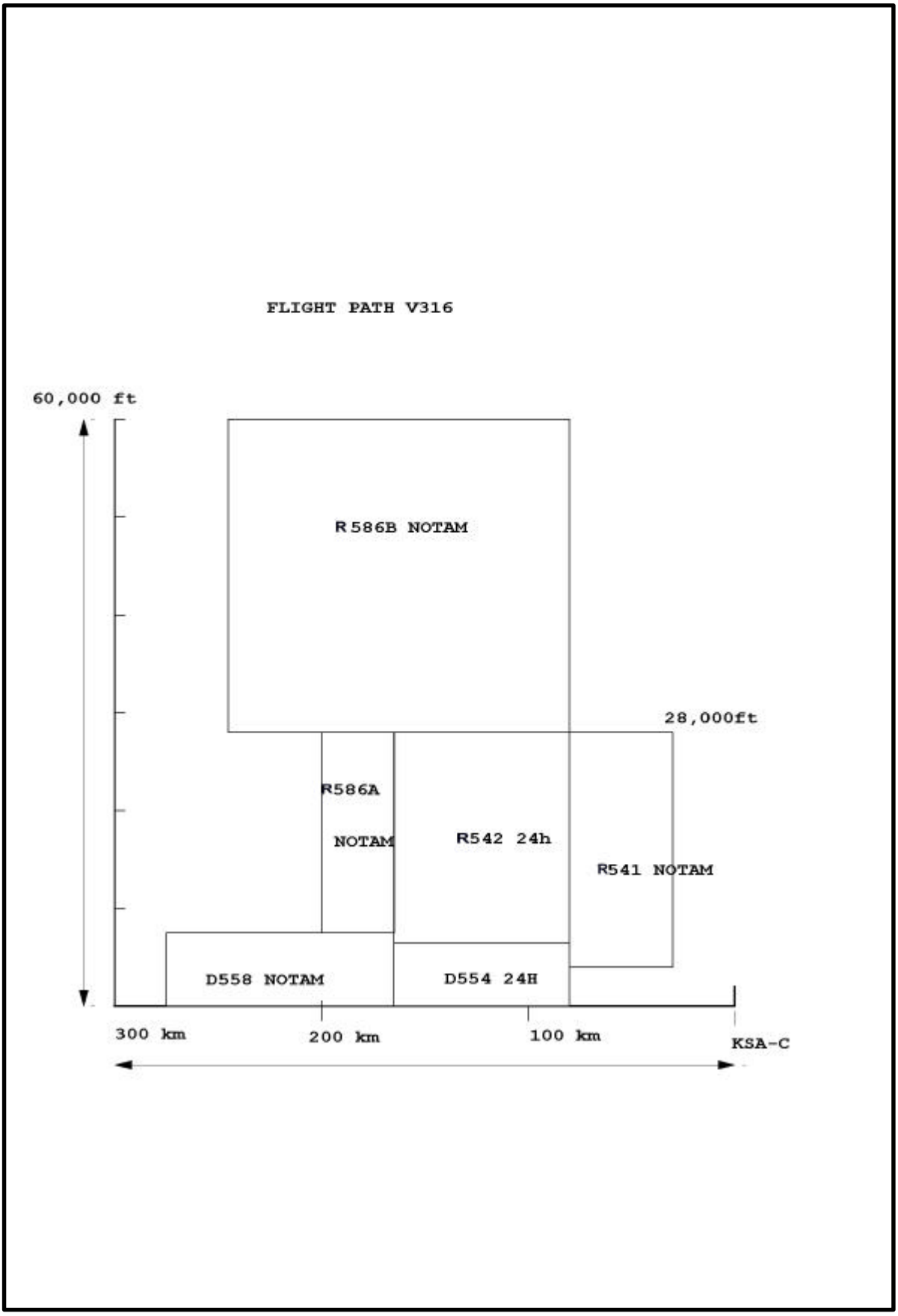
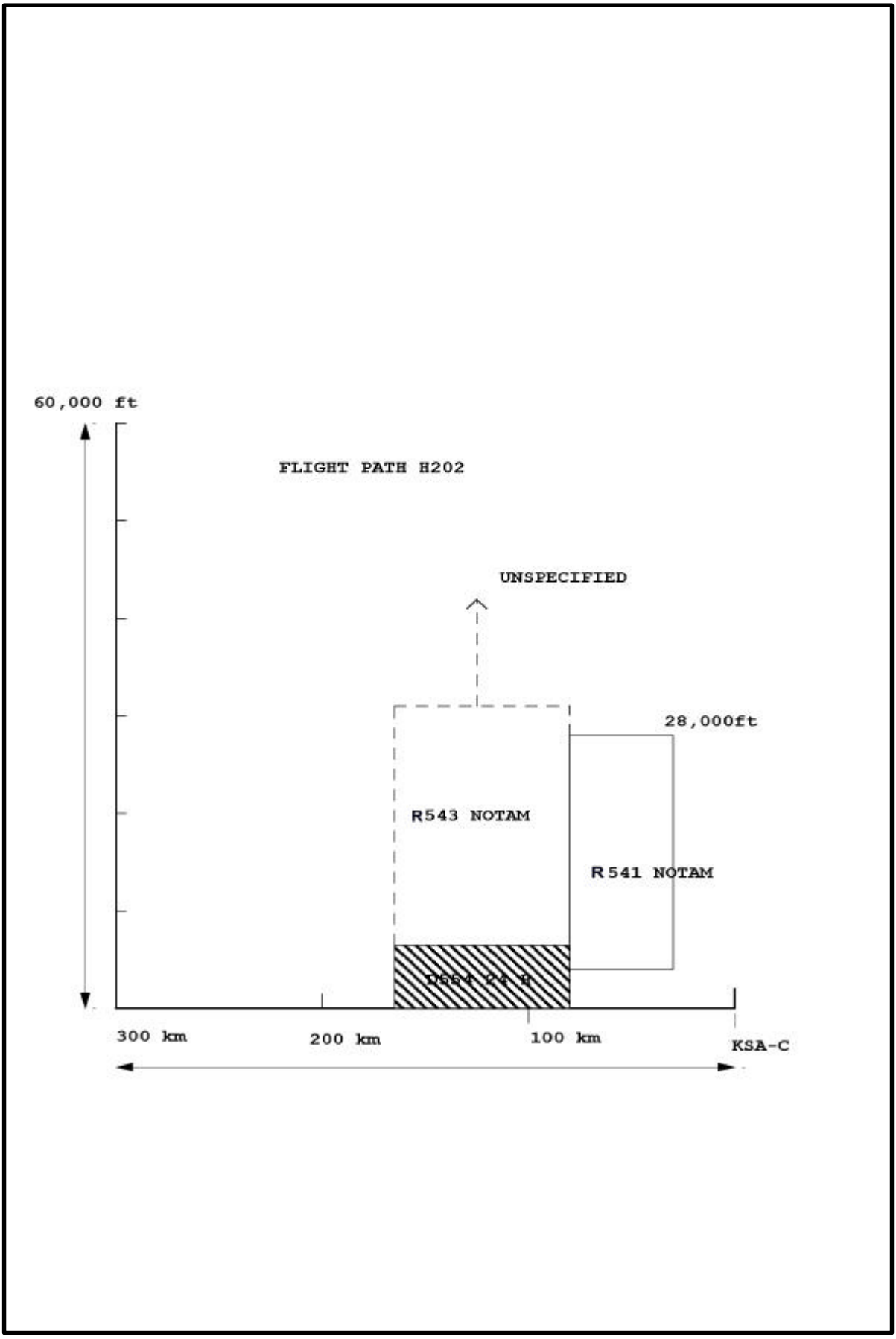


FIGURE F.3 PRD AFFECTATION OF FLIGHT PATH H202
Get fpv202xf~1.tif



From Figures F.1 - 3 one can only conclude that there is significant potential for PRD-type airspace restrictions to affect outgoing traffic from KSA-Centre of the Richmond Tracks. The nearest [NOTAM-implemented] R541 can restrict flying between 4 and 28000 feet for all the Richmond Tracks.

The ones further out variously affect immense multi-hundred cubic km trapezoidal volumes of airspace at altitudes between 6500 - 28000ft (R542) , Surface to 6500 (D554) , surface to 8500 feet (D 558), unspecified above 6500 feet (R543), 7500 to 28000 feet (R586A) 1000 to 60,000 feet (R586C) and 28000 to 60000 feet (R586B).

Without detailed information about the implementation of the NOTAM PRDs it is virtually impossible to predict which section of airspace will be barred to civil traffic on these routes and for what time, or - indeed - within which altitude range.

Approximately equally affected by "R"- and "D"- Zone PRDs are Tracks V295 & H202, although they are both impeded by a 24 Hour "D" zone between 0 and 6500 feet at 80 - plus km and a variable NOTAM zone of unspecified altitude above (R543). In addition, the approach to these appears to be frequently obstructed by R541, allowing traffic through only either above 28,000 feet, or below 4000 feet.

The track most affected by PRD's is undoubtedly V316 which boasts a 24 Hour "D" Zone blocking it below 6500 feet for nearly 100 km at low altitude beyond R541, and a further NOTAM-implementable "D" Zone blocking below 7500 feet for 100 km beyond! Also above these "Danger" zones at 80 km is a 24 hour restricted band between 6500 feet and 28000 feet with a NOTAM-implementable Restricted zone from 28000 - 60000 feet for 164 km beyond.

The prospect of ASA thus "playing it safe" and adopting the "path of least disturbance" (ie flights below 4000 feet up to 80 km and then wherever seemed available beyond) would appear to be a significantly likely outcome.

If this is so, it seems regrettable that the long-suffering residents of Sydney must bear the brunt, when one would expect negotiations between DOTRS and the DOD could provide far more environmentally friendly outcomes.

If it is the case that the Richmond DOD restrictions are such a problem, then perhaps Airservices would be better advised to use a new, more southerly set of tracks, to the southwest of the radial bearing 275 º. One possibility would be to fly steeply out over Katoomba and then turn north west, putting civilian fights well outside the Richmond military airspace trap.

(b) Offshore PRDs:

Table F.3 lists the 24 hour- and "NOTAM"- affected PRDs for flight tracks to- and -from KSA to the North , East and North East.

(b1) <u>24 Hour -Implemented Eastern PRDS</u> [See Table F.3]:
Beginning about 80 km north of Sydney there is an enormous rectangular 24 hour "Restricted" Zone PRD [R 595].

This extends roughly parallel to the coast up to 444 km from KSA-Centre, ending around Coffs Harbour. This zone is roughly 80 km wide and is expressed to affect flights at altitudes from the surface to 60,000 feet. The main track affected is B450 [bearing 059 º] . B450 ultimately divides, with the addition of B474, B580 and A579 heading off on different radials into the north west Pacific [See Figure 6.2.1]. The most southern edge of this restricted zone follows the radial at bearing 078 º from KSA-Centre.

As these civilian flights are unlikely to be higher than 60,000 feet under normal circumstances, then special dispensation must be provided to permit these flights. In any event, they do not affect airspace outcomes in the immediate vicinity of KSA-Centre.

Presumably it is because of these restrictions, that most of the domestic traffic to the immediate north appears to hug the mainland immediately east of the Dividing Range.

(b2) <u>NOTAM -Implemented Eastern PRDS</u> [See Table F.3]:
The next most southerly batch of PRDs is a generally triangular shaped south-easterly inclined wedge with its northern edge bearing 078 º with its apex off Sydney's Royal National Park and its most western edge approximately 22 km off shore, heading south beyond Wollongong. [See Figure 6.2.1].

The most immediate restricted zone within this wedge is R. 485A, whose boundary runs approximately north-east parallel to the southern boundary of R 595 and is about 20 km off-shore. This initially imposes a surface to 1500 foot restriction from 22 km offshore. The restriction extends to 7500 feet from 35 km further out (R485B) and is again increased to 8500 foot at 77 km (R485C) and 20,500 feet at 80 km (R485E) .

The airspace between "R595" from approximately due east and south of the Hawkesbury estuary, and the boundary of the above-described R 485 "wedge" opposite Sydney's Royal National Park is a parallel sided corridor of width about 15 n. mi, without altitude restrictions, heading out east-north-east across the Pacific. This corridor contains one bidirectional track [G595 -bearing 075 º] and one incoming Track [N774 - bearing 089 º]. The "R485" NOTAM restricted south-easterly wedge accommodates Tracks L521 [bearing 102 º - labelled "AUCKLAND"] , M636 [bearing 115 º] labelled "NELSON", and track Y84 (from 12/6/2003).

(b3) Discussion:
Given the average distance of 20 km of the closest of these zones from the coast off Sydney, there is no good military reason why altitude restrictions should affect air-traffic immediately off the Eastern Suburbs coast of Sydney such as appear from currently designed airspace [See discussion of low-flying takeoffs and low-altitude approaches from the north off Sydney's Eastern Suburbs : SS 4.1 & 5.3].

TABLE F.3 NORTH, EAST & NORTH EAST RESTRICTED & DANGER ZONES

ZONE DISTANCE	**km**	**n. mi**	**ALTITUDE EXTENT feet**	**BEARING LIMITS degrees**	**DURATION**	**AFFECTED TRACKS**
1. 24 HR PRDs						
R595-START	**80**	**43**	SFC-FL600	010- 075	24 HRS	**B450**
R595-FINISH	**444**	**241**	SFC-FL600	010- 040	24 HRS	**B450**
R595-START	**84**	**46**	SFC-FL600	010- 075	24 HRS	**B450**
R555A - Nearest point	**21**	**11**	SFC-1500	240- 250	24 HRS	**W113**
R555C - Nearest point	**21**	**11**	SFC-3000	212-240	07:00-21:00	**Y59,W430**
2. NOTAM PRDs						
R485A - Nearest point	**22**	**12**	SFC-1500	080- 185	NOTAM	**L521,M636**
R485B - Nearest point	**35**	**19**	SFC-7500	090 - 170	NOTAM	**L521,M636**
R485C - Nearest point	**77**	**42**	SFC-8500	087-108	NOTAM	**L521**
R485E - Nearest point	**80**	**43**	SFC-FL205	108-122	NOTAM	**M636**

APPENDIX G OVER-THE-WATER OPTIONS ANALYSIS

(APPENDIX "D" FROM *"The Way Forward No. 1"*)

By Philip Lingard for SACF Inc ***23/5/1999***

1. Introduction:

The so-called "Long Term Operating Plan for Kingsford Smith Airport" [#5] [the LTOP or "Noise Sharing Plan] put forward by Airservices Australia was predicated on the following principles:

Airport capacity should be " maintained to the maximum practicable extent" consistent with "noise sharing objectives" with "Movements" capped at 80 per hour with the following noise minimisation directives:

(i) Safety not to be compromised;

(ii) All three runways to be used ;

(iii) Maximum use of flight paths over water and non-residential areas;

(iv) Where not practicable to employ over-the-water modes that overflight of residential areas should be "minimised" and that noise arising from such flight paths is "fairly shared;"

(v) Areas subject to unavoidable noise close to the airport should be provided with "respite" periods which are totally free of aircraft noise;

(vi) Areas overflown by arriving aircraft to a particular runway should not also be overflown by aircraft departing from that runway; and

(vii) Arriving flight paths should ensure that descent profiles are commensurate with "low-power", "low noise" operations. There is no corresponding statement about the noise from departing aircraft.

Since the commencement of the LTOP in mid-1997 over the water modes have not been maximised. Indeed the utilisation of the only available daytime over-the-water Mode [Mode 4] during the course of operation of LTOP has apparently never exceeded **2%** overall; although peak operational movements of around 30 per hour were achieved early in 1998: **KSA Briefing Notes**. There are four theoretically possible over-the-water Modes, according to Airservices Australia LTOP Full Report, Modes 1, 2 , 3 and 4.

Mode 1 is the "Curfew Mode " at present operating from 11:00pm to 6:00am and involves use of only the main north south runway [R16R - 34L] by aircraft reaching specified minimum noise standards and under 34,000 kg weight. All movements are over Botany Bay and the operational capacity is 23 Movements per Hour: LTOPSR p.25.

Although three day-time over-the water modes were proposed in the LTOP Full Report [LTOPFR Modes 2 - 4: See pp 71-82], only Mode 4 made it to the LTOP Summary report stage and was given final "approval" by the governments consultative body, the Sydney Airport Community Forum [or "SACF"].

Numerous attempts have since been made by community groups and politicians from areas newly-affected by noise under Airservices and SACF's LTOP to have Mode 2, in particular, considered for application, but without success. The use of increased over-the-water Modes is always opposed by the majority of politicians and so-called community representatives on the government SACF from the airport's "North -South axis."

One is left to speculate about this resistance to consideration of greater use of over-the-water Modes given the professed objective of Airservices LTOP to maximise over-the-water operations and minimise operations over residential areas; but is left with the unpleasant feeling that the reason is to avoid increased use of operations over Botany Bay and nearby suburbs heavily represented on the government SACF [eg. Kurnell; Cronulla and Rockdale], since there is a relatively small affectation to the north for the over-the-water modes. An alternative explanation, perhaps, is that the reportedly increased workload on Air Traffic Controllers is too great (See below)..

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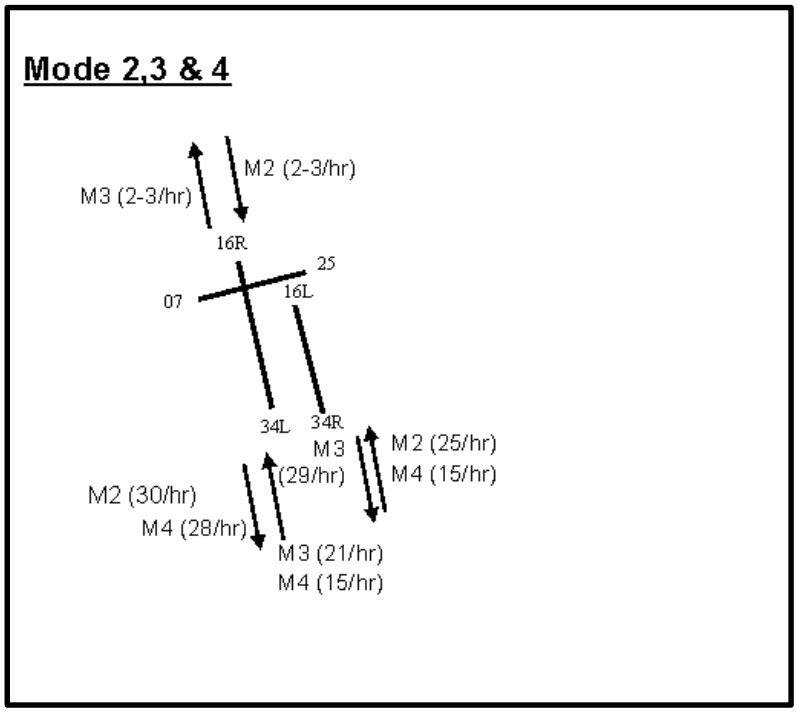
[5] Abbreviations used: LTOPSR = Long Term Operating Plan Summary Report; LTOPFR = Long Term Operating Plan Full Report

2 General Description of Over-the-Water Modes

This description will be conducted with reference to Fig. 1 [Schematic Airport Runway Layout with superposed directions of aircraft movements] .

FIGURE G.1 - SCHEMATIC RUNWAY LAYOUT



[Note: the Original Fig. 1 published in *"The Way Forward"* omitted the Mode 2 Departure capacity data for Runway 34L] .

Airservices documentation states that all the over-the-water Modes [Modes 2 - 4] are theoretically available given in the Bureau of Meteorology's "50 year all months average prevailing weather conditions" for 46% of the time with a minimum of 26% in a typical January to a maximum of 56-57% between May to July [LTOPFR p. 71; 77 and LTOPSR p. 31]. The capacity of operations during the operation of these Modes is theoretically between 43 and 56 operations per hour for Modes 2-4; quoted Sabre SIMMOD [6] modelling by ASA [LTOPFR p. 71; 77 and LTOPSR p. 31], with approximately, but not exactly equal numbers of arrivals and departures: See Table 1. Mode 4 is the only daytime over-the-water Mode to have been given any sort of trial and has been shown to be capable of at least **30 / hour [KSA "Briefing Notes Jan - May 1998].** The LTOP Reports state that Modes 2- 4 are theoretically available throughout the year, but "mainly in the morning and late evening:" See LTOPSR p. 31; LTOPFR pp 71 & 77.

3. Details of Individual Modes:

3.1 Mode 1 - The "Curfew " Mode:

When Mode 1 is in use all arrivals and departures take place over the water off and onto the main "north-south" runway [Runway 34L and 16R]. The runway capacity is limited in operation due to the simultaneous use of a single runway for arrivals and departures during which practice is to space arriving aircraft at 40n. mi.

An interesting comment by ASA in the LTOP Reports is that "the availability of this Mode, other than when it is mandated by legislation is limited to when the downwind does not exceed 5 knots" : LTOPSR p. 26 . Can this mean that downwinds in excess of 5 knots are tolerated during curfew, when visibility is reduced and they are not tolerated during daytime operation, and if so for what reason?

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[6] Note: "SIMMOD" modelling means US Federal Aviation Administrations Airport and Airspace simulation model assuming "existing airfield layout (runways, taxiways and terminal layout) and [nb] current operational procedures.": LTOPSR p. 11

3.2 Mode 2 -

With Mode 2 departures all head south off Runway "16R" [the main north south runway]. All arrivals excepting "long haul jets" land on Runway 34R [the "third runway"] from the south-south-east, and can do so except in wet weather when there is a southerly wind. This is presumably because of the danger of overruns caused by .

TABLE G1 KEY OVER-THE-WATER MODE OPERATIONAL DATA

	MODE 2	MODE 3	MODE 4	MODE 1
ALL MONTHS AVERAGE AVAILABILITY [BOM]	46%	46%	46%	No data - Mode Ordained 23:00- 06:00 hrs
OPERATIONAL[1] AVAILABILITY	downwind < 5 knots #a	downwind < 5 knots #a	downwind < 5 knots #a	downwind < 5 knots #a
SUSTAINED CAPACITY Movements /hour	56	49	43	23
Peak Capacity Movements /hour	59	51	44	25
Arrivals Capacity Movements /hour	27	21	15	13
Departures Capacity Movements /hour	30	29	28	14
Cloud Base Limitation [feet]	3,000	3,000	3,000	3,000
Visibility Limitation [km]	10	10	10	10
Number of People affected by 70dBA impacts B747-200 - Arrivals - From North	134,400	Nil	Nil	Nil
Number of People affected by 70dBA impacts B747-200 - Arrivals - From South	700	700	700	700
Number of People affected by 70dBA impacts B747-200 - Departures -To South	40,000	5,800	9,800	4,000
Number of People affected by 70dBA impacts B747-200 - Departures - To North	Nil	606,300	Nil	Nil

[1] #a Table Footnote Note : The downwind component limitation has reportedly been abolished :SACF 26/2/1999 per K. McLean ASA

skidding in the wet due to the shortness of the third runway which terminates close to ~~the Domestic Terminal Building~~ General Holmes Drive . Mode 2 is suitable for use in low-to moderate southerly winds when otherwise Mode 10 would need to be employed: LTOPFR p. 64ff. With the reported "relaxation" in the downwind component requirement [to around 10 knots], landings from the south should be possible with Mode 2 as long as this criterion is not exceeded.

Table 1 shows that this is the optimum capacity "over-the-water" Mode; but this is partly achieved by landing long-haul 747 and similar aircraft from the North. Elsewhere in the LTOPSR it is stated that long haul jets comprise about 15% of total movements at KSA: [LTOPSR p. 2]. This suggests that during operation of Mode 2 a maximum of 7.5% of the arrivals might need to land on the main north-south runway representing about three arrivals from the north per hour according to the ASA data in Table 1. [Arrivals equal approx. half of the 15% ie. 7.5% of the 27 shown in Table 1 to represent arriving aircraft movements with Mode 2].

Thus the affectation to the north can be expected to be about 7.5% compared with that in strong southerly winds during Mode 10 operation when all aircraft land from the north [3/40 ie. up to 40 aircraft per hour: LTOPFR p. 65]; although in considering residential impact one must have regard to the fact that the LTOP states that Mode 2

availability would be predominantly in the early morning and late evening: LTOPFR p. 71. Presumably this is determined by prevailing weather conditions.

There also must be a 15 degree horizontal "divergence" between over-the-bay arrival and departure flight paths in the use of this Mode, which according to the LTOPFR puts departing aircraft from the main north-south runway on a flight path over Cronulla; though why this is necessarily so is not entirely clear.

3.3 Mode 3 -

Mode 3 is the inverse of Mode 2, that is all departures except for "Long-Hauls" take place to the south -south-east over Botany Bay from Runway 16L [The "third" runway] . According to Airservices it would be available in wind conditions complementary to those suited for Mode 2 , ie. light to moderate northerly winds.

Long Haul departures [ie. overseas bound B747's; 767's, DC9's & 10's] would take off to the north from runway 34L [the main north-south runway] in a manner presumably similar to Mode 9. All landings would be on runway 34L from the south heading approximately NNW.

Like Mode 2 this mode requires simultaneous arrivals and departures from the same runway ; but according to the LTOP Full Report in connection with Mode 2 such use of the same [main] runway for simultaneous landings and departures will not cause significant delays because the departures and arrivals are in the same direction: LTOPFR p. 73.

Table 1 shows that this is a "medium capacity " over-the-water Mode shown by the "SIMMOD modelling to be capable of 49 movements per hour. This is partly achieved by departing long-haul 747 and similar aircraft over the North.

As mentioned earlier, elsewhere in the LTOPSR it is stated that long haul jets comprise about 15% of total movements at KSA: [LTOPSR p. 2]. This suggests that during operation of Mode 3 a maximum of 7.5% of the arrivals might need to take off north from the main north-south runway representing a little over 2 departures per hour according to the ASA data in Table 1. [Departures equal approx. half of the 15% ie. 7.5% of the 29 shown in Table 1 to represent departing aircraft movements with Mode 3].

Thus the affectation to the north can be expected about 6% of that in stronger northerly winds during Mode 9 operation when all aircraft take off to the north [ie. up to 35 aircraft per hour: LTOPSR p. 58 ; 2/35 = 5.7%]. In considering residential impact one must have regard to the fact that the LTOP states that Mode 3 availability would be predominantly in the early morning and late evening: LTOPFR p. 77 and that the 15% longhaul movements implies that only about two per hour would be required to take off over the north with this mode .

According to Airservices there must also be a 15 [or is it 30?] degree horizontal "divergence" between over-the-bay arrival and departure flight paths in the use of this Mode, as with Mode 2 : See general comments LTOPSR p. 21 , but according to the LTOPFR in the description of Mode 3 "all operations in the initial departure phase and the final approach phase of flight are over water with the minimum impact on Kurnell achievable" [!!]: LTOPFR p. 80.

3.4 Mode 4 -

With Mode 4, departures to the south are from both "north south" runways 16L ["third"] and 16R [main] . Arrivals are onto runway 34L [main north south heading north] . Airservices state that this is the "preferred Mode" during all none curfew hours subject to weather and traffic conditions: LTOPSR p. 106; and that failing the availability of this mode then Mode 2 should be reconsidered : [LTOPFR p. 75].

In the context of runway utilisation Mode 4 appears compatible with the use of Mode 3 when the wind direction strengthens from the north forcing northerly take-offs by long haul jets; when the Summary Report states that Mode 4 will be unsuitable and that Mode 3 "*covers this operation*.": LTOPSR p. 34; although despite this apparent endorsement by ASA it should be noted that Mode 3 is also not included in the final LTOP!

Table 1 shows Mode 4 to be the " least capacious" over-the-water Mode shown by the "SIMMOD" modelling to be capable of 44 movements per hour. It has similar weather and operational restrictions to modes 2 & 3 yet is the only one included in the LTOP. Its obvious advantage is that no aircraft overfly the north during the operation of this Mode, and clearly there are advantages to the majority of Sydney residents in this.

Like Modes 2 and 3 Mode 4 is theoretically available throughout the year, but usually in the "early morning" [from ca. 07:30am] and late evening under low wind conditions: LTOPSR p. 31 cf. 106. The maximum stated downwind

tolerance of 5 knots may now be greater due to the reported "relaxation" of the downwind component requirement reported by Ken McLean to the government SACF on 26 /2/1999.

However, Airservices state [LTOPSR p. 106] that Mode 4 cannot be used on weekdays between 06:00 and 07:30 and it suggests that in that period "a cross runway Mode should be used (Modes 5,7 or 14A)": LTOPSR p. 106.

No reason is provided for this statement though one suspects it could be related to the significant density of overseas "long-haul" arrivals in the early morning post-curfew period; but in its typical self-contradictory manner the Summary Report goes on to state that its proposed use will be *"in the early morning, immediately following the curfew and during light traffic periods in the middle of the day or at weekends.*": LTOPSR p. 34

There are obvious "synchronisation problems" with this Mode due to the use of runway 16R /34L for both landings and departures in opposite directions and Airservices state that *"significant aircraft spacing was required on the take-off and final approach tracks, limiting the capacity of the runway."*: LTOPSR p. 31.

As with Mode 3 all operations are stated to be over the water and there is minimal impact on Kurnell: LTOPSR p. 34

4. Airservices Critique of Over-the-Water Modes:

The critiques by provided by Airservices of all the "over-the-water" Modes are similar and so are bundled together in the following discussion for the purpose of providing a basis from which critical questions may be directed to Airservices.

4.1 Airspace Management Complexity:

Both LTOP Reports state that "operational complexity" is greater for the "over-the water" modes than for "normal" Modes, and that arrivals and departures must be *"segregated on the traffic circuit"*: LTOPSR p. 31; LTOPFR pp. 72 & 78 . It is not clear whether this means on the airfield itself or in the air, but either way one would expect some sort of necessary segregation between arrivals and departures both in the air and on the tarmac otherwise there would be collisions between aircraft whichever Mode was being used.

Both Reports [LTOPFR p. 73; 78; & LTOPSR p. 32] also state that there must be "clear" and "distinct" division of "airspace responsibility" between "tower" and "radar" controllers, and that there *"is extra coordination required"* between aerodrome controllers in the SODPROPS modes, at which one shudders to think that there is not ordinarily any "clear" and "distinct" division of responsibility and coordination in this way.

There is also an *"increased monitoring load on final approach and after departure"* and controller workloads are increased with the over-the-water Modes: eg. LTOPFR p. 73; presumably because of the need to ensure that departing and arriving aircraft do not stray onto each others flight paths. One of the reasons for this is the inability of controllers to simultaneous monitor the over-the-water modes and "helicopter arrivals".

One is led to ask whether this could be minimised using some kind of radar system to track aircraft and warn of intrusions into relevant airspace; or perhaps whether helicopters should be mixed in the same air-space as general traffic at KSA?

4.2 Disadvantages :

These are stated to be a 15 degree divergence requirement which puts aircraft over Cronulla and which *"defeats the purpose of the opposite direction operation"* ie. to maximise operations over water. Sometimes this is referred to as a 30 degree divergence and is stated in both reports without justification and avoids any consideration of the relative numbers of people affected by operations "over Cronulla" than in the use of the "parallel" Modes.

The Reports also state without justification that *"only low traffic levels"* are available "with safety" with mixtures of arrivals and departures in the same airspace: LTOPFR pp. 73 , 78 & 80; LTOPSR p. 32 . Whilst one would not ask Airservices to conduct operations in an unsafe manner, a legitimate question is whether the 43- 56 movements per hour projected by the SIMMOD modelling for these Modes is inherently unsafe?

4.3 Advantages :

The most obvious advantage for Sydney residential communities is the reduction compared to Mode 9 and 10 operations in the frequency to which people in residential areas are exposed to 70dBA noise impacts. Although this is not quantified in terms of number of impacts per person per hour in the LTOP reports, the exposure to landing

noise of the 134,400 people affected from the north is between ten and twenty times less than with Modes 9 & 10; because only long haul jets are using the northern approach and departures routes with Modes 2 & 3 at the rate of only 2 - 3 per hour. This is very significantly less than the exposure of 1.5m people on the north, north-western and north-eastern departure routes in Mode 9 operations. There is, of course, no northerly exposure during the operation of Mode 4.

Similarly significantly fewer people overall are affected by both arrival and departure noise; the bulk of the traffic being over the water affecting a total of around 41,100 people : LTOPFR pp. 74 &79; LTOPSR p. 33, compared with potentially 1.5m people with departures north: LTOPSR p. 93; See also Table 1.

Departing aircraft can reach much greater altitude more quickly flying south than with the northern departure modes [LTOPFR p. 74 ; LTOPFR p. 79 ; LTOPSR p. 33 where a typical B747-200 is projectedly at 10,000 ft "over water" - ie. offshore from Cronulla. This is to be compared with the only ca 3000ft altitudes achieved in practice over Ashfield/Croydon/Strathfield - an equivalent distance after take-off - during takeoffs to the north -north-west ; in contradiction to the LTOP prediction which is around 6,500 ft at Wetherill Park in the north west.

5 Questions that should be Asked about Over-the Water Modes :

Q 5.1 Do the "safety" considerations which "limit" the use of this Mode really amount to limitations or do they simply reflect an aversion to change in modus operandi and thus greater complexity for air traffic controllers?

Q 5.2 Is the coordination requirement between "tower" and "radar" controllers any greater than should exist in practice anyway?

Q5.3 Could "coordination" be assisted by greater reliance at the airport on "machine controls" such as automated tracking radar [perhaps this is heretical in view of the controversy over PRM, but it is a question worth putting]?

Q5.4 There is confusion in the description of the LTOP reports as to whether 15 degree or 30 degree divergence [LTOPFR p. 72 cf. p. 73] is required between arrival and departure tracks over the Bay ; which in practice could make the difference between departures having to fly over Cronulla or not?

Q5.5 If safety is a limitation then why does the report state that *"Risk associated with this mode is provided for in the procedures employed and in the development of the operating standard."* While this is a "stock in trade" expression throughout the LTOP summary and full Reports and is repeated for all Mode descriptions, does this not suggest that the risk is controllable for all Modes and therefore that safety is not the consideration alluded to?

Q5.6 Can one assume that these Modes are now more available given the relaxation of the downwind condition referred to by Mr. McLean at the 26/2/99 meeting of the government SACF ; and if the relaxation is to say 10kn **[??]** as applied during parallel operations under the Labour government, does this mean that these Modes might be available twice as much as predicted in the LTOP Reports?

Q5.7 If noise minimisation over residential areas is the criterion as suggested by the preambles to the LTOP Reports, then why was not greater emphasis applied to consideration of Modes 2 and 3 in implementation; why were they left out of the final recommendation, and why is Mode 4 utilised so infrequently if at all?

Q5.8 The LTOP Reports imply that Mode 4 with its <u>opposite direction takeoffs and landings on the same runway</u> and limited over-the-water capacity is inherently preferable to either of Modes 2 or 3 [LTOPR p. 106] ; and in denying Sydney residents the availability of Modes 2 & 3 it contradicts itself in saying that Modes 3 & 4 "provide maximum over-the-water tracking and <u>*should be used whenever weather conditions permit*</u>: LTOPSR p. 21! Why is this not being allowed to happen?

Q5.9 The LTOP Reports state that among the reasons for resistance to Modes 2 & 3 is the "divergence of a minimum of 15 degrees" which is required between simultaneous arrival and departure tracks which *"place[s] aircraft very close to or over Cronulla and would <u>negate any initiatives discussed</u> ..... <u>to move aircraft further to sea off Cronulla.</u>"* Is this actually the case; and is the limitation only applied in two dimensions ? [See also below]

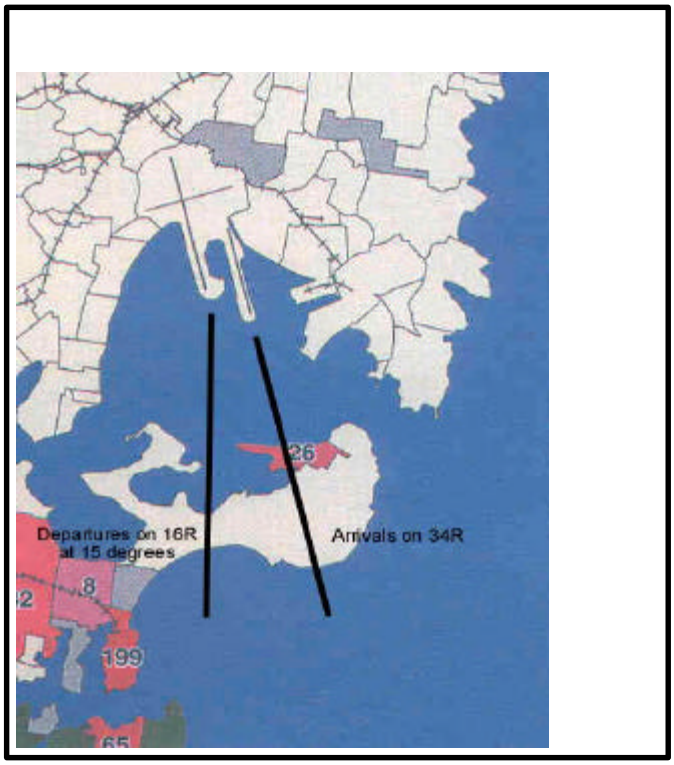
Q5.10A In practice, achievement of a 15 degree separation between departing and arriving aircraft only requires

7.5 degrees from straight-ahead for both arriving and departing aircraft. This does not put departures over Cronulla [See Fig. 2]. In fact even fifteen degrees [See Fig. 2] applied only to jets heading south off Runway 16R provides the necessary clearance in three dimensions. What is the answer of Airservices to this criticism ?

Q5.10B Indeed, departing jets take off much more steeply than arriving craft [20-30 degree climbs are not uncommon; cf. 5 degrees mandated for landing]. It is suggested that this inherently provides the necessary safety clearances for jets departing and arriving in SODPROPs modes, and voids the objection in the LTOP report that Modes 2 & 3 are void simply because they will put departing aircraft over Cronulla. What is the answer of Airservices to this criticism ?

Q5.11 Mr. A. Williams, an independent expert in air-space management [and consultant to the LTOP task force] , has stated that with purely over-water modes (Mode 2 or a mixture of Modes 2 and 4), the SODPROPs throughput could be increased to 65 movements an hour, and the airport only operated above this volume for 1% of first quarter 1998. Hence for all calm days, purely over-water modes should be used. Why is Airservices not maximising the use of these modes to minimise noise over highly populous suburbs?

FIGURE G.2 POSITION OF MODE 2 TRACKS WITH 15 DEGREE DIVERGENCE



Q5.12A <u>SODPROPs</u>:
Mr. G. Harrison [Randwick Forum] has suggested that the noise impact of KSA could be reduced by 40%-70% using combinations of SODPROPs modes, with some modifications. The lower figure would be possible by getting Mode 2 implemented in all suitable downwind conditions, and running SODPROPS for at least all non-peak periods in light and variable winds, especially very early morning and late at night. As shown above this should be possible with all northerly downwinds less than at least 10 knots. Why is Airservices not maximising the use of these modes to minimise noise over densely populated residential suburbs ?

Q5.12B <u>SODJETS</u>:
Mr. Harrison claims that the higher of the above figures could be achieved with a configuration which has been called "SODJETS". This involves confining jets to Mode 2 and putting propeller craft on the EW runway thus increasing the availability of Mode 2 to jets with greater over-the-water capacity. This would result in still fewer jets going over people (excluding Kurnell who should be compensated) when the downwind was less than critical [ie. in all but bad weather]. An addition to the options available with this suggestion could be to include Mode 3 - the true reciprocal of Mode 2 [See above], This would further

expand the availability of SODPROPS /SODJETS into moderate southerly downwind conditions. Why cannot Airservices persue these options?

Q5.13 SODPROPs utilisation in IMC Report:
Airservices and Mr. Lidbetter should be asked whether the alleged SODPROPS utilisation of 5.1% in the IMC Report dated 26/2/99 distributed by Mr. Lidbetter to SACF includes the curfew operations. If it does it is incorrect to say that the curfew mode is a "simultaneous opposite directions on parallel runways" [ie. SODPROPs] mode, and is a misrepresentation of the true utilisation of SODPROPs which is very small - indeed, it is so small as to be unreported in recent KSA Briefing Notes.

In any case the combined utilisation of Modes 1 [Curfew] and 4 [SODPROPS 1] should be up to 14% by now [July 1999]: See LTOPSR Fig. 10 p. 105.

4 August, 2003

A QUANTITATIVE SOLUTION TO THE PROBLEM OF FAIR DISTRIBUTION OF AIRCRAFT NOISE

by
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1) SYNOPSIS

The design work performed by Airservices Australia (ASA) and the Australian Department of Transport (DoT) in 1995-7 to develop the so-called Long Term Operating Plan (LTOP) for Sydney's Kingsford Smith Airport (KSA) was essentially devoid of any rigorous scientific method. While most would agree with the stated goals of the LTOP, to maximise use of water and non-residential land and then fairly share the remaining noise, the actual operational procedures proposed in the LTOP are amongst the worst possible scenarios for achieving these goals. But to prevent the public from readily appreciating this fact, the LTOP avoided any overall measures of noise or fairness. The driving force was clearly the political bias being shown to certain blue ribbon Liberal electorates. To hide this fact and stifle debate, the government exempted the process from the normal environmental review and requirement for an EIS. The government sold the LTOP on the basis that it delivers "fair sharing". While "fair sharing" was indeed a stated goal of the LTOP, any analysis of the resultant flightpaths and noise contours confirms that the LTOP (especially the changes subsequently made to the plan) goes to considerable lengths to ensure against fair sharing where such sharing would negatively impact a federal Liberal electorate. This allegation is supported by a ministerial media release from Andrew Thomson, Member for Wentworth.

This paper sets out the appropriate classes of mathematical models to allow quantitative measures of the effectiveness of proposals and modifications. The method also ensures that policies are assessed and implemented without electoral bias. The method proposed allows the government to still set policy with public consultation, without allowing politicians to continue the misuse of power to bestow favours on electorates held by their own party, thereby shifting pollution to electorates of the opposition party.

The paper also recommends a properly representative body, where all affected residents are equally represented, to replace the practice of the government hand-picking representatives it would like to have on such a body. The proposal is to turn Sydney Airport Community Forum (SACF) from a government-appointed body to a true community forum, to enable it to live up to its name.

2) BACKGROUND OF THE PROBLEM

A mathematical model of pollution effects (and numbers of people affected) is usually developed for any large scale project exposing large numbers to some form of pollution, especially in any developed country. Such models are usually developed to meet a regulatory approval requirement, such as to support an Environmental Impact Statement (EIS) or other approval process. In the case of KSA's LTOP, the government's decision to grant a special exemption bypassing an EIS was needed to hide the lack of any comprehensive model, or any other way to measure the project's overall effects.

In the case of the LTOP, computer modelling was used to estimate the effects of various components, but no overall calculation was ever done on the net benefit/worsening in terms of overall pollution levels.

In the case of the LTOP, the components calculated to varying stages of correctness were:

a) A noise model was used to calculate the width of noise corridors (ie decibel levels at various distances from a flightpath, given different types of planes at different altitudes);
b) The noise model was then also used to estimate a standard whole-of-year cumulative noise level (ANEF - Australian Noise Exposure Forecast) based on the number and mix of plane types on each flightpath, resulting in a noise contour map showing ANEF levels for each locality; and
c) Standard (already available) census map data was also used to calculate the number of people affected in each category of high, medium and low ANEF levels for each flightpath and mode of operation.

The next obvious step would have been to have what Airservices call the "Integrated Noise Model" actually integrate (ie sum the individual component effects) for some overall measure. This step was simply never taken. The equivalent approach for a reassessment of the tax system would be to calculate the receipts from a GST/VAT tax, and estimate the effect of higher compliance given lower personal or corporate tax rates, while failing to add all the component effects together to see whether any proposed scenario had the net effect of increasing government receipts, lessening government receipts, or if it was 'revenue neutral'. Indeed many constituent groups would only lend their support to tax reform if they thought the overall effect was close to 'revenue neutral'. Clearly no government would suggest a changed taxation scheme without calculating overall net effects, yet that is precisely what has been done with the modelling of the LTOP. Despite hundreds of pages of information, the LTOP did not make any information available as to the quantum of additional overall pollution involved with the proposed changes. One can only surmise that the reason was a fear that the public would challenge any set of changes which sought to significantly INCREASE the total amount of pollution.

It took independent research by critics to point out that the net effect of the LTOP was indeed a significant increase in pollution over people, with a corresponding decrease in the amount of pollution over water. Indeed the underpinning assumption of the LTOP (though never explicitly stated anywhere in the LTOP documentation) was that the airport would be 'turned around' so that take-offs would be over people whenever possible, rather than over water whenever possible. There was no disclosure within the document that the LTOP would thus overturn 30 years of accepted noise abatement procedures. Moreover, the department had written in its submission to the House of Representatives in the mid-1980s that "It is universally accepted in nominating preferred runways, that when two directions are available, departing aircraft are allotted the direction affecting the less noise-sensitive area." Hence the LTOP was based on opposing a principal which the department had formally stated was "universally accepted" just a few years earlier. Clearly the reason for refuting universally accepted facts was because the Prime Minister's own electorate was aligned with the end of one of the runways. Yet, that clear conflict of interest meant the situation needed special care to ensure justice and transparency, rather than a bypassing of normal environmental assessment and project approval process with blatant own-party-stacking of the committee allegedly representing the community.

The EIS for the third runway specifically stated that a condition of approval of the third runway was that it would NEVER be used for take-offs to the North. Yet the LTOP, by turning the whole airport around, puts the majority of third runway take-offs in the proscribed direction. That reversal of an environmental guarantee isn't to simply overcome peak loads, as even at 10:45pm when there is very little traffic at the airport, Airservices elects to have planes taking off over 733,500 people (Mode 9), rather than over water in still wind conditions (ie Modes 4, 2 or 10)!

Clearly the important omission of any overall measures of LTOP effects was intentional, as adding the components of the model would clearly not support the government's proposition to refute what until now had been "universally accepted" or an environmental guarantee. Most people would suspect some misuse of power, and expect some respite to be provided to the Prime Minister's

electorate. However, most would be shocked to learn just what level of increase in pollution has been distributed over the rest of Sydney to achieve the goal of providing an 84% reduction in the hours of noise to the electorate of the Prime Minister, and to the other blue ribbon Liberal electorates of Sydney's North Shore.

Aside from overall measures, a quantitative assessment is needed for each mode of operation, so that there can be informed discussion as to which modes are to be favoured. Currently the mode (SODPROPS) which affects the fewest people is least favoured, and that mode is the one furthest below its (relatively low) target for hours of use, as set out in the LTOP. A quantitative measure is also needed to assess each of the government's knee-jerk reactions to community complaint, introducing further modes without any community discussion, to give relief to particular electorates at the expense of other electorates. With an overall measure, one could say whether any proposed change or set of changes would come closer to achieving the stated goals. Currently there is no justification, and one has to again revert to electoral boundary maps to work out the politics of why changes are proposed. The LTOP has developed as an accumulation of bad decisions. Most of these have been deals done 'behind closed doors' with undue influence being exerted by representatives of Liberal electorates. The most recent evidence is leaked documentation confirming misuse of power originating directly from the highest office. The facsimile dated 5 February 1998 from the Prime Minister's office, drafted by the PM's Chief of Staff Arthur Sinodinos, to Paul Zammit MP offers to make specific changes to the LTOP to benefit Paul Zammit's electorate of Lowe to the disadvantage of various Labor electorates, as an inducement to prevent Paul Zammit from resigning from the Liberal Party. Clearly this is no way to determine pollution distribution programmes, nor any form of public policy. The Prime Minister, whilst in opposition campaigned for and achieved the sacking of Labor Minister Ros Kelly for an instance of political favouritism, which was amateurish compared to the scale undertaken by the Prime Minister (and, on his behalf by Joe Hockey MP, Chairman of SACF) with the LTOP.

The government's own laws required an EIS for such a major project as the LTOP. Public submissions to such an EIS would clearly have highlighted the increase in the overall amount of noise pollution over the people of Sydney in order to provide the 84% reduction in hours of noise over the Prime Minister's own electorate. With an EIS the public would have been in a position to question whether the costs were simply too high for such pork-barrelling, and whether the airport operations should be switched after each election to meet the private electoral goals of the party then in power. The current approach is comparable to suggesting that electorates supporting the party in power should also receive a more advantageous tax rate to those who live in electorates which did not support the party in power. Australians expect more rational public policy decisions. Australians usually associate political policies of "To the victors go the spoils" with third world regimes, where corruption is rampant. They do not expect it of a government elected on a platform of introducing a higher standard of ministerial ethics and accountability.

In response to the bypassing of an EIS, Minister Vaile has said as recently as February 1998 that "LTOP was set up after 18 months of exhaustive community involvement." The facts are:

a) The taskforce set up to develop the LTOP never met.
b) The community representatives on the taskforce were never shown the public submissions to the taskforce.
c) The community representatives on the taskforce were shown the LTOP flightpaths at the same public meeting when the public were advised of the decisions of the government.

Moreover, the Minister knows that the "exhaustive community involvement" claim is a lie, yet he and other members of the government keep re-stating it, in the hope that if they repeat the claim in a sufficient number of media releases, it will become true.

In light of that misuse of power and bypassing of an EIS, it is now necessary for independent eminent citizens to take over the responsibilities of Environment Australia and develop a framework that can

be used to measure the effects of the LTOP (and the subsequent knee-jerk changes implemented by the government) and to hold the government to account. This paper sets out an impartial method for measuring the overall effect, while still allowing the policy decision-makers to determine policy, without encouraging them to pick individual beneficiaries. With the vast majority of new noise over Labor electorates, and the most significant percentage reductions in noise provided to Liberal electorates, some impartial means is needed to determine fairness.

3) MODEL A: A SIMPLISTIC APPROACH

An 'objective function' is simply a mathematical term for the thing that one is trying to maximise or minimise by one's decisions. For example, an objective function in personal financial planning may be "to maximise the value of net assets at retirement, whilst still meeting essential outlays in the interim". The simplest objective function for planning noise pollution at an airport might be to minimise the overall noise exposure to residents.

To turn this objective function into a formula, one would seek to calculate the noise exposure for every resident at one instant. This can be shown using the sigma notation which means to sum the decibel noise exposure over all the population by adding the values for every resident (ie every value of "i"):

$$\sum_{i} \text{decibel}_{i}$$

But of course one needs to also sum the noise exposure over time (shown by the variable "t"). This gives a figure for the decibel exposure for all residents when summed over the whole year:

$$\sum_{i,t} \text{decibel}_{i,t}$$

Now of course it is impractical to measure the noise level for every resident for every second of the year. However, the existing modelling (if corrected for some flawed assumptions as to aircraft heights) already sums the total noise over an area for the whole year. It is this summing of decibels over time that produces the Australian Noise Exposure Forecast. Hence we can express the above as simply adding the ANEF figure for all people, thus:

$$\sum_{i} \text{ANEF}_{i}$$

But it still isn't very practical to add three and a half million ANEF figures, to get the total noise for all residents in Sydney. Again that isn't necessary, as the electronic mapping software used for all such planning tasks shows dots on the map for each 'census group'. The dot shown is actually the centroid, or population-weighted centre of each 500 residents. Hence if we use "c" to denote each such census point within earshot of KSA's operations, we get a very manageable equation of the form:

$$\sum_{c} \text{ANEF}_{c}$$

Hence, under the simplest model, the objective function can be expressed as minimising the sum of the ANEF values for each census point. Had the LTOP document added the ANEF figures proposed under the LTOP for all census points, and compared that to the sum of the ANEF figures of the pre-existing operational procedures, it would have shown the government's plan to be one which clearly increased noise pollution over people.

4) THE SHORTCOMINGS OF EXISTING ANALYTICAL TOOLS

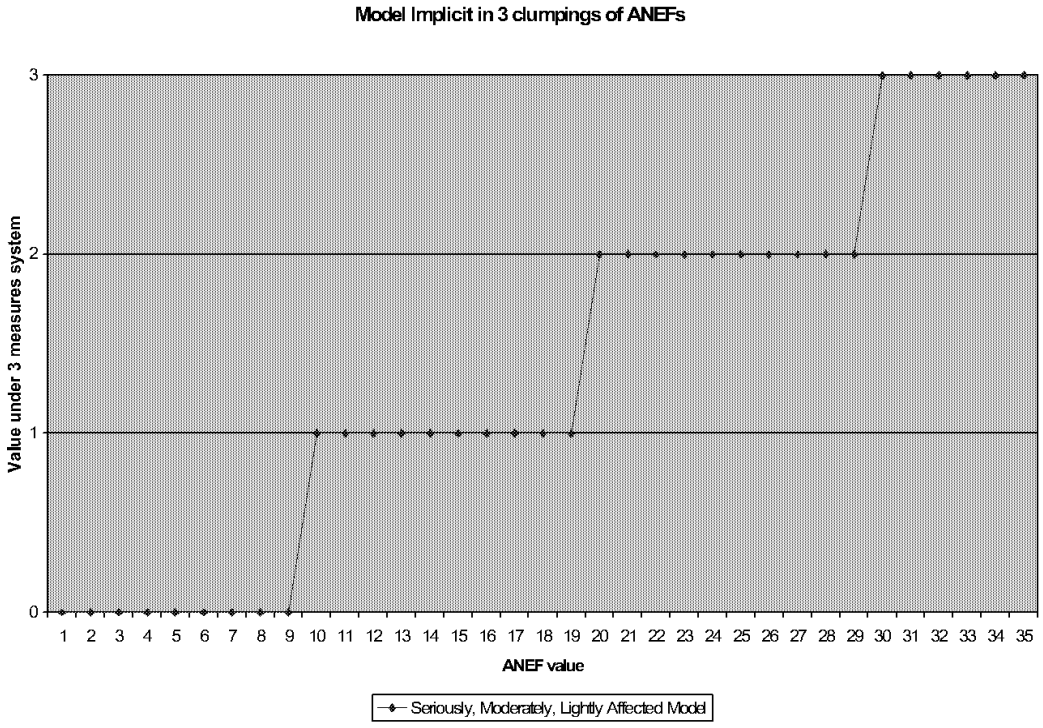
The existing tools are not much better than a simple addition of ANEFs, except for the fact that Airservices does not even issue any figures for changes in the total sum of ANEFs for any proposed change. However, what is often cited by those technically inclined is the numbers of people in seriously affected, moderately affected and lightly affected ANEF ranges.

There are a number of problems with this approach:

a) The cut-offs along the ANEF spectrum are entirely arbitrary and are sometimes selected with the specific intention of 'fiddling the figures' to provide support for the argument being made;
b) The model greatly distorts the effect on populations either side of a cut-off point. A population with an ANEF of 30.5 is considered "seriously affected", whereas the adjoining population with an ANEF of 29.5 is considered only "moderately affected" as if their ANEF was 20.5, even though there is no perceptible change in noise between ANEFs of 29.5 and 30.5.
c) There is no methodology to determine just what increase in moderately affected population is justified to give a slight reduction in the number seriously affected.
d) Because there is no way to weight even seriously and moderately affected populations, usually no consideration is given to the number lightly affected, whereas any reasonable methodology should take into account everyone affected by aircraft noise.

If you combine these problems together, you could literally use this tool to provide technical support for a proposal which gives a ten-fold increase in ANEFs of 29.5 areas for a tiny reduction in ANEFs of 30.5. Importantly this was the tool used to justify the third runway EIS, which is now seen to have been an environmental disaster. This category grouping with no relative weighting is still the preferred tool of Airservices Australia.

The main flaw of this tool is best shown by a graphical representation of the three-stage 'step curve' (even though there is no way to equate between numbers in each category):



Clearly this 'three-clump approach' has a logical problem. The population (taken as a whole) has an intolerance to noise which is clearly smoothly increasing as noise levels and repetitions increase.

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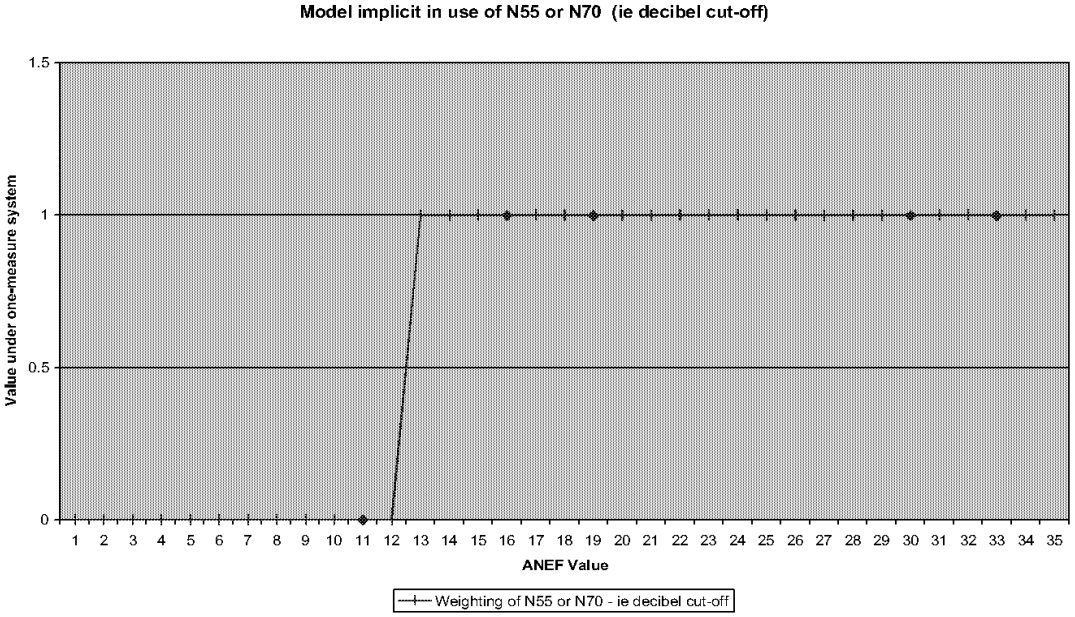
Even if one could show that a single person had some step-function in their intolerance, the evidence is clear that this 'threshold' would vary from person to person. Hence adding overall intolerance to noise over a population MUST produce a smooth curve rising upwards as ANEF values get larger, and such graph should not have any sharp edges or trend reversals (turning points). The 'three-clump approach' seeks to model this intolerance with a very crude step function, despite there being no empirical evidence to support a step function in place of a smoothly increasing relationship. Moreover, the technique is subject to improper use, because of the arbitrariness of the values used. Hence we must use some analysis methodology which incorporates the relative value of each population at each level of ANEF.

A separate tool promoted by some within the community is 'N55' standing for the number of events exceeding 55 decibels. The main proponents of this approach live 20 kilometres from the airport. The main benefit to such activists is that this approach equates the effect of a jet at Sydenham/Marrickville (1-3km from end of runway) with that of the same jet as it passes over Pymble/Ku-ring-gai (some 20+ km from the airport). Clearly these events are not equivalent, and many studies concerning the human response to noise indicates that the decibels of a noise event must be taken into account. The anecdotal evidence is that some fraction of pedestrians will cover their ears when walking past a jack-hammer, whereas they do not take such action when a motor car passes with its engine running – yet those two events exhibit approximately the same decibel difference as a jumbo going overhead at 1km versus 20km from the airport. Again N55 or N70 suffers from the problem that people usually pick the arbitrary cut-off level at a decibel level which supports their argument for or against a particular initiative. The problem with this measure can also best be seen graphically:



The N55 or N70 figure is flawed (compared to measures based on ANEF) because they fail to take into account the smooth nature of the noise intolerance response, when measured for the population as a whole.

A threshold approach for human hearing could well be justified in measuring human response to sub-audible noise levels/frequencies versus audible noise levels/frequencies, but there is no validity to using such method to differentiate within audible noise levels/frequencies. At an overall population level, especially within clearly audible noise levels, we need some smooth (not step) model. Moreover, a single 'step function' is an even worse fit than the 'three-clump approach'. Clearly one needs an overall measure than can properly weight seriously, moderately and lightly affected, and those above and below the 55 decibel level, into one overall meaningful measure.

While not a suitable measure for noise impact, it is useful to put N70 and/or N55 numbers on ANEF charts prepared for public distribution, so that the public also know how many disturbances they can expect per average day. However, endorsing N55 and/or N70 as useful additional count information to disseminate is not an endorsement that such 'simple count figures' are more appropriate figures to use in building an overall impact minimisation model. The fact that most North American and European countries use a cumulative index (similar in overall structure to ANEF) supports the decision of the Australian National Acoustics Laboratory to use ANEF for noise impact.

5) MODEL B: MINIMISE NOISE WITH SHARING OBJECTIVES

The major problem with the simplistic model is that it does not give any incentive to "fair sharing" of noise, which is a stated objective of the LTOP. In other words, because the addition of ANEF figures for various areas is linear, the overall measure does not discriminate between scenarios which would put double the noise over one area, as opposed to half that noise over two separate areas. That is because an ANEF of 30 for one area and zero for another, contributes the same total as a situation where each of the two areas gets an ANEF of 15, because the noise was shared fairly. Clearly this is a shortcoming of the simplistic model, and needs to be taken into account with any model actually used to assess such changes to operational procedures.

The simplest way to overcome this problem of linearity is to add some 'raising to a power' to the relevant variable, as raising to a power will disproportionately increase the weighting given to large numbers. Hence by raising the ANEF value to some power, one is encouraging a minimisation model to shift noise away from locations which already have an ANEF of 30, to locations with lower ANEF figures. Hence this process provides an incentive for sharing rather than concentration of noise.

The appropriate form of the formula is as follows, where 'P' is the value of the power to which the ANEF value of each census point (c) is raised, prior to summation of the results over all census points:

$$\sum_{c} \left((ANEF_c)^{\mathbf{P}} \right)$$

Because the value of 'P' (the power to be raised to) is the same for all census points, it means that no particular electorate can have more 'weight' or 'say' in what constitutes 'fair sharing', 'reciprocity', or 'respite' - each such term having hitherto been used to promote self-interest.

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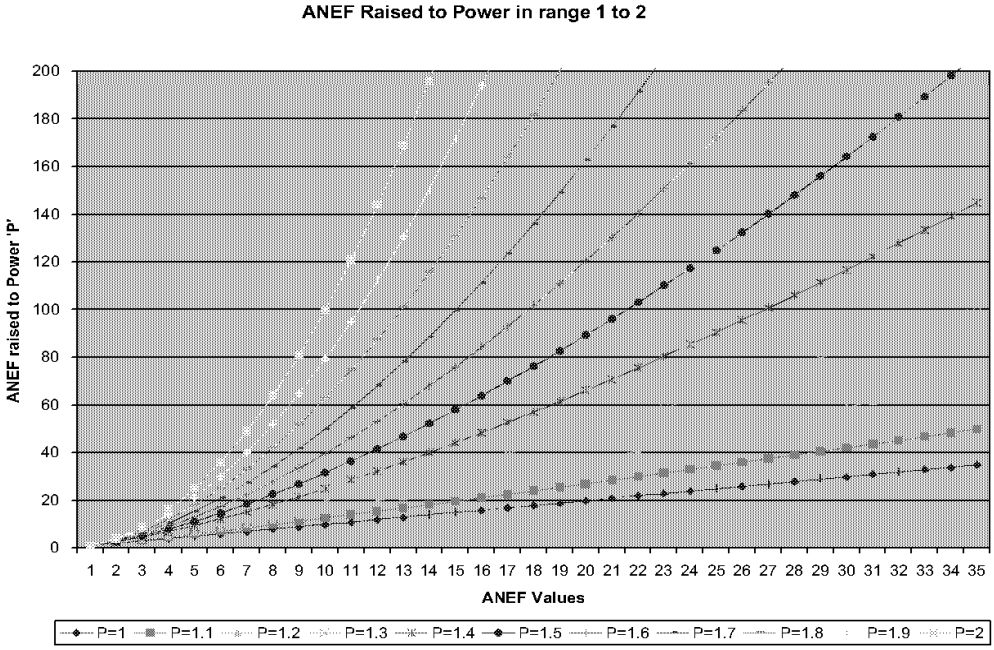

As can be seen from the above graph, as one increases the value of 'P', the faster the graph climbs as the ANEF values increase. Of course, we already know P=1 is just a linear relationship, putting no additional value on higher ANEF values, whereas P=2, the traditional 'square' of the number (ie $ANEF^2$) is the steepest line shown on the graph (though P could theoretically have higher values). Indeed, while a somewhat bold statement, one could say that in light of the fact that the value of 'P' changes the steepness of the curve, the range of all values of 'P' cover all the plausible relationships between ANEF and response to ANEF that meet our criteria of (a) being smooth, (b) increasing more than linearly, (c) having no decrease in gradient or turning points and (d) where no noise brings no intolerance (ie the graph passes through the point X=0, Y=0). To be strictly correct, a more general form of functions which fit our criteria actually include a coefficient (let's call it 'r') in front of the raising to a power, ie $\Sigma(r \ast ANEF^P)$. But because the 'r' coefficient applies to all such terms within the summation (Σ), the 'r' can be brought to the front of the summation, ie $r \ast \Sigma(ANEF^P)$. So in fact the 'r' becomes irrelevant in terms of seeking to minimise such a function.

So just what values of 'P' make sense? If P=1 then you have absolutely no incentive for sharing, as you are simply summing the ANEF values over the whole population, without any incentive to lessen the concentration of the components that add to that total noise figure. As noted above, doubling-up twice as many planes over one census point to produce a relatively high ANEF of 30 (say) would have the same effect (if P=1) as splitting flightpaths to have two census points sharing that noise (each of which would thereby have an ANEF of 15). On the other hand, a value of P=2 (ie the objective function is to minimise the squares of the ANEF values) is a relatively extreme incentive

for sharing at any cost. Consider again the case where one census point could have an ANEF of 30 compared to two census points having ANEFs of 15. The square of 30 is 900, and the square of 15 is 225. Now there are two 15ANEF census points to consider, so the contribution is twice 225 or 450. But 900 is over twice as large as 450, so using a value of 2 for 'P' would lead to solutions where over four census locations would be given an ANEF of 15 to avoid giving one particular location an ANEF of 30. In other words, using this example P=2 means you would be prepared to have a 300% increase in overall noise to achieve sharing. The other hypothetical case to consider is further from the airport. If you could move concentrations of even moderate noise, such as ANEF values of 10 off one area, and fan a flightpath over a wider area, giving ten times as many census points (with an average value of 1 ANEF), you need to compare the square of 10 (ie 100) to the sum of ten times one squared (ie 10). In this example (using P=2) means you would be prepared to have a 900% increase in overall noise to achieve sharing. In short, squaring the ANEF figures gives such inordinate weight to large numbers that it may induce an inordinate growth in overall noise, to achieve respite on 'normally concentrated' corridors.

So just what is the right value of 'P' to use? Credible values are in the range 1.25 to 1.75, with the position within that range a truly political decision. While the decision on a value of 'P' is political, it is truly "without fear or favour" to use Minister Vaile's term for defending the current ad hoc (and clearly compromised) approach. To see the result of raising typical ANEF values to such powers, refer to the above graph or the corresponding figures shown in Table 1 at the end of this paper. Let's examine the outcome with a mid-range value of P=1.5. To do a sample calculation one looks up ANEF values down the left hand side of Table 1 and then looks at the equivalent entry in the column headed "1.5". An ANEF value of 30 raised to a power of 1.5 gives a result of 164. Twice the population exposed to an ANEF of 15 would yield a figure of 116 (twice the value of 15 raised to a power of 1.5 – ie twice the number 58 found in the "1.5" column of Table 1 for an ANEF of 15). Hence with this value of 'P', you would be prepared to have an overall increase of about 40% (164 compared to 116) in the number of people affected by half the level of noise, as concentrate all that noise over just one group.

Indeed, as 'P' is a somewhat mathematical parameter, it would be useful to have the public debate and resultant policy decision determine just what percentage increase in overall population affected by moderate noise would be tolerated to lessen severe noise over people. If you use the example of going from an ANEF of 30 to an ANEF of 15, any given percentage will determine one and only one value of 'P'. If instead one decided that an ANEF value of 20 was more typical (than 30ANEF) for significant noise in residential areas, and compare that with an ANEF value of 5 if fanned, a given percentage increase to obtain "fair sharing" would result in a slightly different value for 'P'. Hence 'P' can be determined directly or can be derived from an 'acceptable percentage increase' in overall noise to achieve "fair sharing", by asking some appropriate hypothetical question of this type.

Importantly, whether 'P' was determined directly, or by deciding an acceptable percentage increase in overall noise to achieve "fair sharing", neither method allows the voting preferences of the specific communities affected to be explicitly taken into account. This is needed to overcome the effect that Joe Hockey has publicly described as "whether they vote Labor or Liberal" (***Southern Courier*** 24 February 1998).

However, the value to be used for 'P' is indeed a valid policy issue. It is that value which should be debated in public forums and discussed. The value used for 'P' is the fundamental trade-off between the preparedness to have additional total noise in order to provide respite for those most affected.

6) BENEFITS OF AN OVERALL MEASURE

The benefit of a formal model and a 'sharing parameter' is that it elevates the discussion above one where each politician draws flightpath changes on whiteboards to move noise away from his own electorate onto the nearest electorate held by the opposition party. It may seem ludicrous to even think of a 'whiteboard approach' to such major public policy questions, but that IS exactly what has

dictated the LTOP to this point. The proof of the Ros Kelly style bias is that virtually every change implemented to the LTOP has had the effect of benefiting Liberal electorates at the expense of Labor electorates - the very few jet departure paths that crossed the middle of Liberal electorates (excluding the now-Independent seat of Lowe which had to be crossed to get the planes off the Prime Minister's electorate) were each removed between the draft and the final LTOP, as a result of Liberal politicians making submissions and obtaining specific relief for their electorates. The opposite treatment was delivered to non-Liberal areas.

This approach is what led Paul Zammit MP, Independent Member for Lowe, to say on an Australian Broadcasting Commission ***4 Corners*** Programme (shown nationally on 2nd and 3rd March 1998) that "The issue of aircraft noise is beyond politics. It is not about maximising the use of an airport to the detriment of the health, well-being and lifestyle of people. It is not about a 'winner take all' attitude by political leaders who redesign flightpaths to favour themselves and their mates."

Paul Zammit was wanting to hold the Prime Minister to the PM's electoral promise "I want to state categorically that those who have not been affected by disruptive and loud aircraft noise in the past in the seat of Lowe, will not be affected in the future." as reported in the ***Sydney Morning Herald*** of 9 February 1996. And of course Mr Zammit is correct in noting that the government has clearly broken this electoral promise. Mr Zammit has pointed out that the PM has kept his electoral promise to his own electorate of Bennelong with respect to aircraft noise. But the bigger question is: Where is the probity in the PM making 'categorical undertakings' to just particular electorates on an issue that is clearly Sydney-wide? The act of making these commitments to particular subsets of the community introduced impropriety from the outset. How can the politicians now claim they haven't meddled, when they promised to meddle from the outset?

Another independent, Clover Moore has not had the benefit of any promises. She was unable to obtain **ANY** representation for her electorate on the forum allegedly representing the communities affected (SACF) despite a major new flightpath having been introduced over her electorate with no community consultation, and no disclosure of such likelihood in the draft LTOP. As the flightpath was one moved off a Liberal electorate, the Liberal politicians running SACF were derisive of the concept of having independents on SACF. But the issue is that the government did not want the community forum to provide adverse feedback on the ad hoc and clearly biased manner of the government's pollution distribution decisions.

Any quantitative measure needs to be compared to the current system, whereby decibels falling on the Prime Minister's electorate are given an implicit weighting at least ten times higher than decibels falling on Labor electorates; and decibels falling on other blue ribbon Liberal electorates are given an implicit weighting at least five times higher than decibels falling on Labor electorates. No government would stay in power if it seriously suggested that the amount of unemployment benefits paid to an unemployed person would depend upon whether the particular recipient lived in a government or opposition held electorate. Similarly, no politician would seriously suggest that there should be two scales for personal tax rates, a lower one for taxpayers residing in government-held electorates and a higher one for those in opposition electorates. Yet the current system of the LTOP design and on-the-fly modification is an exact embodiment of that very principle.

Some have suggested that one cannot reduce aircraft noise to an overall measure of impact. It is correct to say that from an Information Theory perspective, every time one collapses a dimension of the problem to a single value, you loose information. Yet only by collapsing dimensions can one get any quantitative measure. If one said "I don't agree with the 'frequency weighting curve' used to collapse a noise into a single decibel measure, then one would be forced to do all the subsequent analysis using an array of intensities for each frequency, which would undoubtedly lead to information overload in the assessment by the typical person. Moreover, if take-offs versus landings had a variance in terms of the typical frequencies (which they do) then different parts of Sydney would want to argue over which frequencies one should place most weight upon, in order to bolster

their own argument. Now the frequency weighting curve used to produce a decibel figure is somewhat arbitrary, in that it roughly cuts off with a typical person's frequency range, but the main thing is such curve was determined a priori and is, on those grounds alone, neutral as to various interest groups. Similarly, we should determine the curve by which we weight higher ANEFs as being worse than a simple additive effect, and do it a priori, so that there is no argument as to its fairness.

The community as a whole needs a single overall measure, so we can all know if we are progressing to our stated goals or if a proposal is contrary to the achievement of such goals. But that is certainly not advocating the destruction of the next level of information. Additional information will always be appropriate for those close to the problem. An experienced stockbroker will not be satisfied in knowing just the overall Dow Jones or All Ordinaries index to understand how a stock market performed. He/she will want to know the figure for each category, such as the Resource Stock index, Industrials index etc. He/she will probably also want to know how particular stocks performed. But wanting to know deeper levels of information does not invalidate having an overall measure, such as the Dow Jones or All Ordinaries index. Indeed, much of a stockbroker's numerical analysis REQUIRES the availability of some overall index value. Similarly, those close to the management of the LTOP will still want to know ANEF contour maps, population numbers affected etc, while the population at large needs to know that there is a fair overall measure in use.

7) OTHER EQUIVALENT FORMS OF MODELB

It is tempting to think that there must be many other (equally valid) ways of modelling the distribution of noise pollution. Yet those with validity or 'fit' are amazingly equivalent when calculations are undertaken.

One could say "Why limit the noise variable to being raised to just one power, (ie $ANEF^P$) when obviously that is just one simplification of a whole class of formulae of the form:

$$\sum_c (a * ANEF_c) + (b * ANEF_c)^2 + (c * ANEF_c)^3 + \ldots$$

But of course the raising to a non-integer power (eg 'P' in its likely value range between 1 and 2) can be expressed as a formula of exactly this format. And if one changes the values of the coefficients a, b, c … from the relative ratios implicit in the use of a single value of 'P', you introduce wiggles (changes in rate of gradient or even turning points in mathematical terms) into the graph of this function of ANEF. In other words, with different ratios of b/a, c/a, d/a etc you would find that, instead of progressively penalising more and more against higher ANEF values, you would at some points in the range of ANEF numbers diminish that penalisation, or worse still encourage higher ANEFs! Hence adding the ability to fiddle lots of parameters only introduces problems. Besides logic dictates (and a 'degrees of freedom' analysis requires) that just one parameter should be used to handle one implicit trade-off – more noise to meet sharing goals. Hence introducing additional (presumably co-related) parameters is neither justified nor logical, and only opens up possibilities whereby formulae could be intentionally distorted to reintroduce political bias.

8) UNSUITABLE FORMS OF MODELS

When drafts of this paper were circulated and reviewed by representatives of most airport action groups in Greater Sydney, feedback arose along the lines 'But what if the more appropriate model is some form of log function, rather than a raising to a power?' Hence it is worthwhile addressing this particular issue, to mathematically prove that no suitable model can exist which is based on a log function.

Now it is true that human hearing is somewhat logarithmic in nature. A noise wave that has ten times the energy of a less energetic noise wave, will sound about twice as loud to the human observer. But this log function is already incorporated in calculating a decibel level. The relationship can be thought of simply as Noise_level_in_db = Log_{10}(Wave_energy). Hence applying another log

function to a noise level accumulation (ie a measure that is already a sum of decibel log functions) would seek to 'double discount' higher noise levels (because it would be a log of a log of wave energy).

The effect in using logs on ANEFs can be tracked with some simple maths. $Log_{10}(10)=1$; $Log_{10}(100)=2$; and $Log_{10}(1000)=3$ etc. In general $Log_{10}(10^X)=X$, which confirms that the log function is the logical opposite (reciprocal function) of raising to a power. It is possible to prove that, because of this, a log function is the logical opposite of the type of relationship we are seeking to model for fair noise distribution. Indeed a log function would have the effect of encouraging concentrations of noise! $Log_{10}(31.5)=1.5$. Hence if we used log functions of ANEFs, we would be saying that an ANEF level of 31.5 is only 50% worse than an ANEF of 10. Similarly, with a log function we would be saying that an ANEF of 100 (ie living right on the runway tarmac) is only 50% worse than an ANEF of 31.5, or only twice as bad as living 10-15 km away with an ANEF of 10. Clearly this is not the case. It is because the log function is intentionally discounting the effect of additional noise that the use of a log function would encourage concentration, whereas one of the goals of the LTOP is fair sharing, which inherently requires the discouragement of concentration. Another way of thinking about log functions is that a log function drops 'below linear' as ANEF increases (ie the log function would fall below the P=1 straight line on the earlier Model B graph of $ANEF^P$), whereas all the likely models we need to encourage sharing must rise above the linear relationship as ANEF values increase. While the mathematics/logic may be a somewhat difficult for the average person interested in noise sharing, it is important that we rule out these other forms of possible models, in order to get to one which does meet the requirements and provides fairness and impartiality. This proof against the suitability of log functions remains applicable, irrespective of the base used for such logarithmic functions (ie base 10, base e, or any other base), because the 'less-than-linear-growth' is a fundamental attribute of logarithms (and why logs are useful for modelling the opposite type of relationship to raising to a power).

9) MODEL C: ADJUSTING FOR ACCEPTABLE BASE NOISE LEVEL

An adjustment which can be supported by logical argument is to have 'the raising to a power' only apply to ANEF values above a particular acceptable level. All ANEF values would have to be added into the objective function, but the additional incentive/penalty brought about by the component of 'P' greater than one would apply only when the ANEF value exceeds some acceptable level of background noise. In other words, one might say an ANEF of 5 is entirely acceptable and hence one could vary Model B to apply the power to only that amount of the ANEF in excess of 5 (say). This is a 'horizontal axis offset', and cannot have the effect of introducing corruption of the concept of encouraging sharing. The argument supporting this adjustment is that a low ANEF could be put over large numbers of people without interference to their lives, yet anything above this level (ie rather than above zero) should be actively discouraged. The form Model C would then take is as follows:

$$\sum_c \left((f \star ANEF_c) + (\text{If } ANEF_c > 7 \text{ then } (ANEF_c - 7)^{\mathbf{P}})\right)$$

where 'f' represents the fraction of 'base ANEF' that is left in the model, even if the ANEF for a particular census point is below the acceptable level. The constant 'f' could be set to zero if the community thought that there should be no weighting against sub-acceptable ANEF distributions over populations. At the other extreme, 'f' could be set to a value of one, if the community wished to fully penalise even sub-acceptable ANEF distribution. Naturally any value between 0 and 1 could also be used. The argument for some penalisation (f>0) of sub-acceptable noise is because the model is seeking to minimise overall pollution, so even sub-acceptable ANEFs should still be included to some extent. The argument for not having full penalisation (f<0) of sub-acceptable levels of noise is to make sure that the model does not prevent some "fair share" of noise going to the Western suburbs on the basis that, even after fully taking into account those truly affected, because the model is minimising the extent to which flightpaths go over people at all, f=1 could provide sufficient incentive to put all aircraft noise only over Southern, Northern and Eastern flightpaths. Unlike the previously considered blanket ratio coefficient 'r', this coefficient 'f' cannot simply be dropped,

because 'f' does not apply to all terms within the summation (because it doesn't apply to the terms being raised to a power). Hence it is valid to leave 'f' in the model.

For the sake of simplicity let us assume that the computer model will be prevented from raising any negative numbers to the power 'P' (lest we introduce reverse incentives to those intended). Accordingly, for shorthand we can drop the IF statement to make the formula more readable here. Whilst it would make all the formulae in this paper too cumbersome to read, every formula which involves raising any number to a power, such as X^P should be formally stated as $(\max(0,X))^P$ meaning that the value of X is compared with zero and the larger is raised to the power X. Again it must be stressed that the "IF _ THEN _" or alternatively the "MAX(0,_)" construct needs to be incorporated into any computer model, and the extended format is dropped in all formulas in this paper, simply to keep the formulae readable.

Now we should also use the notation $ANEF_{Acceptable}$ in place of the arbitrary ANEF value of 5 to make the Model C formula:

$$\sum_c \left((f \star ANEF_c) + (ANEF_c - ANEF_{Acceptable})^{\mathbf{P}}\right)$$

ie: Minimise: Fraction of Base Noise + Incentive to fairly share noise over acceptable level

Naturally $ANEF_{Acceptable}$ must be a constant – ie the same for all areas of Sydney. If one were to vary such a constant for different census points one would end up corrupting an impartial quantitative analysis to mimic what is done at present, where acceptable ANEF values are implicitly weighted according to the say each electorate has in the Federal cabinet.

The difference between this formula and Model B is that only the ANEF component which is above the 'acceptable level' of noise is grown disproportionately. Technically, if all ANEFs are added in with a value of 'f' above zero, as well as the ANEF component above the acceptable level being raised to the power 'P', the value of 'P' will be lower in this formula than in Model B, to give the same sharing incentive. The only issue with this modification is that one would really need to be certain that the level of 'acceptable noise' was indeed that acceptable to the population at large, and not a figure wishfully inserted by Airservices to downplay the aircraft noise problem. Hence, for this reason alone, this model does not add much for its additional complexity – not that an offset is complex, but the process allows bias to be reintroduced, with little overall gain. Yet of all the possible ways of introducing a 'threshold', this model appears to be the most valid and impartial mechanism.

10) A SOLUTION TO THE 'KURNELL CONUNDRUM'

Now of course a locality like Kurnell will always get a significant share of the noise burden. That is because Kurnell has a population of only a few hundred families, yet it is the only population directly to the South of KSA's parallel runways, compared to approximately 1.5 million people spread over the other three compass directions from the airport. Hence any reasonable value of 'P' will still tend to prefer relatively high noise levels for just this one census point. This is not an attribute of this particular model. Any quantitative model for minimising noise pollution impact will favour putting significantly more noise to the South than the LTOP does, because of the approximately 1000:1 ratio of relative populations, when one compares the South to the North, East and West. However, this is not so much a problem as an indicator pointing to a solution.

The real answer lies in the appropriate financial remuneration for that small number of residents at Kurnell. For far less cost than has already been put into noise insulation of homes around the airport, one could reimburse the people of Kurnell for their historical financial loss. The correct method is not to pay them money in proportion to home prices, but to pay them for only the difference they would have made had they spent the same amount purchasing a home elsewhere in greater Sydney. Hence someone who bought into Kurnell in recent years (and hence got a low purchase price because

it was already heavily noise affected) has not been as disadvantaged as someone who bought their house in Kurnell in the 1950s (ie before jets came onto the scene). The correct way is to use the Valuer-General's figures. If that NSW department can't provide the necessary figures, then one would use the (possibly more reliable) home price-by-suburb figures already commercially available from companies such as Residex, RP Data or Australian Property Monitors. The private firms discard transactions too far away from the median price in a suburb for median price movement tracking. The discarded transactions usually represent non-arms-length transactions (eg sale to a family member) or are an extraordinary property (eg many times normal block size for the suburb), the inclusion of which would distort price movement trends.

One only needs two tables of thirty numbers. The first table is the growth rates for Kurnell median house prices for each year between 30 years ago and the present. The second table is the equivalent growth rates for Sydney-wide houses as a whole. Then if someone has owned a house in Kurnell for (say) 10 years, and the average growth rate in Kurnell over that time was only 4%, compared to a Sydney-wide figure of 8%, then the owner should be paid the compound interest of 4% for ten years on his purchase price.

The cost of such a programme is far less than the cost of purchasing all properties in the suburb. It also recognises that some residents are very fond of the area, are used to the planes and would not like to be forcibly relocated by the government "because some bureaucrat thought it was best for them". Now the government should offer some continuing price protection (ie buyer of last resort) for a limited period, so that more noise over Kurnell in the subsequent 18 months does not cause significant erosion in prices below that used to calculate the reimbursement. Importantly, the department would need to track all property addresses in Kurnell, so that the reimbursement was paid only once in respect of any particular property. This would stop one owner claiming the reimbursement, selling the property and having the new owner claim another reimbursement. Once reimbursed, yet opting not to sell, each owner would be made aware that they had no further claims against the government. That would leave the community at Kurnell in existence, and is a friendlier approach than razing quaint waterfront houses. Besides, the properties could end up as low cost rental accommodation (which the government otherwise has to fund at considerable expense per dwelling). Alternatively, Kurnell could become the hub of a deaf community (people who were deaf from birth or misadventure – not those who become deaf from living under jet flightpaths). Hence this method is far more considerate of the community's desires, and cheaper than compulsory acquisition.

Importantly, once such reimbursement for pollution effects was made, the census point of Kurnell (or any other such area covered by that reimbursement programme) would be excluded from the objective function. In other words the objective function would become "minimise the cumulative ANEF raised to the power 'P', excluding areas fully reimbursed for noise effects."

The only similar variation worth considering is some discount (not removal) of ANEF figures for communities where comprehensive noise insulation has been completed. Like Kurnell this would only affect small numbers of communities very close to the ends of the runways, but it would lessen the current propensity to move planes off these close-in runway-aligned localities, with the effect of putting high levels of noise onto adjoining (non-insulated) areas, which possibly makes even less sense.

From this point forward, each formula assumes that the weighting of ANEF figures for fully-reimbursed areas is nil; and that the weighting of ANEF figures for fully-insulated communities is halved (say). However, such discount factors are not explicitly stated in the quantitative models of this paper (for simplicity of formula representation).

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11) OTHER CENSUS POINT ADJUSTMENTS

There is also a valid argument for taking into account people engaged in 'quiet outdoor leisure activities'. This is to address the concern that significant recreational resources should not become the 'dumping ground' for aircraft noise, simply because they don't have census points. Hence one could validly take into account locations such as Centennial Park, Bondi Beach, Cronulla Beach, other popular beaches, the Royal Botanical Gardens, Zoo, Lane Cove National Park, Royal National Park and equivalent sites.

However, it would be flawed to extend this concept to 'double counting' everyone, by incorporating all workplaces as well as residences. Most people in offices or shopping centres have significantly more noise insulation (especially in air-conditioned sites) and a far higher level of background noise than exists at home. Workers in factories, warehouses and strip shopping centres may not have the noise insulation, but have far higher levels of background noise, also suggesting that they should not be double counted. People driving their cars and trucks should also not be double-counted as they are generally distributed roughly in accordance with the overall population distribution, as well as having very high levels of background noise. The special circumstances for quiet outdoor recreational areas (eg parks) is that they are sufficiently large open spaces to not be covered by existing census points, and one would not want a model to unnecessarily target them for noise on this basis. Hence any outdoor recreational areas with an annual average day-time population exceeding 500 people (excluding those attending noisy events) should be assigned the relevant number of 'bonus census points' on the digital map. The reason for excluding people attending noisy events is to recognise the difference between the average day-time user of a park, and those attending the Sydney Football Stadium or Hordern Pavilion for a sporting event or concert (which are typically net producers of noise pollution).

12) MODEL D: TAKING INTO ACCOUNT HISTORICAL DISCOUNTING OF REAL ESTATE ON TRADITIONAL NOISE CORRIDORS

Model C detailed how to take into account an 'off-set' due to the determination of an 'acceptable level of noise'. The only other justifiable way to deal with 'off-sets' is to seek to take into account previous discounting of residential areas because they have historically received high levels of aircraft noise (and air) pollution.

This approach introduces significant ethical and legal problems and has the potential to be very divisive within the communities involved. Importantly, not every owner within historically affected areas bought into the suburb in the last decade when the noise became much worse. Many owners in such areas purchased their properties long before the aircraft noise problem became a serious problem, and hence they received no 'buy-in discount' because of aircraft noise. Hence the 'historical discount approach' has the problem that not everyone to be preferentially burdened now was a recipient of the benefit for which they are now being asked to pay! In law this approach is never allowed, as it is equivalent to suggesting that ALL relatives of Alan Bond are automatically responsible for his debts, because they presumably received benefits from his breach of fiduciary duty (misuse of company/creditor funds). The problem is that a relative could claim they didn't receive any improper benefit, and hence seeking to impose a burden on them (without any onus of proof) is a form of 'class discrimination'. Similarly, those who have held properties in traditional noise corridors for an extended period could claim (and prove) they never received the benefit, for which they will now be penalised. Hence there are legal and ethical problems with this approach. However, for completeness, this paper will examine how the quantitative model would be adjusted to take into account such a factor, if it was deemed appropriate to proceed down this path.

A related problem is the question of what year's noise levels should one assume are already factored into the average home price discount. The reality is that the noise impact and discount changed each year. Many in the East paid high prices to purchase properties not affected at all by aircraft noise in the years when the East-West runway was closed (following the opening of the third runway in

November 1994). Those in line with the parallel runways would suggest that their problems (and discounts) only became really serious when the airport moved to rely almost exclusively on parallel runway operation. There is also an argument that Simultaneous Independent Mode of Operations (SIMOPS) used in 1988-94 was quite atypical, in that the pre-1988 allocations were more 'traditional'. The challenge is to determine a fair way to incorporate such effect, setting aside for the moment the question of whether such factor is fair. Either way it would be a two-edged sword for both major political parties. The Liberal government is presently putting heavy concentrations of noise on Labor areas under the Coogee/Maroubra and Rockdale flightpaths, citing that theses areas used to receive significant noise (before the East-West runway was closed). Yet the same government is providing an 84% reduction to the Prime Minister's electorate on the grounds that such residents (who have traditionally received noise) now deserve respite. No matter how such historical factor was incorporated, it would deal with the Liberal North Shore in the same way as the Labor East and West, overcoming the problem of contradictory policies based on political allegiances.

As with Model C, some fraction 'f' of the base ANEF (ie the component not raised to a power) should remain in the formula, so that ALL pollution is factored into the objective function, while applying the disproportionate penalties/incentives against noise levels in excess of half (say) of the historical ANEF figure for each census point (c). The reason one should not want the penalty function to 'kick in' at only the full historical level of ANEF is to overcome the argument that the airport has not been historically managed in anything like an optimal manner. The airport may have been run in a safe manner, but operations were never organised with a goal of lessening the pollution effects on the people of Sydney. If you had the disproportionate penalties 'kick in' only above full historical levels, it would be equivalent to saying that Hunters Hill should bear the full impact that it used to have, before there would be any need to consider respite/sharing. Clearly this is not consistent with a goal of "fair sharing".

Hence the correct way is to simultaneously take into account both concepts of:

a) all noise that can be shared, should be shared; AND
b) to the extent concentrated noise is still unavoidable, such concentrations may as well be located where they have already been factored into residential real estate prices.

This leads to a model when the single raising to a power factor 'P' is replaced by two factors, each involving raising to a power (ie splitting 'P' into component factors). One factor (let's call it alpha) is to favour sharing generally, whilst the second factor (call it beta) is to favour concentrations (to the extent they can't be avoided) being put on historically noise-affected areas in preference to new previously-unaffected areas. The resultant formula is (again assuming we force the computer model to insert zero as the result of raising any negative numbers to any power - to prevent reverse incentives):

$$\sum_{c} (f \star ANEF_c) + (ANEF_c \quad ANEF_{Acceptable})^{\alpha} + (ANEF_c \quad 0.5 \star ANEF_{Historical})^{\beta})$$

Minimise:	Fraction of Base Noise	+	Incentive to fairly share noise over acceptable level	+	Incentive to allocate remaining concentrations in historical areas

There needs to be one further check - that one is not using inconsistent starting points for the two raisings to powers. Specifically, half the $ANEF_{Historical}$ should not be less than the $ANEF_{Acceptable}$, lest one would be saying that there should be a more-than-linear incentive to keep some areas below a noise level that is considered an acceptable baseline for the whole region. This would be logically inconsistent, but only needs a MAX() function of the two factors to correct. This also ensures that alpha and beta are somewhat 'comparable parameters', in terms of choosing values for each from hypothetical situation questions. While this paper has tried to keep all formulae readable, it is necessary here (for completeness so that it is clear how to precisely implement a computer version of Model D) to specify one complex formula. Hence the full implementation of Model D with the only change being the incorporation of the relevant Max() functions is:

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$$\sum_c (f * ANEF_c + \max(0,(ANEF_c - ANEF_{Acceptable}))^{\alpha} + \max(0,(ANEF_c - \max((0.5 * ANEF_{Historical}), ANEF_{Acceptable})))^{\beta})$$

Let's call this 'The Definitive Model D Formula' for later reference. Technically one could replace the 0.5 reference to the $ANEF_{Historical}$ 'kick in' point with a more generalise parameter, but moderate changes in this parameter from 0.5 make little difference. It is important to note that incorporating alpha and beta factors is not a suggestion that these two inventive/penalty factors have anything like the same relative weight in the overall formula. The object of this paper is simply to specify how such component approaches can be incorporated. One possible scenario is that, after considerable public debate, public opinion puts very little weight on the concept of historical real estate discounting versus present fairness, and so the beta can be very small, making the historical factor relatively unimportant, with the major 'sharing incentive' being solely the alpha factor, because it is completely suburb-neutral and party-neutral.

The reason for showing alpha and beta factors separately is that this more generalised form of the objective function allows for the historical factor to be incorporated, to the extent that approach might obtain broad community support. Irrespective of the value of beta, this approach would at least prevent the historical factor being cited as the basis for concentration of noise on electorates of the party not in power at the time, while the opposite concept of respite/sharing is cited to remove noise from historical corridors within electorates held by the party in power at the time.

The best way to determine the values of alpha, beta and 'f' is to utilise the services of an expert in such matters, such as Professor Jim Parkin of the Graduate School of Engineering at University of Technology, Sydney. He has written a book on the subject titled "Judging Plans and Projects" by Ashgate Publishing, Aldershot, UK, 1993 (ISBN 1 95628 434 4). His "case judgement" methodology would be well suited to the problem of coming up with unbiased estimates of alpha, beta and 'f', or failing any agreement, determination of a value for Model B's 'P'. Prof Parkin's own methodology entails presenting various groups (community, political, planning etc) with hypothetical alternative scenarios which are scored on various factors considered salient to the decision. A set of weightings can then be produced that captures the values expressed by the sample. These are then applied in the evaluation of real alternatives, and rank the alternatives on the basis of the captured values. A combination of his methodology and the appropriate quantitative model would result in a fair mechanism, which would demonstrably have broad community support through real consultation.

13) AN ALMOST EQUIVALENT FORM OF MODELD

One possible change that could be justified (for widespread understanding) is to replace alpha and beta with simple coefficients of the square of the relevant factors, if that was necessary to overcome the average person's conceptual difficulty in understanding the raising of numbers to non-integer powers. It is not quite as good, as this approach forces the noise/share trade-off to a second power (ie the only value of 'P' that it allows is P=2). In practice this puts slightly too high a cost on the achievement of "fair sharing", but it is nevertheless a 'workable variant'. The equivalent formula is:

$$\sum_c (A * ANEF_c + B * (ANEF_c - ANEF_{Acceptable})^2 + C * (ANEF_c - 0.5 * ANEF_{Historical})^2)$$

ie: Min: Base Noise Component + Incentive to fairly share noise over acceptable level + Incentive to allocate remaining concentrations in historical areas

Mathematically, 'A' is identical to 'f', the relative value of 'B' is entirely correlated with alpha, and the relative value of 'C' is entirely correlated with beta. Again, in any proper implementation, there is a need to put appropriate MAX() functions around some terms, to ensure against raising a negative number to a power and to ensure that the historical reference level is not below the region's overall baseline value of acceptable ANEF.

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14) THE MODEL D PROBLEM OF FAIRLYCALCULATING HISTORICAL ANEFs

Whether one uses alpha and beta powers, or B and C coefficients under Model D, the problem remains: How do you determine the historical ANEF figure to use for each census point in a fair and consistent manner?

The most appropriate way to do this is with a 'moving average' whereby you start with the ANEF figure of 30 years ago, and to calculate the moving average for 29 years ago, you calculate 85% of the 30 year ago figure and add 15% of the 29 year ago figure. Then for the next year, you again take 85% of the moving average to that point in time and add 15% of the current year value. This can be represented by a simple formula, for each census point (c) for each year (t):

$$ANEF_{Historical\ c,\ t} = (0.85 \ast ANEF_{Historical\ c,\ t-1}) + (0.15 \ast ANEF_{c,\ t})$$

The physical reality that this encapsulates is an assumption that approximately 15% of the population change rental accommodation or sell their houses in any given year. This approach ensures that no one year's ANEF figure is used, to overcome the Marrickville/Leichhardt/Bennelong argument that "but we didn't have that level of noise until the third runway was opened", or the Coogee/Rockdale argument that "but we had no noise here until the Howard government came to power and re-opened the East-West runway". A moving average if far fairer than some simple average over the past 30 years, as the moving average puts less weight on the very old values. Whether one uses 10% or 25% as the 'current year weighting' in the moving average calculation is a policy decision and doesn't dramatically affect the outcome. However, the percentage should ideally be the measured percentage of the population which relocates or sells each year. Naturally, the 'new noise' from a few months operation of the LTOP should not be included in 'historical' weightings, as clearly the price owners paid for their houses has not incorporated this effect. Moreover, it can clearly be shown that the LTOP noise pollution is derived from a politically-corrupt process, and hence has no validity for use in future planning.

Now of course one doesn't need to deal with separate ANEF figures for each of the past 30 years. The geographical distribution of noise was essentially stable for many years, right up to 1988 when SIMOPS came into effect. Then the SIMOPS distribution was in effect until November 1994. Then the post-third-runway operations were in effect until the Howard government came to power and re-opened the East-West runway in May 1996. An advantage of a moving average is that you can simplify the formula if there were just a few ANEF values that were each in effect for known periods of time. So let's simplify the general formula to determine the historical ANEF (called $ANEF_{Historical}$) based on the ANEF values for a particular census point in each major date range, namely:

a) the pre-1988 ANEF ($ANEF_{PreSIMOPS}$);
b) the 1988-Nov94 ANEF ($ANEF_{SIMOPS}$);
c) the Nov94 to May96 ANEF ($ANEF_{PostSIMOPS}$); and
d) the May96 to Dec97 ANEF ($ANEF_{PreLTOP}$).

The $ANEF_{Historical}$ for that census point (c) can be simply calculated using these values/periods as:

$$\begin{aligned} ANEF_{Historical\ c} = {} & (0.85^{9} \ast ANEF_{PreSIMOPS}) \\ & + ((0.85^{8} + 0.85^{7} + 0.85^{6} + 0.85^{5} + 0.85^{4} + 0.85^{3}) \ast 0.15 \ast ANEF_{SIMOPS}) \\ & + ((0.85^{2} + 0.85) \ast 0.15 \ast ANEF_{PostSIMOPS}) \\ & + (0.15 \ast ANEF_{PreLTOP}) \end{aligned}$$

This may seem complex, but using the current year weighting of 15%, the coefficients calculate to:

$$\begin{aligned} ANEF_{Historical\ c} = {} & 0.231617 \ast ANEF_{PreSIMOPS} + 0.382508 \ast ANEF_{SIMOPS} \\ & + 0.235875 \ast ANEF_{PostSIMOPS} + 0.150000 \ast ANEF_{PreLTOP} \end{aligned}$$

The calculation of historical ANEFs needs to be done impartially if ANY use is to be made of the beta factor in Model D, as one would not want any ad hoc bias introduced into a model, given the

whole purpose of having a quantitative model is to introduce fairness and transparency into the process.

15) MODEL E: INTEGRATING OTHER POLLUTION & RISKS

It turns out that 'The Definitive Model D Formula' is more than adequate to determine a fair distribution of pollution. But to avoid criticism that this paper left out factors required for an 'ultimate model', let's consider the other factors one could decide to include, and what form those might take.

There is a significant public risk factor in flying objects of up to 400,000kg over people's homes. Indeed if you were to lift heavy weights over people's homes using a crane, you would need to go through an extensive DA/BA approval process, which would include the asking of the question whether there was any viable way to avoid the risk. Yet the chance that a crane's wire would snap is about as unlikely an event as a plane falling from the sky. Moreover, the risks are inherently different for take-off and landings. Importantly, with take-offs over people, you can have up to 50,000 litres of highly flammable fuel which will add to the incendiary devastation caused by an impact over a residential area.

This 'crash risk' is not completely correlated with noise. Take for instance the flightpath up the middle of the main section of Sydney Harbour. In the event of a crash, it is likely that the debris would scatter primarily over water, yet there is significant side-noise over waterfront suburbs to be taken into account for the noise factor. Similarly, Mode 2 take-offs over Wanda Beach would ensure crashes killed no-one on the ground, yet there is side-noise to be considered for North Cronulla. Of greater importance is that a noise-only model favours moving all flightpaths off the Western suburbs of Sydney because of the total population so affected by noise on any such flightpath. While the number to be flown over with Eastern suburbs flightpaths is fewer in total number before reaching the ocean, the likely number to die on the ground from a crash is much higher in the Eastern and Inner Western suburbs, because of the much higher population densities in such areas. In short, noise pollution is proportional to total population under the flightpath, whereas crash risk is proportional to average population density under the flightpath. Hence adding a specific factor for the expected cost of crashes does change the resultant preferred flightpaths. Some would argue that the correct way is to only take into account the likely dollar value of destruction on the ground, and loss of life. But if one is going to go to this level of detail in modelling, one should factor in the difference in chance of survival of the crew and passengers, because losing power over water is likely to result in far more crew and passengers surviving, compared to having an aircraft come down in crowded residential areas.

On top of the general crash risks of about one in a million flights, there are the added safety costs of intentionally introducing safety compromises to achieve noise sharing. The current abrupt 115° turn at just 500 feet onto residential areas after take-offs from the third runway are solely to achieve a transfer of noise from a Liberal Minister's electorate (Wentworth) to that of the former Labor Minister for Transport (Kingsford Smith). The Civil Aviation Safety Authority (CASA) has approved the manoeuvre after considerable thought. CASA believe it is still within acceptable safety limits, but neither Airservices nor CASA has suggested that such a manoeuvre does not detract from overall safety. So in this instance we have safety compromises simply to achieve political bias. There is no obstruction or airspace conflict in front of the planes that causes them to bank so severely at such a low altitude. Airspace separation may require a 30° separation from the flightpaths of the parallel runway. But the only reason for extending the deviation from the minimum 30° separation to a full 115° is to avoid flying over Liberal areas which receive NO flightpaths. In an entirely general model one needs to add in the additional safety risk/cost for each such manoeuvre such that reductions in safety are not encouraged in any resultant plan. Manoeuvres such as the 115°right turn on 34R clearly entail a long-term cost in terms of additional crash risk. If one built a computer model around Airservices statements that more than 90° turns "do not lessen safety" then the obvious conclusion is to have jets that can't depart over water leave the airport and do one turn after another.

The resultant flightpath would be a spiral upwards in ever increasing circles over purely airport land (to minimise noise and crash risk to the population at large). Now no-one is suggesting that Sydney's flightpaths should look like a three dimensional model of the double-helix structure of DNA molecules, but it is worthwhile pointing out that such an outcome is indeed 'the logical conclusion' of ridiculous claims made by Airservices. However, under what Joe Hockey calls "The Joe Hockey LTOP" flightpaths are already distorted for political bias. In almost all major airports around the world, jets continue straight for some time after take-off, while propeller aircraft quickly bank away from the jet flightpath, lest a following jet catches up to a propeller aircraft. In Sydney, the jets must do a 115º or 65º bend onto primarily Labor areas, while the propeller aircraft proceed straight ahead to the Liberal North Shore. Having the jets bank an average of 30º (flightpath specification is for banking of at least 25º) causes their lift to be reduced significantly, which is simply inconsistent with the ICAO-A steep climb procedures required of them. In short noise abatement procedures are compromised because Joe Hockey wants the Liberal areas to get propeller flightpaths, so Joe can argue that the jets can go anywhere near areas such as his own electorate, for safety reasons.

The next biggest factor to take into account in Model E is air pollution. Again this is not strictly aligned with noise pollution, as departures have far higher hydrocarbon output that arrivals, due to the thrust required to gain speed and altitude (as opposed to losing speed and altitude). US research has indicated that from the time the engines are started, take-off (including average taxi times) of a fully-laden Boeing 747 produces the same amount of total hydrocarbon pollution as if one operated two million petrol lawnmowers for 20 minutes. This calculation ignores all pollution generated after the aircraft reaches 3,000 feet (ie truly take-off and initial climb, rather than whole-of-flight calculation). This is a staggering amount of pollution to put into the air we all breath. Again US research indicates that major airports consistently rank at or near the top of the list, in terms of 'point sources' of air pollution in any major city. The total air pollution of an airport is usually similar in scale to that of the largest oil refinery or petrochemical plant in the area. Factoring the cost of such air pollution would add additional pressure to have more take-offs over water, even if that required putting additional noise pollution over specific groups such as Kurnell.

After these major factors of public risk, induced additional crash risk, and air pollution, one gets to 'second order factors'. A good example is that a significant fraction of East West runway operations pass very close to the Prince of Wales hospital complex. Over the past decade most other hospitals in Sydney's eastern suburbs have been closed to relocate to this mega-hospital site, on the grounds of economies of scale, with respect to operating theatres and specialist equipment. POW is the logical destination for the majority of casualties of any aircraft disaster at KSA, or in Sydney's East. The worst possible scenario is that an aircraft crashes into the POW buildings while on final approach for the East-West runway. Not only would the number of casualties be significant, but the place to take them would be destroyed. The aircraft warning light mounted on the hospital roof should act as a constant reminder of the 'double whammy' possibility, albeit remote. San Francisco was alarmed by a study in the late 1970s which pointed out that much of that city's emergency medical capability was on the army base occupying the island at the mid-point of the San Francisco-Oakland Bay Bridge. The army obtained the land at low cost, because it was landfill only 2m above water-level, hurriedly built for the 1939 World Fair. In any major earthquake, it is likely that the on-ramps to the Bay Bridge would collapse, and if that didn't happen there was a reasonable chance that the landfill could subside into the bay, due to liquefaction. Hence it is not inappropriate (but indeed prudent) to have disaster plans consider even moderately rare possibilities, as that is exactly what disasters are – relatively rare possibilities.

Of lesser consideration than avoiding major hospitals is the avoidance of flying over a refinery. The reason is that a refinery only has an economic cost, and does not involve any significant change to loss of life probabilities, compared to residential areas. However, some weighting should be put on major infrastructure items, as losing a billion dollar item in a crash is far worse than a crater in a park or a crash in the bay. However the current corrupt LTOP has planes intentionally flying over the refinery in preference to deserted Wanda Beach or the few streets of Kurnell. Even the current

corrupt LTOP specifies a goal of increasing over-water use for simultaneous take-offs and landings, which Airservices calls Simultaneous Opposite Direction Parallel Runway Operations (SODPROPS). There are two identified SODPROPS modes. Mode 4 is where aircraft take off to the South over the bay from the shorter third runway, while aircraft land from the South on the main runway. Mode 2 is the opposite runway allocation, where aircraft use the main runway to take-off and use the shorter runway to land. The LTOP notes that if Mode 4 was found to be not working satisfactorily, Mode 2 should be reinstated. The problem with Mode 4 is that as soon as controllers have a single long-haul take-off, such plane cannot take-off on the short runway, hence the controllers hardly ever go into Mode 4. The opposite runway configuration of Mode 2 is the only workable configuration, as all planes can land on the shorter runway, and all planes can take-off on the longer runway. The additional benefit of Mode 2 is that it bypasses the refinery, flying over uninhabited land to the immediate South of the refinery, whereas Mode 4 puts planes directly over the refinery on final approach. The ONLY problem with Mode 2 is that it brings side-noise to the Northern-most extremities of Cronulla Beach, which is in a marginal Liberal electorate – Again petty party politics has prevented an obviously good flightpath from being used. Any independent assessment would not preclude Mode 2, even before introducing weightings to discourage a crash into the refinery.

In summary, Model E would have an objective function of minimising the "total impact" of aircraft operations on the residents of Sydney. This would be formulated in terms of noise pollution minimisation and sharing principles (as set out in The Definitive Model D Formula) as well as containing other pollution factors, probabilistic loss of life values and estimates of property damage caused by disasters. The hard part is trying to get these various factors into one overall unit of measure. The obvious measure is dollars, and one can estimate what noise pollution costs and even air pollution, but the hard value that any such formula needs to include is an estimate of the dollar value of each life lost. It is always contentious whether one uses only the likely future value to the economy of that life lost, or whether one includes other values. Having stated that this is a contentious issue, such values are not impossible to estimate, as insurance companies and courts are constantly making such decisions, determining insurance payouts for various classes of disabilities through to and including death caused by others. Every time an aircraft crash kills someone, courts in some country or other are determining the insurance payout to each person's estate, and the typical values for OECD countries are known. A dollar value is placed on life implicitly by all public policy decisions which incur a risk of disaster. An implicit low value is being put on life by the existing LTOP, with its additional flights and risky manoeuvres over people for meagre electoral benefits to one political party.

The form a Model E objective function would take is therefore based on a whole series of dollar-valued impact components, such as:

$$\sum_{c} \text{((noise function as in Model D or B)} \ * \ \text{(cost of each ANEF per 500 people))}$$

$$+ \text{ (probability of disaster} \ * \ \text{cost of such a disaster)}$$
$$+ \text{ (extra probability of disaster from an introduced noise abatement manoeuvre} \ * \ \text{cost of such a disaster)}$$
$$+ \text{ (probability of disease per kg of } NO_X \ * \ \text{cost of each such disease case)}$$
$$+ \ \ldots \ \ldots \ \ldots$$

Hence one is seeking to minimise the overall cumulative cost of all identified impacts, expressed in common units of measure (using best available estimates for conversion to that common unit of measure).

16) A NEED FOR HONESTY IN THE FIGURES

The current propaganda of the government is to talk about 'aircraft movements' rather than noise per se. Yet this seeks to equate the environmental impact of the landing of a small propeller aircraft with the take-off of a fully-laden long-haul jumbo. No one who has witnessed these two events could

honestly claim that they were equivalent. However to get away with such nonsense, you would need to (a) bypass an EIS or any other proper environmental study; AND (b) stack any community forum intended to provide input. The sole reason for perpetuating the myth that props have the same impact as jets is because of the clear conflict of interest of all those involved in the decision-making, from the Prime Minister down.

Aside from measuring the wrong variable, Airservices has been shown to have been intentionally dishonest and misleading in their publicly released figures. The noise contour maps released to the public are correctly adjusted for complex factors, such as the mix of aircraft on a particular flightpath etc. However, the noise contours assume aircraft are flying at over twice the altitude they are actually flying in many instances. Because noise drops off with the square of the distance to the source, doubling aircraft height has the effect of understating the noise by a fourfold factor. Moreover, the error was pointed out to Airservices many months ago, but the bureaucrats have done nothing to correct the model or release valid information. Similarly, Airservices have noise monitoring equipment at known sites on major flightpaths, yet have never 're-calibrated' their noise forecasts (ANEF) in light of the actual noise readings they have observed. In terms of the true scientific method, one would have to call this approach 'fraud' – as any scientist using such an approach to support his findings would be ridiculed and would find his results ignored.

Similarly, the government has consistently stated that the LTOP allocations are fair because "17% of movements go to the North." Yet when pressed in a radio interview on station 2BL on 17 December 1997, Joe Hockey admitted that the figure is only 10% if you use the normal definition of northern suburbs. (North of the harbour has always been the universally accepted definition in Sydney). The other 7% is intentionally deflected over Labor areas in what are clearly defined as the western suburbs of Sydney. Given the inordinate veering of all take-offs to avoid true North Shore suburbs, the only non-misleading way to put it is that "Only 10% of movements will now reach the Northern suburbs (which everyone understands to be the Liberal areas of the city, including the PM's electorate)." Included in that figure of 10% are a significant fraction of propeller movements.

As recently as 2 February 1998 Minister Vaile issued a media release requoting Joe Hockey's misleading 17% figure for the North and stating "These figures demonstrate that the Government is committed to achieving a more equitable distribution of all noise, consistent with LTOP." Just days later on 5 February 1998, the Prime Minister's office issued its fax offering to meddle in the process for the sole purpose of providing electoral benefit for a specific electorate. Minister Vaile's office must have been fully aware of such offer to meddle, as the PM's fax contains detailed technical options that could only have come from Vaile's department. Then when the PM's fax was leaked, Minister Vaile went public with a media release dated 9 February 1998 headlined "Aircraft Noise Sharing 'Without Fear or Favour'". Some of the Minister's more outrageous statements in that media release include "The computer generated maps clearly show the noise *is being shared more fairly…* If Mr Zammit had hoped for political favours to be done then he was bound to be disappointed. In all our meetings with Mr Zammit we have emphasised that all Sydney people are equal share holders in the aircraft noise problem and that it should therefore be shared as equally as possible… that's what the people of Sydney – as equal shareholders in aircraft noise – wanted. The LTOP was set up after 18 months of exhaustive community consultation… There is no 'Magical Cone of Silence'."

But the clear facts are that the Minister is simply wrong on most counts. There has been continual political interference, from the outset, and continuing right up to the days immediately preceding his media release, and the Minister knew this (which is precisely why he protesteth too much). Moreover, most of the politicians made a public undertaking to their electorate to meddle on their behalf. Political favours <u>have</u> been done, and these form the backbone of the LTOP's noise distribution patterns – moving noise away from all blue ribbon Liberal electorates. Any quantitative analysis would confirm that the people of Sydney have not been treated equally. Mr Zammit's complaint is that his electorate was the sacrificial lamb to get planes off the PM's electorate. The LTOP's community consultation certainly took into account all the needs of the North Shore, but was

trivial in its dealings with communities to the East and West, and non-existent with respect to newly affected areas such as Paddington/Double Bay and Burwood/Concord. Moreover, the Randwick/Woollahra Councils' and City of Botany Bay Council's ADJR (Administrative Decisions Judicial Review) cases in the Federal Court will soon 'prove' that the taskforce never met or decided anything, and that all planning emanated from the government without consultation. Moreover, the person in charge of the community consultation process clearly disagrees with the Minister, because Joe Hockey, Chairman of SACF issued a newsletter to his own electorate in late 1997 claiming total ownership of the LTOP. Joe Hockey's newsletter ***Focus North – A Newsletter from Joe Hockey MP Federal Member for North Sydney*** October 1997 states "John Howard and Joe Hockey have delivered on a crucial pre-election promise to the people of Lane Cove. In 1996 Joe promised a reduction in air traffic over Lane Cove, and currently, air traffic over Lane Cove is 32% of all Sydney air traffic, down from 55%. And for the people of Lane Cove, the best is yet to come!…" The attached front-page graphic correctly labels the LTOP as "Joe Hockey's Long Term Operating Plan", which displays uncharacteristic veracity from the government's main salesman of the LTOP. However, Joe Hockey has been ably assisted by those with a similar geographic bias. Minister Vaile's Chief of Staff and former aviation adviser Chris Falvey and the primary community representative on the IMC/SACF, David Lidbetter both live on waterfront Drummoyne which also benefits from the flightpath deviations that bring the PM's and Joe Hockey's electorates down to 10%. Hence the Minister's claims as to fairness are based on false advice, fudged statistics, misrepresentations and the views of a clearly non-representative politically-appointed body. The LTOP is NOT "what the people of Sydney wanted", but what Drummoyne, Lane Cove and Hunters Hill wanted – and why wouldn't it reflect what these three areas wanted, when they have inordinately higher levels of representation on the IMC and SACF compared to the rest of the purported "equal shareholders" of Sydney. In Minister Vaile's hypothetical company, everyone may own a share of the problem, but there is certainly not one vote per share!

Minister Vaile's emphatic and repeated statement that "the people of Sydney [are] equal shareholders in aircraft noise" is however a firm statement that the position of the government is for total reliance on an alpha (fair sharing) factor, with no weight to be put on a beta (historical) factor. The concept behind beta is to recognise an inequality in the shareholder status. Finally, the Minister's assertion that there is no better and fairer way to distribute noise (ie reference to there being no Magical Cone of Silence) can be proven to be wrong. Opening Mode 2 is the type of Win/Win situation that would clearly be identified with any quantitative measure (irrespective of the model and/or parameters), as it brings a very significant reduction in overall impact of aircraft noise, without introducing any undue concentration.

One can only read the Minister's claim of "without fear or favour" as a wholehearted endorsement for using a quantitative measure for determining the fairness of any particular distribution pattern. The Minister confirms that he presently relies on non-quantitative visual evidence claiming "the flight paths in and out of Sydney now look something like the spokes of a wheel. They're the day by day proof that the noise is being shared around much more fairly." But the Minister's ill-informed visual interpretation of a complex three-dimensional map is far from "proof". The spokes of the Minister's wheel are indeed very crooked, and this qualifier goes beyond references to 115° deflections in flightpaths! Yet the fact that the Minister believes the fairness of the current plan can be "proved" can only be taken as his endorsement of an independent quantitative tool, such as Model D or B. Besides if the Minister is so certain that there is no better solution, and that the process is "without fear or favour" then he should have no reservations in endorsing a tool which would provide the proof he wants.

Minister Vaile's cabinet colleague, Minister Andrew Thomson, Federal Member for Wentworth, also contradicted Minister Vaile's claim, when Minister Thomson issued a media release on 3 March 1998 stating "Fanning out of flights all over the eastern suburbs… cannot happen." But if the goal is indeed fair sharing, how can the government insist on using fanning where it suits them and using concentrated flight paths where fanning would not suit them? Minister Thomson went on to state

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"This mysterious proposal [fanning over the East and use of Mode 6A] is like previous ones that advocated planes flying over residents instead of factories or water and is very likely unlawful." The facts are that MOST of the LTOP changes fit Minister Thomson's criticism, as preventing Mode 2 SODPROPS and the major turning around of the airport direction (preference for Northerly take-offs over Southerly take-offs) clearly has the effect of moving noise from over water to over residents, affecting a million people's health and well-being. On the issue of what is unlawful, the current ADJR case will most likely prove that ALL of the government's decisions regarding the LTOP have been unlawful. But it is still good to see that even cabinet members are prepared to put on the public record that their colleagues are acting unlawfully with regard to the aircraft noise issue. The fact that even cabinet is split as to what is fair and/or legal is even more justification for a quantitative measure to be introduced. Under the current system every politician wants to be Ros Kelly, disagreeing with the rorting of others, yet wanting to implement their own rorts!

The definitive proof that the Prime Minister, Minister Vaile, Joe Hockey, DoT and Airservices have all sought to mislead the people (and that the politicians have misused their power of office) can be found in a simple regression analysis. The proof lies in a formal statistical test of the proposition "That the relative increase or decrease in noise over each census point is closely correlated to the value of that census point to the party in power." Importantly, one needs to compare the ANEF values in existence before the Howard government came to power (ie not just immediately prior to the LTOP) and compare these to the Howard government's long term aspirations (the LTOP figures). The change in ANEF levels is therefore given by $ANEF_{LTOP}$ minus $ANEF_{Pre\text{-}Howard}$.

The political value variable would need to be a simple variable set to:

+3	Electorate of a government minister
+2	Safe Liberal electorate,
+1	Marginal Liberal electorate,
0	Untenable Liberal or independent electorate (eg Lowe),
–1	Marginal Labor electorate,
–2	Safe Labor electorate, and
–3	Electorate of an opposition shadow minister.

The Australian Electoral Commission has published formal assessments of each electorate in terms of ranking them "marginal" or "safe" based on a statistical analysis of the last election results. Using such AEC categorisation would ensure that the political variable was not arbitrary.

The correlation would investigate winners/losers on the basis of just one variable:

$$ANEF_{LTOP} - ANEF_{Pre\text{-}Howard} = \text{Function (political\_value\_of\_electorate)}$$

The correlation should be run for all Sydney and also run separately for each of the four compass points, as the inner Northwest Labor areas receive an advantage because the PM's electorate is further along on the same flight path (yet within that compass direction all noise has been moved from Liberal to Labor/Independent areas). The correlation coefficient determined by such a cross-correlation would be particularly high, and the statistical confidence (R^2) would be more than sufficient to state that the favouritism shown to federal Liberal electorates was not a result of some chance process. If needed, one might also include a second variable for 'En_route_to_PM's_electorate" (value = true/false) in the overall correlation, to test identifying those locations which gain, even though they may not be Liberal, simply because they are en-route to the PM's electorate.

Another interesting correlation to perform is to look at just areas which get 'bent noise', meaning that they only receive noise because a flight path has been deviated from runway heading to fly intentionally over that area. This represents the truly 'discretionary noise' of the LTOP. This correlation removes from consideration all areas which naturally fall in line with any runway, but specifically looks at whether the new areas the government has specifically targeted to receive noise can be correlated with the political value of those areas. The regression analysis would be of the form:

$ANEF_{LTOP}$ ✶ Degrees_bent_through = Function (political_value_of_electorate)

This would have an incredibly high correlation, as only the electorate of the former Labor Minister for Transport, Laurie Brereton, receives noise by having flightpaths bent through 115º (the Maroubra flightpath). Then there is no noise over most of the Liberal seat of Wentworth covering a bending range of 65º through 100º. Then there is the Labor seat of Sydney which gets the Paddington flightpath at a bend of 65º from runway heading. Then there are the Liberal seats of North Sydney and Warringah which get no departures, but would get them if the deflection was between 0º and 65º. Given that all the necessary data is readily available to perform such correlations, this statistical approach would be the appropriate impartial test of the government's claim as to the LTOP having been developed "without fear or favour" versus the community's and opposition's claims that the LTOP is based almost entirely on political bias.

In summary, when one has proof that the figures produced by Ministers, SACF, DoT and Airservices are intentionally misleading, that the wrong variable (movements not noise) is being used to encourage bias, and that suburbs within the city are being re-classified to enable misleading propaganda, and that only one party's seats are affected by 'bent noise', you really need to go 'back to basics' to determine fairness. That is the primary reason why use of a formal model is a fundamental pre-requisite for any fairness and transparency to be brought into the process.

17) A NEED FOR HONESTY AND INTEGRITY IN THE APPROACH

If one could get onto solid ground using numbers, one still needs to ensure that the approach of how these numbers are then used is not compromised. For example, community representatives need to come together and determine the appropriate parameters, such as a value of 'P', based solely on their respective concept of what amount of additional pollution would be appropriate as a trade-off for sharing the burden more fairly. This is certainly not forcing the model to produce additional pollution, but simply allowing the trade-offs to be made where situations arise which come down to such a trade-off. In the more complex case of determining values for alpha and beta, various hypothetical cases should be used to determine the extent to which straight sharing is important, versus factoring in historical noise levels.

Whichever model is used, it is important that such parameters are set well before the community representatives can perceive what a self-interest perspective would dictate, in terms of compromising their value system. In other words, one needs to determine model parameters, before the detailed modelling is done, lest someone who claimed a priori that a low value of 'P' or alpha was appropriate, later wants to change that view to a far higher value of 'P' or alpha on the basis that such change could lessen KSA's overall impact in their own locality. However, even working backwards to determine parameters from model outcomes is not going to produce anything as corrupt as the current LTOP, as each parameter has the same effect on similar classes of areas, whether they vote Liberal or Labor.

This approach of the methodology of this paper is not just applicable to KSA, but could be equally applied to other contentious airports around the country or internationally. Moreover, with government media releases claiming the current system is fair, and opposition media releases claiming it is not fair and will be changed with a change in government, there is an urgent need for an impartial method to gain bipartisan support. The alternative is to have a continuation of the practice whereby the government of the day adjusts pollution distribution patterns to 'dump' on supporters of their opponents – this is no way to implement city-wide planning obligations. The tit-for-tat approach gives people even less confidence as to where to live and where to sell, as it means all localities are under a potential threat of undue concentration of noise – and more so if the location is near an electoral boundary!

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18) A NEED FOR FAIR AND PROPER REPRESENTATION

Even if one had perfect data and the perfect model, there is no guarantee of fair outcomes if the body evaluating the results is heavily weighted towards one particular interest group. The government has elected to run with a hand-picked selection of people whom it states represent the views of the community. The resultant committee, Sydney Aircraft Community Forum (SACF) is neither representative nor community-based. SACF started with about 90% of its members representing areas to the North, with significant over-representation of the Liberal North Shore. It has been gradually expanded to incorporate 'invited representatives' of other areas, but has never allowed such an approach to lessen the majority position held by Liberal representatives, despite the fact that the bulk of all aircraft noise is now moved to Labor electorates. Yet Labor and independent elected representatives have failed in seeking to be 'invited' to this government-controlled committee. Some Liberal areas have all three levels of their government representatives (ie federal state & local) on SACF, while certain Labor areas have been refused even a single representative.

The oppressive regime and clear lack of fair representation is intentionally perpetuated by the Chairman of SACF, who has a clear conflict of interest in the matter, having used such biased representation to dramatically reduce the noise exposure over his own electorate. Joh Bjelke-Petterson never managed to organise a gerrymander that was as unfair as the one managed in Sydney today by Joe Hockey with the endorsement of DoT, Environment Australia and the Federal cabinet.

The solution is clearly to demand that the government recognise the validity of democracy. Every federal member, state member & local government council in the region affected by KSA's operations should be allowed one representative on SACF. The vote of each representative should then be weighted by the number of people that person represents and the average ANEF exposure of his/her constituents. This means that Blue Mountains Council would not have as much say as Marrickville Council, because each delegate's say is weighted in accordance with the impact of the airport on their constituents. This would mean that every affected resident would have three representatives, with potentially a federal member of one party, a state member from another, and an independent representing their local council. In short it would lessen the clear political bias as to the party breakdown of who is on SACF at present, and the party preference given as to who is invited onto SACF. It would also work to ameliorate misuse of power in that, if Joe Hockey was to get a properly-constituted SACF to agree to his plan to remove all jet departures from his and the Prime Minister's electorates (as the corrupt LTOP/SACF/IMC has done), then this would proportionately lessen the voting power of the representatives of those areas 'blessed' by such decision, and put more voting power in the hands of those oppressed by such decision, thereby causing a natural balance against such excesses.

The facsimile from the Prime Minister's own office of 5 February 1998 referred to gaining SACF approval, as if SACF was indeed a Liberal Party dominated rubber stamp for the government to provide token community approval. The Prime Minister's fax also stated that major changes to the LTOP would not need to go to SACF for approval. That documentation proves that the government does not take the concept of community consultation seriously, and is fully aware at the highest level of the corruption.

A properly constituted SACF (or more likely the type of independent Sydney Airport Commission as proposed by Independent Federal MP Paul Zammit) is required to give the government ANY CREDIBILITY over the LTOP issue, and the opportunity to restate the government's commitment to democracy and transparency (if indeed the government does believe in the concepts of democracy and transparency in government). However, if the peak community representative organisation was to remain SACF, clearly an independent chair is required. Joe Hockey has shown himself unable to stand aside on issues of clear conflict of interest, and his actions are de facto endorsed by the government as a whole so long as the Department of Transport and Environment Australia recognise SACF as being representative of the community at large (despite evidence to the contrary).

This is not an academic argument, as at the December 1997 meeting of SACF, Paul Zammit moved a motion which amounted to a condemnation of the whole LTOP process. This motion was only narrowly with a vote of 11 to 9. But when you 'normalise' the votes, such that each affected area of Sydney only had one vote at SACF, the motion condemning the LTOP would have been clearly carried. It was only the multiple representatives from various Liberal areas (Hunters Hill, Lane Cove and Kurnell/Cronulla in particular) that prevented rejection of the whole plan for its bias. Similarly, Joe Hockey has now taken on the role of attempting to gain additional benefits for a single company, Fox Studios, by his writings in support of the Fox plan, despite its rejection by the areas affected. Mayor of the City of Botany Bay, Cr Ron Hoenig admonished Joe Hockey's lack of probity stating "I am astonished credence could be given by any Federal Government-supported organisation to an approach by a commercial organisation to vary flight movements when, obviously, people do not matter."

It is also unacceptable that community representatives from only the North and South sit on the Implementation and Monitoring Committee (IMC). Clearly, with the East and West receiving comparable noise to the North, representation must be proportional to the impact. The demands of the people are validly for "No noise without representation" to borrow from the American War of Independence slogan. Joe Hockey's stated argument that the representative of the South and the representative of the North who are presently on the IMC are there representing the whole of SACF is a nonsensical circular argument, given SACF's clear North-South bias over East-West. Importantly, those two representatives have a history of making decisions which are contrary to the wishes of the East and West. The East and West have made a number of formal submissions to the Minister to allow for proper representation, but have been denied this basic right. If the LTOP was indeed "without fear or favour", the government would have no need to blatantly manipulate the representation of people affected.

The fact that SACF is heavily gerrymandered so as to be dominated by a North-South alliance does not justify why the IMC representation should also be so limited. Similarly, Joe Hockey's approach of having SACF vote to support the current non-representative nature of both SACF and the IMC does not add validity to either entity. It is like President Soeharto hand-picking the members of the Indonesian presidential electoral assembly to ensure his own continued support without opposition. Australians expect to see that kind of anti-democratic approach only in lesser developed countries, and do not expect it from formal instruments of the Australian federal government. The fact that the DoT, Minister Vaile, Environment Australia and Minister Hill each endorse the anti-democratic arrangement of SACF and the IMC reflects on the probity of those departments and the Ministers personally, especially in light of the allegations of bias, deception and impropriety concerning the LTOP, which are so serious that they go to the government's fitness to govern. Joe Hockey's disdain for proper representation, fairness and transparency are the factors that, left unchecked, will most certainly lead to jets being routed over his seat of North Sydney following any change in government. The government's whole approach to the LTOP is the surest way to ensure that it remains a short term, rather than long term plan. Irrespective of how noble the original intention may have been, the process is clearly sullied by political bias, despite the government's protestations to the contrary. It would be far more honourable and less effort for the government to make the bodies representative, rather than putting so much effort and political capital into attempting to support Joe Hockey, when his fascist approach to the problem is clearly indefensible.

19) RECOMMENDATIONS

The recommendation are:

1) That a properly-constituted representative body of all affected residents be formed, preferably including one representative nominated by each of the three levels of government for each affected area.
2) That each representative's vote on such committee be weighted in accordance his/her constituent numbers and their average noise exposure (ie population represented times

average ANEF exposure of that population). This ensures representation proportional to impact.

3) If items 1 and 2 are not implemented, then the independent Sydney Airport Commission, as proposed by Paul Zammit MP, must be established. (The principle being that the people are better judges of what they want than a judge, but if they are not to be given a say, then a judge is better than a gerrymander.)
4) The properly-constituted representative body should then deliberate and consider the trade-offs to determine a value of alpha, beta and 'f' in 'The Definitive Model D Formula'.
5) It is not likely that any such body would reach an agreement to split the weighting between factors of 'fair sharing' on the one hand and an 'historical leaning' factor on the other, or indeed determine meaningful values for each of alpha, beta and 'f'. Hence the recommendation is that following a discussion to see if agreement can be reached on a more complex model, such body should then revert to consideration of Model B (or C at the discretion of that body), and a vote be used to determine a median (not mean) value of 'P' as determined by secret ballot of such properly-constituted representative body.
6) Then EVEN IF a properly-constituted body could not come to agreement on a value of 'P', the quantitative model could still be used in that, when any change was put forward, the net gain/loss in overall impact could be tabled for a range of values for 'P' by Airservices, in its support function for the properly-constituted body. That way, some proposals, which do not make sense, irrespective of the values placed on sharing versus more noise parameters, would stand out as being unworthy of any support. Similarly those proposals which lessen overall impact for all values of 'P' would also be identified and it would be difficult for detractors to seek to stifle proper consideration of such proposals.

The recommendation is to NOT pursue the far more complex possibilities contemplated by additional factors highlighted in the discussion of Model E. That would be bound to be a long and tortuous debate, over items which would have little practical impact in the end. Some measure of independence is required, and Models B through D provide that objectivity. To try to weight second order factors is far more difficult and should only ever become a longer term project for a sub-committee of the properly-constituted representative body. Due to the inherent complexity of Model E, anyone who now claims that "Only the precision of Model E will be acceptable" is presumably seeking to frustrate any quantification of impact, with the view to maintaining the ad hoc nature and political corruption of current decision-making methods. The additional factors for Model E can only be developed after the basic trade-offs of Model D or B (or C) have been implemented, and fairness has been introduced into the process. Besides, even Model B, with only one factor to determine ('P') will get rid of 95% of the political bias in the current ad hoc system, in the same way as an immigration ranking or HSC score (as much as one might debate finer changes to such methods) essentially replaces favouritism with fairness. Similarly, there is no need to worry about losing the complexities of Model D, as most areas which have historically received noise AND must continue to receive noise will in fact be allocated noise even under Model B. Besides, it is a difficult logical argument to say that locations further out from the airport should continue to receive a penalty (if fanning could lessen that penalty) simply "because that's the way it's been done."

In summary, the author has no problem with the simplicity of Model B being used ($\Sigma ANEF^P$) it is very elegant, contains everything one needs to induce sharing, is fair, non-arbitrary, simple to implement and "without fear or favour". The determination of the more complex models, and public discussion concerning them is still a useful exercise to show that all such possible models were considered, even if the process reverts to a simple and elegant solution.

20) HOW A QUANTITATIVE MODEL WOULD WORK IN PRACTICE

Whether using Model B, C or D, one would then have the technical framework to consider flightpath changes or operational changes at the airport. That way suggestions could be measured against known criteria. Examples of proposed changes that could be quantitatively measured include:

a) The Woollahra/Fox Studios proposed changes to move the Paddington/Double Bay flightpath to points further West (though it is pretty obvious that fanning flights rather than shifting concentrated flightpaths will give a lower overall impact figure).
b) The Eastern Coalition Airport Group (ECAG - representing Sydney's Eastern suburbs' councils) proposal that planes taking-off to the North on the third runway remain on runway heading for a further three kilometres over purely airport land, using ICAO-A steep-climb noise abatement procedures, and THEN turn over residential areas (rather than turning away from airport land and onto houses at just 500 feet). (This would obviously result in a lower overall impact figure, though the IMC didn't care for the suggestion and have gone with implementing ICAO-A through the existing climb, even though planes are clearly not reaching the altitudes of ICAO-A.)
c) 'Sydney's Northern No Fly Zone' whereby there is an 85° arc between Concord and Double Bay which receives no jet departures so as to favour the blue ribbon Liberal electorates north of the harbour. (Large arbitrary exclusion zones would not be supported by any quantitative model.)
d) Take-offs to the North on the third runway follow strict flightpaths, while simultaneous take-offs to the North on the main runway are fanned out over large areas. The contradictory policy arises because in the Northwest, only by fanning can the aircraft be diverted from Liberal electorates onto Labor ones, whereas in the East any fanning would put planes onto a Liberal electorate. (Inconsistent policies are unlikely to result in lower overall impact figures – clearly fanning will deliver a lower overall impact figure.)
e) The flightpath changes proposed by the Prime Minister's office in February 1998 and now under consideration by Airservices could be assessed to determine whether they quantifiably increase sharing or are simply additional political interference. (The triple reciprocity proposed for Coogee is unlikely to deliver lower figures, though measures to fan flights off Lowe would lessen overall impact.)

It is not intended that the model will suggest where flightpaths should go – it is only that by having an overall impact measure, one knows whether a particular change (or a particular component of the existing plan) is beneficial or not, using an objective measure. One can argue that one cannot reduce the complexities of a human being to a single score, yet that is exactly what is done for immigration approval, HSC, access to university, etc etc. While there are many drawbacks, we have found it necessary to introduce some method of scoring to these areas to prevent rorts in immigration, graduation and matriculation (inter alia). We now need a scoring system in terms of noise pollution distribution, to prevent the types of rorts we see at present from SACF. And like the scoring systems used for immigration, HSC and matriculation, the scoring system should be subject to evolutionary improvement.

So what are some of the likely changes to LTOP with a quantitative measure. With any objective measure, SODPROPS would be quickly escalated from concept to reality. Mode 2 (or a mix of Mode 2 and 4 - let's call it Mode 2/4) can deliver 65 movements an hour purely over the bay, according to Tony Williams, the independent expert who has monitored and critiqued KSA operations for 25 years. Now any SODPROPS mode is only weather-available 45% of the time (all light and variable wind conditions). Planes would still have to land and take-off into the wind in all strong wind conditions. Yet, people would be happy to know that on the quiet days when aircraft noise bothers them most, the planes are over water to the maximum extent possible. Actual throughput data for KSA indicates that over the past year, actual movements have only exceeded 65/hour less than 1% of the time.

Now if one doesn't accept that SODPROPS (once it ceased to be 'knobbled' for political reasons) can actually achieve 65 movements an hour, you could drop down to the 40-50 range that Airservices believe is possible for use of two runways. This is still sufficient to allow all jets to use SODPROPS, while some propeller aircraft could be allocated to the East-West runway at peak times. Mode 2 is compatible with this minor cross-runway use with SODPROPS, because the main runway would only

have slow speed taxiing at its Northern end where it intersects with the East-West runway, and most propeller aircraft don't need the full length of the East-West runway to take-off or land. Currently an aircraft aborting a landing on the third runway (34R) in Mode 2 would veer to the right and return to the ocean via the Coogee flightpath, which would affect such concurrent use of the East-West runway. But that 'escape route' could be varied to proceed straight North over airport land and then turn Eastwards. The allocation of all jets in fine weather to Mode 2/4 SODPROPS, with peak overflow of just propeller aircraft to non-SODPROPS, leads to a useful definition of 'SODJETS'. This plan was suggested by Tony Williams, but is only a variation on existing SODPROPS proposals. Even the author submitted an entirely over-water proposal called Keep All Planes Over Water – KAPOW in a formal submission to Airservices on 10 July 1996. In short Airservices have known for a long time how to reduce the noise impact of KSA's operations on the people of Sydney. But Airservices staff are so blindly led by their political masters (and will freely admit this to anyone who speaks to them) that they now have no interest in improving matters for anyone other than those in blue ribbon Liberal electorates. In short they wait for Joe Hockey to make the decisions.

It is highly likely that measures such as SODJETS as proposed by Tony Williams would measure well in any objective measure, and lead to significant improvements in overall average noise pollution levels that Sydney residents are exposed to. It is possibly the best example of the type of Win/Win situation that would be clearly identified by a quantitative measure. Moreover, the current practice of putting planes over 733,500 people (Mode 9) at 10:45pm (when there are very few movements at the airport) is nothing short of incompetence by Airservices, and would be highlighted as such by any quantitative measure. The third runway is used for an average of four jets between 9:30pm and 11pm and those four can just as easily head off South in all light and variable wind conditions.

21) DAY-TO-DAY OPERATIONAL DECISIONS

The recommendation to use one of Models B-D does not address how one should make the day-to-day operational decisions. The models in this paper are only intended to assist in developing overall annual averages. Even with a valid annual ANEF allocation, there should not be any undue concentration on any particular area in time-sensitive hours (early morning or late at night), nor any undue concentration in home hours versus work hours, nor any undue concentration on weekends versus during week days, nor any undue concentration according to season of the year (except to the extent truly dictated by seasonal changes in weather patterns).

The correct approach for this day-to-day allocation function is to use a simple computer model which keeps track of cumulative noise load on each area, to ensure random selection within available modes and sub-modes, as is done at Logan Airport, Boston Massachusetts. The Logan software has been offered to Airservices, but locally-developed software (or even a spreadsheet) could be used to provide this level of operational decision making support, without political bias. On an operational basis wind direction and strength is very important. Yet, there are enough options to prevent pummelling any particular area when the same prevailing winds last a number of days. The operational rules should be that no area in Sydney receives more than X percent of its overall allocation of noise for the year in any day, nor more than Y percent in any consecutive three-day period, nor more than Z percent in any three-month period. The only exemptions should be sub-modes which are only used in strong winds from a particular direction. This approach, in conjunction with the broader/fairer sharing a Model B-D would bring, could even meet Fox Studio's needs, due simply to the number of flightpaths to achieve "fair sharing". All the studios need is prior advice of the likely times of KSA's operations that would affect them. But if one is doing this, it would be better to put the operational plan up on an Internet web page, and let all such industries and concerned residents understand exactly what the forecast usage is for the days and weeks ahead. That way one is displaying the probity that businesses owned by Mr Murdoch have only the same rights as other corporations.

If one went to a during-year integrated computer model and operational model (ie combined planning and operational issues in one program), one could even incorporate time-of-day and season-of-year changes to the underlying population distribution. A typical time of day model would be to assume that the number of people at each census point is 500 from midnight to 8am, then (say) 300 from 8am to 6pm (reflecting that 40% of residents go to work), going back up to 500 from 6pm onwards. Similarly, the population for quiet outdoor recreational sites could be modelled to note that such sites are only occupied during daylight hours. Seasonal changes would incorporate using the 'correct population' for park areas, given the attendances at such recreational facilities vary dramatically during summer versus winter and weekend versus weekday, as well as varying by daylight hours versus night time. With this enhancement, significant summer recreational assets such as Bondi and Cronulla beaches would be credited with a number of census points on summer weekends, thereby providing an incentive that any share of noise allocated to such summer recreational assets is incurred in off-peak times/months, rather than during times of peak use of that asset.

22) APPLICATION TO A SECOND AIRPORT

The same quantitative rigor of a formal model should have been applied to the Badgerys Creek EIS. The government should ask for its millions of dollars to be refunded by the consultants Rust-PPK simply on the grounds that Rust-PPK failed to adequately disclose that its bodies corporate (as defined under the Corporations Law) are one of the largest landowners in the environs of Badgerys Creek. Because Rust-PPK's sister company owns the adjoining tip and landfill site, their landholdings in the area are possibly second only to the Commonwealth. Had the EIS been used as an independent expert's report for a prospectus or other application in the commercial world, the consultants would face a potential $50m class action suit for their failure to disclose a clear conflict of interest.

Moreover, even in a beauty contest, there is no credibility in comparing number one on the shortlist to only number nine on the shortlist. Yet that is what the Badgerys Creek EIS did. It compared options A, B and C runway configurations of Badgerys Creek to options A and B at Holsworthy. Yet Holsworthy was only ever ranked ninth in the original shortlist, and only received further consideration because of personal representations to the members of Federal cabinet by an small company (which I am advised had paid up capital of $2) with a commercial interest in developing the Holsworthy site if such site was transferred from Commonwealth ownership. The obvious alternative to Badgerys Creek was a site outside the Sydney basin linked to Sydney by fast train. The number two site on the original shortlist was such a site (Wilton near Appin) but the benefits of being outside the Sydney basin and linked by fast rail (the major policy alternative) was never seriously considered by the consultants. Any model of the types set out in this paper would clearly have favoured an outside-the-basin solution such as Wilton over Badgerys Creek, for exactly the same reasons that there is now public outcry over the potential site being Badgerys Creek – far fewer people would be affected by its adverse environmental impact if the site was outside the Sydney basin. The ordinary man in the street can immediately grasp this fact, yet Rust-PPK having been swayed by millions of dollars to tow the government line, could not see this obvious fact.

With Badgerys now rejected by the Local Government Association, and with the Federal government now delaying any such controversial decision until after the next election, we have 'decision paralysis'. But any analysis of the cause of such paralysis is the government's insistence on only considering inherently bad decisions, using inherently flawed analysis techniques. Only an open, transparent, fair analysis of all the options will meet the reasonable needs of the people, and it is about time that this government showed some commitment to such democratic principles, and gave up trying to 'sneak through' its own Minister's or cabinet's private agenda items, as if the populace is sufficiently dumb to be fooled by such an approach. The government deserves all the flack it is receiving over Badgerys Creek, because it has done nothing to rebuild public confidence since the prior lies and deception campaigns (spanning the terms of both major political parties) when it has sought to misuse an EIS to 'sell' a concept, intentionally understating the environmental impact such EIS process was designed to highlight.

Unfortunately, the department remains committed to a pro-aviation stance with no heed for its own environmental impact. It still prefers deals done behind closed doors, secrecy at all costs, and this encourages political meddling. All of the bureaucrats deserve admonishing for failing to stand up as whistle-blowers when they see clear instances of undue political influence. The lack of alternative employment opportunities in Canberra perpetuates such compromise of otherwise good men and women. In short, it is appropriate to repeat here the advice (which the department never on-provided to the members of the taskforce) that the author provided to the taskforce some two years ago at the outset of the LTOP planning process:

> *"For the true political process to work, one needs to have a majority* [on the committees] *as representatives of the people, which is NOT ACHIEVED by having the public submit their plans to a committee of technocrats for in-camera consideration! I am afraid that the very structure of the committee does not auger well for the significant changes needed.*
>
> *"In my view the committee should be representative of the people of Sydney, to whom the aviation industry representatives could make applications for the rights to produce pollution (noise or any other) in much the same way as private developers need to approach a council with their proposals and establish that their plans will not have undue environmental impact on other citizens' quiet enjoyment and other amenities. Now I know that industry representatives will argue that aviation is far more important than the hotels the tourists stay in when they have landed, and hence should not have to go through the same planning regime as the hotels. However, if you ask the average Australian, or their elected representatives, you would be surprised at the extent to which they think the same types of approvals ARE APPROPRIATE (especially in light of the arrogance and lack of consideration shown in the past)…*
>
> *"I would hope that all information, including detailed proposals, constraints and technical evaluations are made available for public review and comment. The Internet makes perfect sense for this, as no bureaucracy can claim that it costs too much to inform the public, as the information can be put up by one computer support person, giving access to the committee members for less than the cost of duplicating paper-based reports. And whatever subset of Sydney's 3.5 million residents as are interested can review the same material at no additional cost to the ASA. As the ASA has been perceived to be very secretive in their deliberations and decisions, this would be great leap forward in openness, transparency and accountability."*

Needless to say, the department ignored the advice for openness, information dissemination and accountability – deciding instead to stay with its traditional approach of secret in-camera deliberations, and eventual release of only the 'answers' and not the logic that led to such answers.

23) NEXT STEPS

The next step is for the Department of Transport and Environment Australia to issue a formal opinion on whether quantitative measures of sharing are endorsed by such bodies or whether, by their silence, they condone the current politically-corrupt ad hoc decision-making by unrepresentative bodies.

An attempt has also been made to send this paper to all SACF members. However, the SACF Secretariat state that they are under strict instruction that they cannot distribute items addressed to SACF to the members, unless that distribution is authorised by the Chairman of SACF, Mr Joe Hockey. With such stifled information flows, I hereby ask the Minister to approve this feedback being sent to the members of SACF, irrespective of whether Mr Joe Hockey wants them to receive such material. Besides what democratic process is at work which prevents mail from the community going to the committee purportedly representing the community? Then when SACF have had the opportunity of reviewing the quantitative methods of this paper, the public can be made aware of their endorsement of fair measures and democratic principles or, by their silence, their endorsement of an unrepresentative body and unfair politically-corrupt decision-making.

The responses/positions of the various government and quasi-government bodies will then be offered as further evidence in the case brought by the Eastern suburbs councils in the Federal Court ADJR cases concerning the LTOP process. In light of the damming evidence concerning the conduct of the

Prime Minister, Joe Hockey, SACF (as a whole) and Airservices, any refusal to move to an independent and transparent process can only be taken as an admission of guilt and a continued statement of intent to misuse power for electoral benefit.

This material will also be used to support Paul Zammit's public calls and media/legislative campaign for a Judicial Enquiry into the LTOP process and the establishment of an independent Sydney Airport Commission. As the press provide greater coverage to the ADJR case as it unfolds, it will become public knowledge that fair independent measures were offered to the government, in light of Airservices inability/unwillingness to develop such a model.

Finally, this material will be published internationally, through the Internet links between Sydney's airport action groups and those in some 18 other countries around the world. The Howard government and Airservices can then be held up as an example internationally of how not to plan airport operations, and this can become a case study for other governments and community groups in other countries, so as to avoid the process becoming de-railed by self-interested politicians intent on meddling improperly.

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The author would also like to thank the following people for their valuable feedback in the development of this paper:

Phil Anderton, City of Botany Bay aircraft noise expert and Eastern Coalition Airport Group (ECAG) representative;

Cr George Newhouse, Waverley Councillor and Eastern Coalition Airport Group (ECAG) representative;

Henri Richards, representative-designate of Eastern Suburbs to the Implementation and Monitoring Committee (IMC), Eastern Coalition Airport Group (ECAG) representative and Randwick Aircraft Action Forum (RAAF) member;

Kevin Duffy, Bankstown and Environs Airport Group and Coalition of Airport Action Groups (CAAG);

Tony Williams, member of LTOP taskforce and independent adviser to Coalition of Airport Action Groups (CAAG), Randwick City Council, Woollahra Council, Independent MP Paul Zammit, Eastern Coalition Airport Group (ECAG) and others

4 August, 2003

Table 1
ANEF values raised to various powers from 1.1 to 2

ANEF values are shown in left column; Top Row shows power raised to ("P");
Cells of main body show result of raising ANEF value to that particular power ($ANEF^P$).

RAISED TO POWER⇒ / ANEF⇓	*1.1*	*1.2*	*1.3*	*1.4*	*1.5*	*1.6*	*1.7*	*1.8*	*1.9*	*2.0*
1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	3	3	3	3	3	4	4
3	3	4	4	5	5	6	6	7	8	9
4	5	5	6	7	8	9	11	12	14	16
5	6	7	8	10	11	13	15	18	21	25
6	7	9	10	12	15	18	21	25	30	36
7	9	10	13	15	19	22	27	33	40	49
8	10	12	15	18	23	28	34	42	52	64
9	11	14	17	22	27	34	42	52	65	81
10	13	16	20	25	32	40	50	63	79	100
11	14	18	23	29	36	46	59	75	95	121
12	15	20	25	32	42	53	68	88	112	144
13	17	22	28	36	47	61	78	101	131	169
14	18	24	31	40	52	68	89	116	151	196
15	20	26	34	44	58	76	100	131	172	225
16	21	28	37	49	64	84	111	147	194	256
17	23	30	40	53	70	93	124	164	218	289
18	24	32	43	57	76	102	136	182	243	324
19	26	34	46	62	83	111	149	200	269	361
20	27	36	49	66	89	121	163	220	296	400
21	28	39	52	71	96	130	177	240	325	441
22	30	41	56	76	103	141	191	261	355	484
23	31	43	59	81	110	151	207	283	387	529
24	33	45	62	86	118	162	222	305	419	576
25	34	48	66	91	125	172	238	328	453	625
26	36	50	69	96	133	184	254	352	488	676
27	38	52	73	101	140	195	271	377	524	729
28	39	55	76	106	148	207	289	403	562	784
29	41	57	80	112	156	219	306	429	601	841
30	42	59	83	117	164	231	324	456	641	900
31	44	62	87	122	173	243	343	484	682	961
32	45	64	91	128	181	256	362	512	724	1024
33	47	66	94	134	190	269	381	541	768	1089
34	48	69	98	139	198	282	401	571	812	1156
35	50	71	102	145	207	295	422	602	858	1225

APPENDIX I TIME-SEQUENCED CATHERINE-WHEEL PROTOCOL [#7]

[MECHANISM FOR SAFE- IMPLEMENTATION OF FLIGHT PATH SPREADING.]

This is a proposal originally developed by the author in February 1998, at the commencement of the LTOP introduction, but not previously published. This is the full version of the proposal outlined in S. 6.5 of the main text.

I.1 Introduction :

As mentioned earlier, The Long Term Operating Plan for Sydney (Kingsford Smith) Airport [LTOP] is the plan for airport departures and arrivals which has been in the process of implementation since December 1997, and has resulted in the introduction of additional aircraft noise to many suburbs (including the North West, the East and the North East) not previously affected in this way.

In proposing the ANEF -ANEI system for monitoring Noise Distribution, it is noted from the "LTOP-96" [LTOPSR] Summary Report at page 102 that :

"The Task Force considered a wide range of inputs and parameters that might be used to monitor the *equidistribution* of noise": para 7; and

> "To achieve this there has to be a wide understanding of what is meant by fair and equitable. The task force environment working group *was not able* to identify what is meant by fair and equitable." *The task force environment working group was not able to identify a single criterion to demonstrate equity* BUT it was able to identify a number of considerations which together, and in balance, could be considered to constitute the basis for a fair and reasonable distribution of noise. " *[Author's emphases]*

And then follows a list of parameters which include the "Average Noise Exposure" (ANEF); "Noise Level and Duration of Exposure" (T70); "Respite" ; "Number of Overflights " (involving a "Noise Metric" (N70)); "Time of Day or Night" and the specification of "Non-Reciprocal Flights".

First, in failing to identify ***"what is meant by fair and equitable"***, the so-called *"Sydney Air Traffic Management Task Force"* clearly failed in its allotted goal to achieve "fair sharing" [LTOPSR p. 10] of noise which could not be directed over the water or non-residential areas.

Second, the "LTOP-96" Reports show that the Task Force restricted its considerations to departure plans, defined by the various operating "MODES", to pathways effectively comprising "FREEWAYS IN THE SKY". Although in some areas these behave more like multi-lane freeways (over the north west); in others (eg. Coogee-Maroubra), the flight tracks are highly concentrated.

Moreover, (perhaps an unintended consequence of the *"noise-share"* targets), is that until the very outermost limits of Greater Sydney have been reached, aircraft do not gain altitude towards cruising level, remaining at 2500 - 3500 ft above sea level.

The noise exposure for residents of areas immediately underlying the "FREEWAYS" is thus concentrated by LTOP Modes 7, 8 and 9, being the one's particularly affecting the overflight of residential areas to the west, northwest, east and northeast of the city. Although some spreading was subsequently introduced in some areas of the inner northwest, elsewhere there can be all-weather concentrations [eg. Strathfield, Parramatta, Winston Hills] .

Inevitably, such concentration of flight paths exposes more people in the underlying specific areas to aircraft noise, to which people in other areas of the Metropolitan Area are never exposed, even though Airservices Australia alternates use of the various Modes from time to time and from day to day.

I.2 Local Experience:

In the first phase of the "LTOP" beginning with December 4 1997, "Freeways in the Sky" were being used over many residential areas, and numerous complaints were made by many people to the Noise Enquiry Line. Subsequently (whether as a result of complaints is difficult to assess), a less concentrated exploitation of particular flight paths appeared to be employed over the inner north west.

From mid- March 1998 there appeared some "fanning" of flight paths within the general "Freeway" tracks representing Mode 9 over the North West, but these benefits were never introduced in the east .

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[7] By P.S. Lingard

From both personal and reported observation of aircraft trajectories in the sky, and the provision by AirServices Australia of "Lochard Noise and Flight Path Monitoring System " reports to residents, there is still a tendency to over-concentrate the flight paths in narrow low-altitude corridors [Both east and west], resulting in excessive exposure to noise in contravention of Recommendation 5 of the "LTOP-96" Report Summary.

I.3 Proposed Alternative Modus Operandi for Departures [The Catherine Wheel Proposal]:

This proposal is based on the following premises:

(a) That at Take-off aircraft must be travelling parallel to their respective runway;
(b) That by some distance from the runway end the aircraft can have reached a particular height setting which is both safe and achievable;
(c) That there must be some distance interval during the climbing process when it is not desirable for the aircraft to bank or execute turns;
(d) That depending on wind conditions certain operating "Modes" for Take off and Landing are available and that others are not. Some of these "Modes" are discussed in the "LTOP-96" report;
(e) That beyond some distance from the airport, the aircraft must join some air corridor on its journey to its ultimate destination

In relation to premise (b) trials of heavy jets by Qantas and Ansett have shown that a height of 3000 feet is reachable by the heaviest aircraft [climb attitude 15 degrees] within 3 km of the airport. This is also confirmed by Boeing manuals of procedure [#8]. At the original time of writing this, ICAO -"A" [now ICAO NADP 2; AIP ENR 1.5 Para 11.1.6] operations with initial climbout to 1500 feet had been trialled over both the east and the north west, but have not since been consistently employed over either.

In relation to premise (c) it is understood from discussions with pilots [and the LTOP Report[#9]] , that turns may be executed at or above 800 and 1500 ft depending on the aircraft and the aircraft load [ICAO "A" and "B" specify turns at 1500 and 1000 ft. respectively]. It is not essential to know the precise restraints on turning for the current proposal to be put forward. For more detailed discussion of Noise Abatement Departure procedures see S. 8.2.2 above.

In relation to premise (d) it is accepted that there may be technical and safety considerations immediately following take-off which may limit the trajectories which a given jet may employ from a given runway.

Presumably such limitations may be determined by the fact that other aircraft may be taking off simultaneously from an adjacent parallel runway, or from a runway at right angles to the given runway, as well as those determined by the aerodynamic and inertial characteristics of the plane.

I.4 The "Catherine Wheel " or Clock-Hand Proposal:

I.4.1 A Critical Radius:
This submission is based on the idea that beyond some critical radius from the runway centre [described as "KSA Centre" here] , it should be possible for Airport Traffic Control to direct each successive aircraft to turn into a trajectory differing from the previous one by some increment of a few degrees. The critical radius may vary depending on the aircraft operating characteristics, aircraft type, weight and speed.

I.4.2 Successively Displaced Trajectories:
The resulting trajectories would thus be successively displaced, like the second hand of an analogue clock, each successive departing plane ascending long the path of a different spoke of an imaginary wheel on a different compass bearing until it reaches the outer perimeter of a defined "great departure circle." (or GDC) [See Fig. I.1].

I.4.3 The Great Departure Circle [GDC] :
This latter circle would be defined at a position that would be well beyond the boundaries of the greater metropolitan area at around 20,000 ft [See Fig. I.2] .

By the time each aircraft reached the edge of the defined great circle its altitude would be sufficiently great that it would be able to peel off into its respective air navigational corridor and head for its destination.

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[8] "747 Procedures" Zagoren M. (2000)
[9] LTOPSR (1996) p. 102

In addition to the Great Departure Circle, there should also be a "Great Arrival Circle" [GAC] , one possible position for which is also shown in Fig. I.2 [See discussion in S. I.6.4].

I.4.4 A Giant Catherine Wheel:

The resulting aircraft movements, as each peeled off successively, into the air corridor designated by its port of destination, would have the appearance of a ***Giant Catherine Wheel*** when viewed from space on a hypothetical axis of rotation through the centre of Kingsford Smith Airport [Fig. I.1]. .

I.4.5 A Vastly More Equitable Distribution of Aircraft Noise:

The fact that the departure trajectory for each successive aircraft [in whatever **"LTOP" MODE]** occurs along a different spoke of an imaginary wheel, each spoke lying in a different angular position from the previous one, will mean that the *locus at ground level of the impact of aircraft noise* will continually change, thus spreading the noise closer to the airport significantly more equitably. But suburbs distant from the airport will not hear any aircraft noise, because the early steepest possible climb towards cruising altitude of the aircraft will put them above any notional "noise critical altitude" [See S. 8.2.2 & Appendix L] .

FIGURE I.1 THE GREAT DEPARTURE CIRCLE

Cth_Fig1.tif

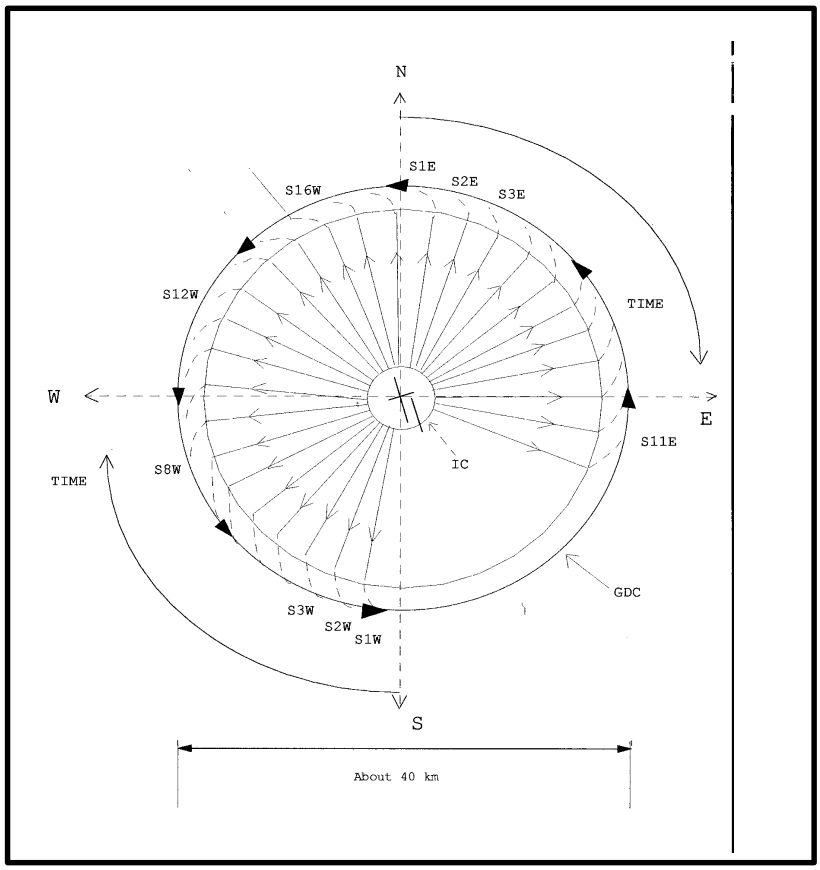
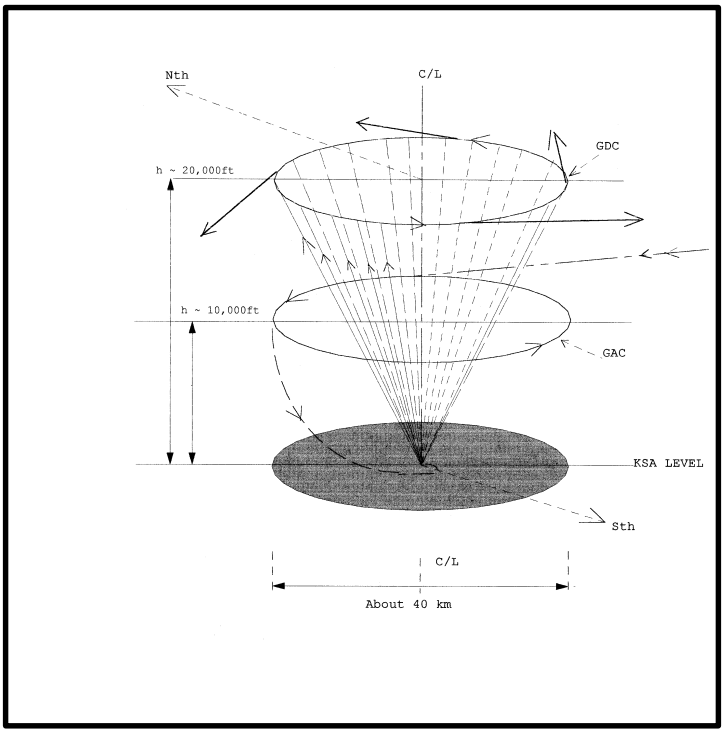


FIGURE I.2 ELEVATION CONCEPT OF THE TWO GREAT CIRCLES
Cth_Fig3.tif



I.4.6 The Angular Displacement of Trajectories:
The Department of Transport and Regional Services (now DOTARS) estimates that there will be a total of 316,000 aircraft movements in the Sydney Basin region by 1999-2000: *See "Sydney Basin Air Traffic Projections" - Aircraft Movement Outlook ; http://www.dot.gov.au/progams/avpol/avstats/sydbasin.htm.*

This amounts on average to about 865.75 "movements" per day. Given that approximately half of these will be arrivals and half of them departures, one arrives at a figure of around 433 departures per operational day. This translates to around (433/17 = 25) per operational hour given that there are 17 non-curfew hours each day.

Given that some arrivals and departures will normally take place during curfew using *"LTOP-96" MODE 1*, the above estimate of average departures and arrivals per hour requiring to use non-curfew Modes must each be a little less than 25 per hour; although in the early morning period this may be considerably greater.

We will consider Mode 9 as a practical example, because this happens to concern people in most residential areas of Sydney (the East, North East, West and North-west most of all].

Given that the arrivals are concentrated into a funnel passing across Botany Bay, it should be possible to discount there being any possibility of departures interfering with arrivals in any real sense [This aspect will be taken up again later - See I.6.4 "Technical Considerations" - Arriving Aircraft - The Great Arrival Circle].

Of course, this ignores the present reality that due to sloppy air-space design by Airservices Australia, we have departures overflown by arrivals all across the city forcing the low altitude departure flying which is observed [See. S. 8.2.5 *REMOVING THE DEPARTURE CEILING FOR TAKEOFFS OVER LAND, Vol. 1*] .

A conservative estimate for the current operating plan for Mode 9 shows that around 270 degrees of arc is potentially available to accommodate the "spokes" of the "Great Circle" comprising the Catherine Wheel trajectory plan, as centred on the intersection point of the "East-West" and the Long parallel runway. This arc lies between compass bearings approximately South by South West and East of KSA [#10].

This means that there is notionally available about 10 degrees of angular deviation between each successive trajectory for the Catherine Wheel/Clock Hand proposal considered above.

---

[10] See LTOPSR p. 62 - Sydney MODE 9 departures.

I.4.7 The Spatial Displacement of Trajectories at Ground Level:
The above discussion implies a possible separation of ca. 0.7 km between successive trajectories at 4 km from KSA (ie. by a circle approximately including Marrickville and Brighton-Le-Sands) ; or ca. 0.5 km at 3 km from KSA. (ie. by a circle approximately including Sydenham and Arncliffe).

I.4.8 The Temporal Distribution of Noise Impacts at Ground Level:
Because each departure trajectory need only be employed once each hour (using the estimates of departure frequency given above), people at most ground stations need only be exposed to the maximum jet noise around once per hour; or at the most twice at extremely busy times.

Furthermore there would be absolutely no need to concentrate all the flights over the 5 discrete MODE 9 "Freeways" in the sky as occurs now.

Once on its pre-determined trajectorial "spoke", each aircraft will stay there, climbing steadily until it reaches the Great Departure Circle.

Thus as the aircraft proceed further and higher from KSA the spatial separation of their Noise Imprints will increase until they join the Great Departure Circle. At the circle they will all traverse in the same rotational direction until arriving at some appointed position for peeling-off to their respective destination corridors.

It is recognised that at some times of the day aircraft departures will exceed 25 per hour; resulting in a theoretical noise exposure at each radial position of at the most twice per hour. A "Lochard" plot received by the author for Mode 9 operation between 7:00am and 9:00am on 12/2/98 shows around 55 departures in that two hour period.

This proposal shows that there is no inherent requirement for all departing aircraft traffic in the vicinity of Sydney Airport to hog the same notional spatial Freeway; or even one of five.

I.4.9 Average Noise at Ground Level:
How this proposal will in practice affect the ANEC/ANEI measures of average Noise Level at Ground Level in the inner city region remains to be seen, as this can only be achieved by exercising the relevant mathematical model.

However, it is clear that with the Catherine Wheel the spreading of trajectories as proposed will reduce the Noise impact in the presently-affected Mode 9 "Freeways" to between one 25th and one 50th of the present projected average levels. This is because the frequency of exposure in terms of Noise Incidents Per Hour must be reduced in proportion to the number of Departure Radii intersecting the Great Departure Circle at different points.

It is submitted that this would be a fairer and more acceptable result for all but the few remaining residents within a 2-3 km radius of the airport runway centre [KSA Centre].

I.5. Conclusion:

It is submitted that the above proposed method of operation could significantly reduce the overall impact of aircraft noise resulting from departures during the operation of "LTOP" Mode 9 and similar Modes.

The distribution of Aircraft Noise achieved by employing the proposal would certainly be more "Fair and Equitable" than that achieved by the present "noise share Freeway" plan.

With respect to the proponents of the current LTOP scheme, it is submitted that any reasonable examination of the proposed Catherine Wheel or Great Departure Circle model will show that it is capable of achieving significantly Fairer and more Equitable sharing of the necessary aircraft noise than is being achieved now.

The fact that the model is only here discussed with application to Mode 9 does not imply that it should not be applied to the other "LTOP" "residential " modes, where these involve overflying of residents [Eg. Modes 7 8, & 9].

It is proposed that sequencing Catherine Wheel departure trajectories be employed in conjunction with a suitable noise metric system for quantitative distribution of noise impacts across residential areas which reflects the perception of impact by residents, but with the overall objective of minimising aircraft noise on residents everywhere. A possible quantitative methodology for noise impact dosimetry is described in S. 6.4 *[SYSTEMETISING THE MEASUREMENT OF DOSE-RESPONSE]* above

Recommendation: That Airservices Australia implement a reorganisation of the airspace above Sydney Kingsford Smith Airport to eliminate the practice of departing aircraft being required to fly underneath

arrival routes, and implement a system of departure track rotational sequencing so that no single point on the ground in a residential area hears more than one or two aircraft movements per hour during daylight hours.

A system is proposed in which this can be achieved by creating two separate "roundabouts in the sky" for jet aircraft whereby the departure roundabout is at twice the altitude of the arrival roundabout and all departing jet aircraft are sequenced onto the departure circle roundabout in such a way as to avoid conflicts between themselves and arriving aircraft.

It is proposed that such a system be employed in conjunction with a quantitative methodology for monitoring the dose of noise impacts across residential areas which reflects the perception of impact by residents, but with the overall objective of minimising aircraft noise on residents.

As submitted in S. 6.3.1 *[UTILISATION & POTENTIAL FOR OVER-THE-WATER MODES],* **it has been estimated that, properly implemented, over-the-water modes should be able to accommodate at least 70% of the maximum movement capacity of KSA [100 % for arrivals] for between 85 & 95% of the time, depending on the currently prevailing meterological cycle. Trajectory sequenced (Catherine Wheel) departures for *unavoidable* residential overflying would readily cater for the rest.**

I.6 Further Technical Considerations:

I.6.1 Mode 9 Departures - Practical Implications of the Catherine Wheel Approach:

Figure I.1 showed the plan view of the model in operation assuming a 270 degree accessible departure field ranging from compass S-SW to East as discussed above.

The "Great Departure Circle" [GDC] is shown having a diameter of around 40 km; and will be at approximately 20000 feet.

This means that the Great Departure Circle will have its outer limit above approximately St. Marys, and its northern and southern limits will be at around West Head and Thirroul, respectively, but this is only for illustration, and in no way affects the operating principle.

The Inner Circle [IC] lies at the "Critical Radius" for safe operational banking or turning of aircraft immediately after take off [This could be at 3000 ft and 3 km from KSA centre, or elsewhere as needs may be] as described in S. I.1, above.

The "spokes" of the hypothetical Catherine Wheel, separated by 10 degrees of arc, are each shown numbered in the order in each hourly period in which they will be employed [eg. S_{1E}, S_{2E}, ... - S_{NE}].

Two sets of numbered "spokes" are shown, corresponding to departures from the two main parallel runways [S_{1E} & S_{1W} etc from 24 hour clock positions 23:00 to 15:00 and 17:00 to 22:00, respectively]; which must be operated synchronously with each other.

All departure trajectories are numbered clockwise around the Inner Circle; but there is separate numbering and sequencing for the Eastern and Western parallel takeoff runways (34R and 34L) . This is to avoid the possibility of aircraft which are leaving the two runways simultaneously from turning into each other.

I.6.2 Utilisation of Successive Departure Trajectories:

Use of each radial trajectory would be sequenced and programmed into a computer for allocation to each departing flight in chronological order; so that no two departing aircraft could be allocated the same trajectory at the same time, and no trajectory is employed more than once or twice per hour.

Delayed flights would have their departure trajectories deprogrammed as soon as notification of delay was given; and only allocated another trajectory according to their next anticipated departure time.

Trajectory information would be radioed from control to aircraft immediately prior to taxiing, along with information about which runway and entry point to employ.

Once all the angular trajectory [ie "spoke"] positions have been employed for a given runway in any period, then the cycle will be repeated for each parallel runway, but always maintaining strict adherence to the clockwise rotation of trajectory use.

Given the present geographical runway and current operation of Mode 9 it would be possible for each sector to be fully utilised in this way.

I.6.3 Behaviour at The Great Departure Circle:

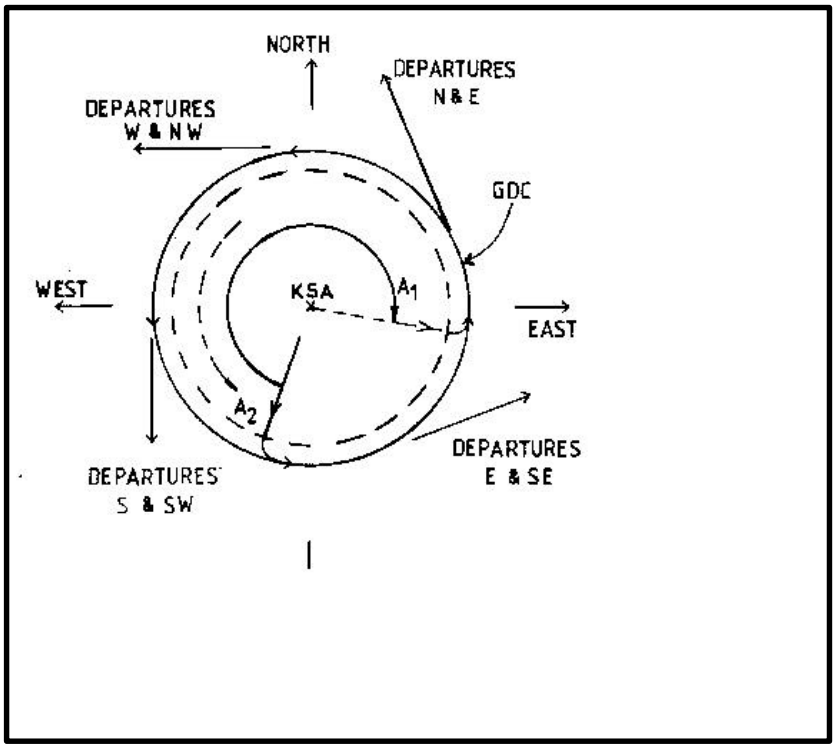
Aircraft arriving at the Great Departure Circle would do so at 10 degree-separated circumferential positions and at times corresponding to their departure schedule. To avoid the possibility of simultaneous arrival of aircraft at the same point on the Great Departure Circle, Airport Traffic Control [ATC] selection of the trajectories must occur in the opposite rotational sense to that of the aircraft's traverse of the Circle, ie. Clockwise selection of the trajectory positions when the Circle is being traversed anti-clockwise and so-forth. Thus for the western sector ["clock" positions 18:35 to 23:00 in Fig. I.1], the take-off cycle would start with the trajectory at radial S_{1W} ["clock position" 18:35].

Similarly, for the Eastern Sector ["clock positions" 00:00 to 15:00] the cycle of take-offs will begin with the trajectory at radial clock position "Noon" [Spoke S_{1E}] and finishes at 15:00 -16:00 "o'clock" [Spoke S_{NE}].

Some adjustment to flying times might be necessary to position aircraft traversing the Great Departure Circle at safe distances from each other.

Each aircraft would then traverse the Circle until its departure point was reached in a position adjacent to its designated international or domestic air corridor. It is this periodic peeling characteristic which lends the name of "Catherine Wheel" to the present model. Figure I.3 shows the proposed peel-off procedure for aircraft leaving the Great Departure Circle. .

FIGURE I.3 PEEL-OFF PROCEDURE AT GREAT DEPARTURE CIRCLE
Cth_Fig2.tif



The arcs A1 and A2 in Figure I.3 show the direction of aircraft traverse of the departure circle for the eastern and western sectors, respectively.

I.6.4 Arriving Aircraft - The Great Arrival Circle:

Corresponding to the Great Departure Circle, there would be a Great Arrival Circle which arriving aircraft would approach at an altitude below that of the departure Circle. There is probably more than one way of doing this, and the description here is provided for illustration only, as the final result will have to be calculated by aeronautical experts.

In this scenario, to avoid intersecting the trajectories of departing aircraft towards the Great Departure Circle, arriving aircraft would need to descend to an altitude of , say, 10000 ft at a distance beyond the Great Departure Circle; and cruise at that altitude towards the perimeter of the Great Arrival Circle where they would join a procession around the circle until they reached the appropriate point for the commencement of the descent to Botany Bay Heads.

Preliminary calculations suggest that a 10000ft Arrival Circle would need to be at a distance of about 20 km from KSA centre to avoid aircraft interactions; ie. directly below the departure circle.

There are be a number of possible arrangements, however, including that where the Arrival Circle was say, at an altitude higher than the Great Departure Circle and considerably further out, but below cruising height. This would need to be positioned far enough away to allow departing craft to reach cruising height before reaching the radial position of the Arrival Circle. To ensure optimum altitude gain for departing aircraft, however, it is recommended that every attempt be made to ensure that the Great Arrival Circle [GAC] is located below the Great Departure Circle [GDC] so as to minimise departure noise impacts on the ground. An elevation view of the two Great Circles as envisaged in this proposal was shown in Figure I.2 [S. 6.5.4 Main Text, Fig. 6.5.4.1] .

I.7 STATISTICS ON CATHERINE WHEEL PLAN:

Time to arrival at Great Circle at 300km/h = [40/300*60] = 6 minutes

Distance along Great Circle between adjacent trajectories = [10*80*(22/7)/360] = 6.98km

Time to traverse Great Circle between trajectory access points: [6.98/300*60]= 1.396 minutes

Therefore too dangerous for trajectories to be taken up anticlockwise for anticlockwise traverse of Circle

Conclusion : Must access trajectories clockwise for anticlockwise traverse of Great Circle.

END
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SYDNEY AIRPORT COMMUNITY FORUM

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www.dtrs.gov.au/airports/sacf/sacf1.htm

14 April 2000

The Hon. Daryl Williams AM QC MP
Attorney-General
Parliament House
Canberra ACT 2600

Dear Attorney-General

I am writing in my capacity as Chairman of the Sydney Airport Community Forum (SACF) regarding protective legislation pertaining to airports and aircraft.

I would appreciate it if you could advise me whether the National Environmental Protection Measures Act (1998) excludes inter-governmental agreements (cooperation with the States) in the matter of environmental protection of residents from overflying aircraft. If so, why is this the case?

In addition, please advise me if and to what extent the Air Navigation (Aircraft Noise) Regulations and the Air Navigation (Aircraft Engine Emissions) Regulations regulate noise emissions from aircraft in flight or when landing and taking off while over residential areas near an airport.

Dr. P. S. Lingard, the Secretary of the Sydney Airport Community Forum Inc., believes that in order for these regulations to be effective in controlling aircraft noise and emissions near residential areas there would need to be regulations in the manner and altitude of flight of certain aircraft. Further, he believes that such regulation could only come about through air-traffic control under the supervision of Air-Services Australia. I would appreciate it if you could consider these matters and advise me accordingly.

Further to these points, please advise me if the Air-Services Act and Regulations stipulate any criteria controlling the maximum noise level on the ground or pollutant vapour concentration in the air at

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ground level, and provide protection against noise and emissions from overflying aircraft.

Finally, I would appreciate it if you could inform me as to whether laws providing for certain noise maxima in relation to emissions from industrial sites near residential areas might also be applied to aircraft flying over residential areas.

I greatly appreciate your consideration of these matters and look forward to your response.

Yours sincerely

Brendan Nelson

DR BRENDAN NELSON MP
Federal Member for Bradfield
bh

Senator the Hon Robert Hill
Leader of the Government in the Senate
Minister for the Environment and Heritage

Dr Brendan Nelson MP
Federal Member for Bradfield
Sydney Airport Community Forum Chair
PO Box A301
SYDNEY SOUTH NSW 1235

19 JUN 2000

Dear Dr Nelson

Your letter of 14 April to the Attorney-General, the Hon Daryl Williams AM QC MP, regarding protective legislation pertaining to airports and aircraft, in particular the *National Environment Protection Measures (Implementation) Act 1998,* has been forwarded to me for reply.

The National Environment Protection Measures (Implementation) Act 1998 provides for the implementation of National Environment Protection Measures (NEPMS) in relation to activities of the Commonwealth and Commonwealth agencies. Under the Act the Minister for the Environment and Heritage may apply State and Territory laws implementing NEPMs to the activities of the Commonwealth and Commonwealth agencies, which would otherwise be immune from such laws.

If an activity involves a matter of national interest the Minister may make a declaration that an alternative Commonwealth regime for the implementation of the NEPM will achieve the appropriate environmental outcomes and is more appropriate than the application of State and Territory laws. If such a declaration is in force, State and Territory laws implementing the NEPM will not apply. It is also possible for regulations to be made excluding the operation of a particular provision of State or Territory law, or excluding a particular activity, if the Minister thinks it desirable because of considerations relating to a matter of national interest.

Matters relating to the management of aviation airspace or airports, including aircraft emissions, aircraft noise and on-ground airport management, may be prescribed by regulation as matters of national interest (except matters specified in subregulation 1.04 (2) of the *Airports (Environment Protection) Regulations 1997).*

Parliament House, Canberra, ACT 2600
Telephone 02 6277 7640 Facsimile 02 6273 6101

2

The following matters have been prescribed (in regulation 4 of the *National Environment Protection Measures (Implementation) Regulations 1999:*

(a) a matter relating to the management of Australian-administered airspace by Airservices Australia under the *Air Services Act 1995;*

(b) a matter relating to the management of an airport that is an airport site within the meaning of the *Airports Act 1996.*

This is consistent with the Government's position that the Commonwealth continue to administer aviation and airport matters so as to ensure a consistent national approach to handling such issues. Given that the aviation industry operates on a network basis across Australia it would clearly not be appropriate to have different regulatory regimes applying in respect to aircraft operations and airports. We are not excluding the application of NEPMs from aviation matters, rather we are ensuring that such measures can be applied consistently across Australia through Commonwealth aviation specific legislation.

In relation to airports, the *Airports Act 1996* and the *Airport (Environment Protection) Regulations* made pursuant to that Act, establishes in conjunction with NEPMS, a Commonwealth system for regulating activities on airports that generate, or have the potential to generate, pollution or excessive noise. To ensure these outcomes are achieved, the Act and Regulations prescribe the development and implementation of an approved airport environment strategy and the establishment of environment standards.

Noise and engine emissions from aircraft in flight, or when landing and taking off from an airport, are regulated by the *Air Navigation (Aircraft Noise) Regulations* and the *Air Navigation (Aircraft Engine Emissions) Regulations* respectively. These Regulations put in place controls on aircraft noise and emissions through design and manufacturing requirements. This is consistent with the international approach to such matters and in accordance with our international obligations through the International Civil Aviation Organization (ICAO).

As you know, Australia has one of the quietest and cleanest aircraft fleets in the world and continues to be a key player within ICAO in working toward stricter aircraft noise and gaseous emission standards for new aircraft. The Australian airlines phased out their older noisier "Chapter 2" equipment well ahead of international requirements and their fleet is now made up of modern "Chapter 3" jet aircraft.

Australia is also actively participating through the Kyoto Protocol fora, and ICAO, in developing greenhouse emissions options designed to address both national and international concerns. The National Pollutant Inventory NEPM

3

has as its principle aim, provision of information on emissions entering the environment. Since July 1998 larger industrial facilities have been required to estimate and report annually their emissions of the chemicals listed on the National Pollutant Inventory. This information is publicly available on an Internet database. Information on aircraft operations will be included in the database.

1 am advised that aircraft flight paths and altitudes around airports are controlled through operational requirements. As you know, the flight path arrangements at Sydney Airport were arrived at though a major consultative process during the development of the Airport's Long Term Operating Plan (LTOP). These flight paths are codified in the Airport's formal Standard Instrument Departures and Standard Arrival Routes and in the operational documentation of Airservices Australia.

In developing these operational procedures and requirements the *Air Services Act 1995* explicitly places a responsibility on Airservices Australia to ensure that as far as practicable the environment is protected from the environmental effects of the operation and use of aircraft.

Yours sincerely

Signed by Minister Hill
19 June 2000

Robert Hill

: A Handwritten postscript at the end of Minister Hill's original letter to Dr. Nelson states:
" In case of confusion - as there is no NEPM [National Environment Protection Measure] for aircraft noise The National Environment Protection Measure (Implementation) Act does not apply. Noise is regulated under other C/W legis & regs."

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14 July 2000

COPY

Dr. Brendan Nelson,
Chair , Sydney Airport Community Forum,
Suite 8 12-16 Tryon Road
Lindfield NSW 2070

Dear Dr. Nelson:

Re. "Protective Legislation":-

I write again to thank you for raising the legislative protection issue with the Attorney General, which correspondence was forwarded on to the Minister for the Environment. I recently received from your office a copy of the response from Robert Hill dated 19 June 2000 which I now wish to address.

Broadly, the Minister's letter covers the matters outlined in my short paper ***"ENVIRONMENTAL PROTECTION FROM OVERFLYING AIRCRAFT"***, which appeared as an Appendix to the SACF Inc Position Paper, ***"The Way Forward from Sydney's Airports Quagmire."***

Although the wording of the Minister's letter is different from that used, either in your letter, or in my short paper, I believe that it correctly acknowledges the present situation, ie.

1. The regulation of aircraft impacts [noise and pollution] is excluded from NEPM coverage by Regulation 4.

2. The only *specific* reference to aircraft noise is that in the Air Navigation Regulations which pertain to certification of aircraft engines during manufacture. I understand that the standards for this involve running tests on the tarmac, and do not include measurements on the ground when the aircraft is flying overhead.

3. The Airports Act and Regulations only purport to control *"activities on airports that generate, or have the potential to generate, pollution or excessive noise."*

4. The Airservices Act by s. 8(1)(d) authorises the ***"carrying out [of] activities to protect the environment from the effects of, and the effects associated with, the operation of Commonwealth jurisdiction aircraft" (s. 8(1)(d))*** ; but as the Minister says, aircraft flight paths and altitudes around airports are controlled *"through operational requirements"*.

Dr. Brendan Nelson, Chairman, Sydney Airport Community Forum 14/7/2000 cont'd:

The Minister does not expressly say so, but I believe that his letter confirms my assertion [See *"ENVIRONMENTAL PROTECTION FROM OVERFLYING AIRCRAFT"*] that there is presently *no specific regulation* governing the maximum permissible aircraft noise level at ground level from aircraft on controlled flight paths above residential areas. At least I have not been able to unearth any such regulation by extensive search, but this is not legal advice. I was hoping that the Attorney General might be able to exercise his officers to determine this position.

At the same time, the Airservices Act [as stated in my paper] by s. 19 exempts Airservices Australia from the obligation to comply with State and Territory "land use laws"; which would include State Noise Acts and laws regulating gaseous emissions. Yet the Act by s. 77(2)(f) does provide the 'governor-general' with power to make regulations prescribing matters: ..... **" regulating the environmental effects of the operation of Commonwealth jurisdiction aircraft".**

Given that the Minister implies that the government now recognises that aircraft emissions will in future be included among "larger industrial facilities" in inventories of chemical emissions, along with other industrial sites, one feels justified in asking, why is aircraft noise excepted?

A possible solution, however, is to impose regulations on Airservices ensuring that, except where safety considerations otherwise demand, the altitude of any aircraft must be such that the noise level on prescribed residential areas at ground level is less than some number of decibels. As you would be aware, but subject to meteorological factors, noise intensity diminishes by an inverse square law according to distance from the source, ie the aircraft engine. I am not suggesting that aircraft should be forced to fly on flight paths which are dangerous, or to run their engines excessively slowly when in flight, to control aircraft noise impacts on the ground.

If "noise-sharing" is then still necessary, the regulations could perhaps ensure that, over some suitable short time frame [preferably hours, but not a year, as with the ANEF], unavoidable, but minimal, noise is averaged evenly over the affected residents. This may encourage Airservices to design flight path systems which take these issues into account, thus fulfilling their obligation under s. 8(1)(d) whilst, hopefully, not compromising safety.

In his letter the Minister confirms that your Forum [Govt SACF] has the guernsey to significantly influence flight path arrangements over Sydney. If noise is the issue, may I suggest that there could be no better method of bringing this about than by introducing a suitable regulation under the Airservices Act, either from within Parliament, or by the Minister instructing the Department of Transport to implement such a regulation?

This Forum will be interested in your response, and also to see what reply might be forthcoming from the Ministers if such a proposal is mooted from SACF. Thank you for your concern.

Yours sincerely,

Philip S. Lingard
Secretary, Sydney Airport Community Forum Inc

r/nel0004.sacfinc

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P/MK 4/10/2000

SYDNEY AIRPORT COMMUNITY FORUM

Philip S Lingard
Secretary
Sydney Airport Community
Forum Inc
PO Box 104
SUMMER HILL NSW 2130

Philip

Dear ~~Mr~~ Lingard

Thank you for your letter of 14 July 2000 canvassing your proposal for Regulations to be developed which set maximum permissible noise levels at points on the ground for aircraft overflying residential areas.

I have noted the points you raise about the absence of legislation which imposes maximum permissible aircraft noise levels for a receiver on the ground.

Environmental noise is legislatively controlled through a range of approaches which are targeted to suit each particular noise source based on the administrative and technological feasibility of applying the controls. While stationary noise sources are commonly controlled through specifying maximum noise levels at the receiver, I am advised that mobile and portable noise sources are generally controlled by imposing design standards and use restrictions.

For example, noise from motor vehicles is controlled by imposing Australian Design Standards on motor vehicles and through the adoption of design standards for roads. Noise from domestic appliances such as lawnmowers is controlled through imposing design standards on the mowers and through restricting the hours at which they may be used.

Aircraft noise is controlled in a similar manner. As you are aware, aircraft are required to meet international noise and emission standards set through the International Civil Aviation Organization (ICAO). In addition, the hours of use are controlled through legislated curfews; the numbers of noise events are controlled through legislation such as the *Sydney Airport Demand Management Act 1997* and flight paths are controlled through promulgation of formal procedures and plans such as the Sydney Airport Long Term Operating Plan.

I am advised that contrary to your apparent assertion that '...aircraft noise [is] excepted [from regulation]', aircraft noise is almost certainly the most heavily regulated form of environmental noise in Australia.

Irrespective of the above I fully support the broad thrust of your letter that we need to continually search for better aircraft noise outcomes for the community. I am committed to this challenge.

Thank you for raising these issues with me.

Yours sincerely

Dr Brendan Nelson
Chair

APPENDIX K BACKGROUND TO ACOUSTIC CALCULATIONS

b. 21/5/2003; r 29/6/2003

By P.S. Lingard and H.P. Richard

CONTENTS

K.1 Basic Acoustic Principles Relied On:

K.1.1 Instantaneous Sound Intensity Level in Decibels:

$$dB = 10 \log_{10} (I_1/I_o), \quad (1.1)$$

where I_1 is the instantaneous intensity of sound per unit are per unit time at the point in question ; and I_o is the reference intensity [Commonly 10^{-16} Watt/cm^2]

See Blitz [#11] p.16; AIOP HBK 3-7 [#12]

K.1.2 Instantaneous Sound Pressure Level in Decibels:

$$dB = 20 \log_{10} (p_1/p_o), \quad (1.2)$$

where p_1 is the instantaneous pressure of sound at the point in question ; and p_o is the reference pressure [Commonly 20 micropascals: SAE AIR 1845, p. 35]

K.1.3 Sound Intensity:

Is the average rate of sound energy transmitted in a given direction per unit area:

$$I_x = 1/T \int_0^T p\, v(x)\, dt \quad (1.3)$$

where p = instantaneous sound pressure;
v(x) = instantaneous particle velocity
AIOP HBK 3-5 [See [#2]]

K.1.4 Relation between Sound Intensity (I) and Sound Pressure (p):

For a spherical wave of "effective sound pressure" p and propagation speed c in a medium of density ρ

$$I = p^2 / \rho c \quad (1.4)$$

for spherical propagation.
AIOP HBK 3-5 [See [#2]]

Note: Eq. (4) differs from that described in Blitz [#1] which is multiplied by 1/2.

K.1.5 Intensity at distance r from point source of Power P_m :

$$I(r) = P_m / 4 \pi r^2 \quad (1.5)$$

where P_m = "Power of source" : Blitz [#1], p. 15

Note: Power equals the *"rate of doing work"* , or the rate of production of energy per unit time.

K.1.6 Relationship between Sound Pressure, Intensity and Radius:

From (4) and (5) :

$$I = p^2 / \rho c = P_m / 4 \pi r^2 \text{ [AIOP HBK [#2] 3-5 and Blitz [#1]]}$$

Therefore: $$p^2 = \rho c P_m / 4 \pi r^2 \quad (1.6)$$

Hence p^2 (not p) $\sim 1/ r^2$

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11 Blitz, J. (1967) Fundamentals of Ultrasonics. Butterworths, London

12 American Institute of Physics Handbook 3rd Ed.

K.1.7 Sound Exposure Level (SEL) in decibels [called L_{AE}]:

$$L_{AE} = 10 \log \{ \int_0^T (p/p_o)^2 \, dt \} = 20 \log \{ \int_0^T (p/p_o) \, dt \} \quad (1.7)$$

Here p_o is the "reference pressure" which for noise levels expressed in decibels is internationally agreed as 20 microPascals. See SAE AIR 1845 Eq. B1, p. 35 [#13]

Note that $(p/p_o)^2 = I/I_o$ by Eq. (4)

For constant p, the integral in Eq. 7 becomes simply (p/p_o), ie:

$$L_{AE} = 20 \log (p/p_o)$$

K.1.8 Sound Power of Source:

For a source vibrating with particle velocity v_p and sound pressure p_s:

$$v_p = p_s/\rho c \quad (1.8)$$

See Blitz Eq. 2.32, where ρc = Acoustic Impedance.

$$v_p = \omega a = 2 \pi f a \quad (1.9)$$

where ω = angular frequency of vibration, a is the amplitude and f is the frequency.

Energy per unit volume (or Energy Density) $E = (1/2) \rho v_p^2$ [Formula for Kinetic Energy] (1.10)

See Blitz p. 16 [#1] (Eq. 2.36a)

K.1.9 Intensity of Sound (I) = "Energy Flow per Unit Area per Second" :

For a spherical source of finite radius, s, the total energy :

$$P_m = (4/3) \pi s^3 E$$

where E is the energy density per unit volume.

Thus $P_m = (4/3) \pi s^3 (1/2) \rho v_p^2$; where $v_p = p_s /(\rho c)$

Hence $P_m = (4/3) \pi s^3 (1/2) \rho (p_s/\rho c)^2$ (1.11)

Intensity of Source $I = P_m / (4 \pi s^2)$ (Eq. 1.5)

Hence $I = (s/6\rho c^2) p_s^2$ (1.12)

where p_s is the sound pressure and s is the radius of the finite source.

Thus $I \sim p_s^2$

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[13] SAE AIR 1845 (1986) Precedure for the calculation of airplane noise in the vicinity of airports

K.2. The Model and Methodology:

The stimulus for this exercise originated in the Department of Transport and Regional Services [DOTARS] March 2000 "Discussion Paper" which considered the possibility of using better understood noise metrics for disseminating information to the community about aircraft noise [# 14] . Although superficially attractive, the Southgate approach only describes the existing status-quo and underestimates the real noise impact for levels greater than 70 dB(A). Also, it still leaves the "forecasting role", for land-use planning, and insulation specification, to ANEF - the "Australian Noise Exposure Forecast, " and fails to help the person in a newly-affected zone.

While the DOTARS paper concedes that complaints now arise from a significantly wider area than from within Airservice Australia's ANEF 20 contours, it submits that the parameter "N70" might be a preferable way to warn and advise communities of the prevalence of aircraft noise in their chosen suburb. The N70 (dB(A) approach consists of defining contours representing the regions within which flightpath noise, aggregated over an "average" day or year equals or exceeds 70 dB(A) .

The present approach was borne of the belief that SACF Inc should be producing practical recommendations to Government for improved "on-the-ground" regulation of aircraft noise .

To discover how "N70" and ANEF, and the other metrics compare, an artificial, but mathematically useful, model was adopted which assumes that over a point on the ground under a flight path, or a confluence of flightpaths, there pass a given number of aircraft movements per day. Each such movement constitutes a "flyover."

For convenience, this is computed as so many movements per hour, each of which has a duration of 0.5 minute (ie 30 sec) each flyover producing the same "maximum decibel level" , L_{max} , of 70 db(A) at the chosen point on the ground.

The subsequent process (described below) involves calculating how this scenario affects the metrics individually, eg. N70 [this is obvious], then L_{eq} , ANEF, DNL, CNEL and, finally the overall comparison. In S. 7 a "flyover" correction is computed to allow for the fact that the actual maximum noise level on the ground varies as an aircraft passes overhead, and this is applied to the final Metric Comparison given in S. 8.

K.3. Definition and Calculation of ANEF

ANEF = EPNdB [# 15] + 10 x Log (Nd+4Nn) - 88 [AS 2021 - 2000 p. 45] (3.1)

Given that EPNdB ~ dB(A) max +13 [# 16] [# 17]

ANEF ~ dB(A), max + 10 x Log(Nd+4Nn) - 75 (3.2)
Where Nd is the number of "daytime" flights and Nn is the number of "nighttime" flights.

In a typical 17 hour day at KSA of such events, there are 12 hours in "daytime" and 5 hours at "nighttime" for the purpose of calculating ANEF. The results are listed in Table K.1 for dB(A), max = 70 dB:

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14 "Expanding Ways to Describe and Assess Aircraft Noise" Southgate, D. , Aked, R. , Fisher, N., & Rhynehart, G. ISBN 0 642 42262 1 , Mar 2000 [http.www.dotars,gov.au]

15 EPNdB = Effective Perceived Noise Level in decibels

16 "Aircraft Noise in Australia" Hede A.J. & Bullen R.B. NAL Report No. 88 Table 8.1, p. 181 (1982)

17 Telco D. Southgate DOTARS Airport Operations 29/10/2001

TABLE K.1 ANEF vs N70

EVENTS	INTERVAL	MOVEMENTS	ANEF	N70
PER HR	Mins	PER DAY	dB(A)	PER DAY
1	60	17	10.05	17
2	30	34	13.06	34
3	20	51	14.82	51
5	12	85	17.04	85
10	6	170	20.05	170
15	4	255	21.81	255
20	3	340	23.06	340
30	2	510	24.82	510
45	1.33	765	26.58	765
60	1	1,020	27.83	1,020
100	0.6	1,700	30.05	1,700

K.4. Definition and Calculation of Time and Energy Averaged Equivalent Mean Sound Level L_{eq} [#18]

By the definition of the Decibel;

$$dB(A) = 10 \log (I_i/I_o) \quad \text{……..…….} \qquad (4.1)$$

where

I = sound intensity = dP / dA;

dP = "rate of flow of energy" [# 19] ; and

I may be given as:

$$I = P_m / 4 \pi r^2 \quad [\text{Eq. } 1.5]$$

where P_m [point] = power of source.

For a plane wave:

$$I = c E$$

where

E = "energy / unit volume of a plane wave" or Energy Density;

c = wave velocity.

Therefore,

$$E = I / c \quad \text{……...} \qquad (4.2)$$

For a series (*i*) of constant intensity sound pulses of duration dt (minutes) spread over a period T:

The energy average $(\sum E * dt) / T$ may be given by

$$E_{ave} = (1/c)\,(1/T) \sum_1^N I_i * dt, \quad \text{……} \qquad (4.3)$$

where

dt = the pulse spread time, and

N = the number of pulse events in the defined period T.

From Eq.(4.1)

$$I_i / I_o = \log^{-1} (dB_i /10); \qquad \text{and}$$

$$I_i = I_o * \log^{-1} (dB_i /10) \quad \text{……} \qquad (4.4)$$

where dB_i signifies the A-rated decibel level of the pulses, assuming each to be of constant intensity.

From Eq. (4.2) and (4.3)

$$E_{ave} = I_{ave} /c = (1/c)\,(1/T) \sum_1^N I_i * dt,$$

where the suffix *"ave"* stands for average energy and intensity, respectively.

Substituting I_i from Eq. (4.4) :

$$E_{ave} = (1/c)\,(1/T)\; N * I_o * \log^{-1} [dB_i /10] * dt \quad \text{…….……} \qquad (4.5)$$

A general formula for L_{eq} from a sound level pulse of dB_{max} imposed m times per hour for time dt over period T can be obtained from :

$$E_{ave} = (I_o/c) \times (m \times (T/60) \times dt/T) \times \log^{-1} \{ dB_{max}/10\}$$

$$= (I_o/c) \times (m \times (T/60) \times dt/T) \times 10^{\{ dBmax/10\}}$$

From (4.2) : $I_{ave} = E_{ave} \times c$

Therefore : $I_{ave}/I_o = (m \times dt/60) \times 10^{(dBmax/10)}$

Therefore $L_{eq} = dB_{ave} = 10 \log \{I_{ave}/I_o\}$

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18 P.S. Lingard & H.P. Richard

19 Blitz J. (1967) Fundamentals of Ultrasonics, Butterworths, London, p. 15

ie L_{eq} = 10 log {m x dt/60} + 10 log $\{10^{(dBmax/10)}\}$ (4.6) [# 20]

Worked Example:

Assume that each pulse has maximum 70 dB(A) noise level:
From Eq. (4.1)

$I_i / I_o = \log^{-1} (dB_i /10) = 10^7$.

For m = 40 and T= 60 minutes (i.e. 40 events per hour) and dt = 0.5 minute [half minute pulse]

Substituting in Eq. (4.6)

L_{eq} = 10 log {m x dt/60} + 10 log $\{10^{(dB/10)}\}$

10 (log {40 x0.5/60) + 10 log $\{10^{(70/10)}\}$
= -4.771 + 10 log $\{10^7\}$
= -4.771 +70 = 65.23 dB(A)

ie the resultant "time average" L_{eq} [60 min]

Additional typical results for 70 dB(A) pulses are reproduced in Table K.2 :

TABLE K.2 TYPICAL CALCULATIONS OF $L_{eq}(T)$

Number per hour m	**Spread interval dt (min)**	**L_{eq} 60 dB(A)**
40	0.5	65.2
40	1	68.2
60	1	70 **

The asterisked result in the above Table confirms that the methodology is correct for the result becomes 70 dB(A) when 100 % of the time is occupied by noise at the maximum 70 dB(A) level.

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[20] Note: Eq. 4.6 is equivalent to Eq. (2) in Sect. 150.205 of US 14 CFR FAR Part 150 "Airport Noise Compatibility Planning" ** where dt = 1 unit of time.

K.5. Definition of "DNL" the US Day, Night Level or L_{dn} :

From US Federal Aviation Rules FAR Part 150 Chapt. C Section A150.305 Eq (3) :

$$L_{dn} = 10 \text{ Log}_{10} [1/T \{ \int_{0:00}^{07:00} 10^{[dB(A)+10]/10} dt + \int_{07:00}^{22:00} 10^{[dB(A)/10]} dt + \int_{22:00}^{24:00} 10^{[dB(A)+10]/10} dt \}] \quad (5.1)$$

where T is the integration period (usually 24 hours).

If there are m flights per hour each producing an average noise level impact of L_A (dB(A) then the above reduces to :

$$L_{dn} = 10 \log_{10} [(1/T) \{ 7 m \times 10^{[LA+10]/10} dt + 15 m \times 10^{[LA/10]} dt + 2m \times 10^{[LA+10]/10} dt \}] \quad (5.2)$$

where dt is the average duration of the sound event.

At Sydney Airport [KSA], the "daytime" period is 15 hours [7:00am - 10:00 pm] and the "night-time" period is 2 hours [10:00pm - 11:00pm and 06:00 am - 07:00 am] with a period of 7 hours during which there should be zero movements. Therefore:

$$L_{dn} = 10 \log_{10} [(1/T) \{ 7 \times (o) dt \, 10^{[LA+10]/10} + 15 m dt \times 10^{[LA/10]} + 2 m dt \times 10^{[LA+10]/10} \}] \quad (5.3)$$

The first term is within the logarithm goes to zero for nil events, ie:

$$L_{dn} = 10 \log_{10} [m dt/T \{ 15 \times 10^{[LA/10]} + 2 \times 10^{[LA+10]/10} \}$$

$$= 10 \log_{10} \{m dt/ T\} + 10 \log_{10} [15 \times 10^{[LA/10]} + 2 \times 10^{[LA+10]/10}] \quad (5.4)$$

The resulting values of DNL for various values of m are listed in Table K.3 . The blue [dark hashed] zone in the Table indicates the number of flights per hour which would be considered acceptable in the USA. The yellow [lighter hashed] band indicates the 80 per hour movement cap for KSA.

TABLE K.3 DNL VERSUS NUMBER OF 70 dB(A) FLIGHTS PER HOUR [T = 30 seconds] [# 21]

X dB(A) LEVEL	**L_{max} = 70dB(A)**
Number of Flights per Hour	**Resulting L_{dn} or DNL**
2	53.86
4	56.87
6	58.63
8	59.88
10	60.85
20	63.86
30	65.62
40	66.87
50	67.84
60	68.63
80	69.88
120	71.64

[21] Data from spreadsheet dnlestr5.wk4/xlw and portable document file dnlestr5.pdf.

K.6. Definition of California's "Community Noise Exposure Level" (CNEL):

The difference between this metric and the "Day-Night-Level" or DNL is that the hours between 7:00 pm and 10:00 pm are weighted by an intermediate loading of 3 dB(A), whereas both the DNL and CNEL have 10 dB(A) loadings for the hours between 10:00 pm and 7:00 am.

The formula for DNL in US Federal Aviation Rules FAR Part 150 Chapt. C Section A150.305 Eq (3) is :

$$L_{dn} = 10 \text{ Log}_{10} [1/T \{ \int_{0:00}^{07:00} 10^{[dB(A)+10]/10} dt + \int_{07:00}^{22:00} 10^{[dB(A)/10]} dt + \int_{22:00}^{24:00} 10^{[dB(A)+10]/10} dt \}] \quad (6.1)$$

where T is the integration period (usually 24 hours).

By analogy with this the formula for CNEL should therefore be:

$$L_{cnel} = 10 \text{ Log}_{10} [1/T \{ \int_{0:00}^{07:00} 10^{[dB(A)+10]/10} dt + \int_{07:00}^{19:00} 10^{[dB(A)/10]} dt + \int_{19:00}^{22:00} 10^{[dB(A)+3]/10} dt + \int_{22:00}^{24:00} 10^{[dB(A)+10]/10} dt \}] \quad (6.2)$$

If there are m flights per hour each producing an average noise level impact of L_A (dB(A) then Eq. (6.2) reduces to :

$$L_{cnel} = 10 \log_{10} [(1/T) \{ 7 m \times 10^{[LA+10]/10} dt + 12 m \times 10^{[LA/10]} dt + 3m \times 10^{[LA+3]/10} dt + 2m \times 10^{[LA+10]/10} dt \}] \quad (6.3)$$

where dt is the average duration of the sound event.

At Sydney Airport [KSA], the "daytime" period for CNEL is 12 hours [7:00am - 7:00 pm] and the "evening period is 3 hours [7:00pm to 10:00 pm] and the "night-time" period is 2 hours [10:00pm - 11:00pm and 06:00 am - 07:00 am] with a period of 7 hours during which there should be zero movements.

Therefore CNEL = $L_{cnel} = 10 \log_{10} [(1/T) \{ 7 \times (o) dt \, 10^{[LA+10]/10} + 12 m dt \times 10^{[LA/10]} + 3 m dt \times 10^{[LA+3]/10} + 2 m dt \times 10^{[LA+10]/10} \}] \quad (6.4)$

The first term is within the logarithm goes to zero for nil events, ie:

$$CNEL = L_{cnel} = 10 \log_{10} [m dt/T \{ 12x 10^{[LA/10]} + 3 \times 10^{[LA+3]/10} + 2 \times 10^{[LA+10]/10} \}]$$

$$= 10 \log_{10} \{m dt/ T\} + 10 \log_{10} [12 \times 10^{[LA/10]} + 3 \times 10^{[LA+3]/10} + 2 \times 10^{[LA+10]/10}] \quad (6.5)$$

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The resulting values of CNEL for various values of m are listed in Table K.4. The blue [dark hashed] zone in the Table indicates the number of flights per hour which would be have been considered acceptable in California when this metric was employed. The yellow [lighter hashed] band indicates the 80 per hour movement cap for KSA.

TABLE K.4 N70 VERSUS CNEL [# 22]

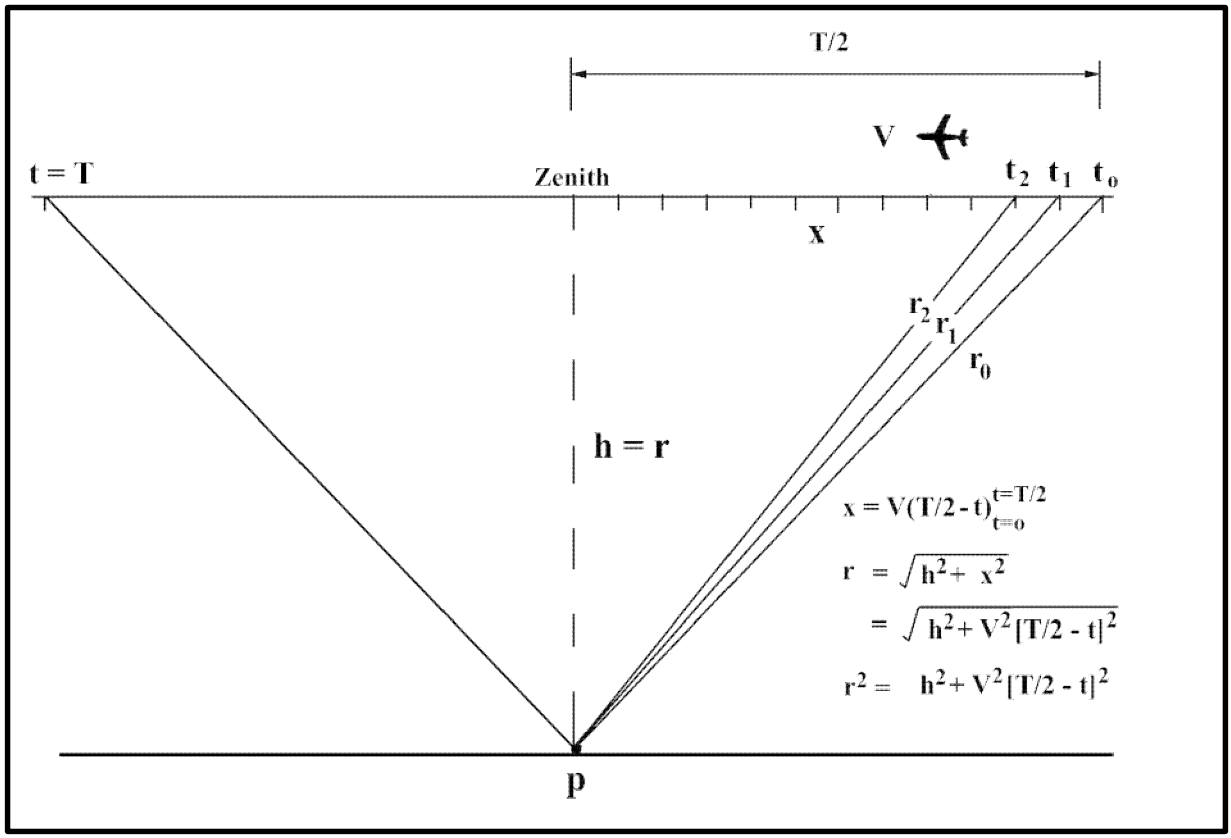
X dB(A) LEVEL	**L_{max} = 70dB(A)**
Number of Flights per Hour	**Resulting CNEL**
2	54.21
4	57.22
6	58.98
8	60.23
10	61.2
20	64.21
30	65.97
40	67.22
50	68.19
60	68.98
80	70.23
120	71.99

[22] Data from spreadsheet cnelst3.wk4/xlw, and portable document file cnelst3.pdf.

K.7. Correction Applied for Aircraft Fly-Over or Over-flight :

K.7.1 **AIRCRAFT FLYOVER CALCULATIONS** [#23]

FIGURE K.1 TYPICAL GEOMETRY OF AN AIRCRAFT FLYOVER



Definitions:
T = Event Interval
V = Aircraft Velocity
h = Altitude of Aircraft
x = Horizontal distance of aircraft from zenith at time t given by $x = V(T/2 - t)_{t=0}^{t=T/2}$
r = Minimum distance of aircraft noise source at time t = r(t) given by $r = \sqrt{(h^2 + x^2)}$
I = sound intensity [~ (pressure)^2]

Calculations:

$r = \sqrt{(h^2 + V^2 [T/2 - t]^2)}$ ……..…….. (7.1)

If dB_{max} = 70 dB(A) = $10 \log(I_p(h) / I_o)$ where I is the sound "intensity" (~ pressure ^{2})

dB_{Eng} = 112 dB(A) [AS2021 for 747-200] = $10 \log (I_{Eng} / I_o) = dB_{Eng}$

Where subscript Eng means origin of sound is at the aircraft engines.

$I_p(h) / I_o = 10^{(dBmax / 10)}$ ……..... (7.2)

Where I = sound intensity [~ (pressure) ^{2}]; and p is a point of observation; dB_{max} is the maximum measured noise level in dB(A) on the ground.

$I_{Eng} / I_o = 10^{(dBEng/10)}$ ……..... (7.3)

Where I = sound intensity [~ (pressure) ^{2}]; dB_{eng} is the maximum measured noise level at the engine in dB(A) .

Now $I_p(h) = kI_{Eng} /(h^2)$ [Inverse square law] …….....……. (7.4)

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where k is a scaling constant, or constant of proportionality, which will vary with the units of altitude measurement employed.

For a given maximum sound level at the observation point, p:

$$I_p(h) / I_{Eng} = kh^{-2} = 10^{(dBmax / 10)} / 10^{(dBEng / 10)} = 10^{\{dBmax / 10 - dBEng / 10\}}$$

Boundary conditions for straight overhead position:

For $dB_{max} = 70$ & $dB_{Eng} = 112$ [747 -200];

Berglund et al (1995) show that if there are four similar sources then one must add 3 dB(A) per additional source, i.e. 9 dB(A) to the amount of the original source.

Thus dB_{AC} (where subscript AC stands for aircraft) in the case of the 747-200 would equal 112 + 9 = 121 dB(A).

Therefore: $kh^{-2} = 10^{[7 - 12.1]} = 10^{-5.1}$ …… (7.5)

Thus if a four-engined aircraft registering 112 dB(A) per engine at source produces a maximum sound level of 70 dB(A) at the observation point , p, when the aircraft is at 1000 m [3281 feet];

$k_{(Imperial)} = h^2 \times 10^{-5.1} = (3,280.8)^2 \times 10^{-5.1} = 85.50$ ……. (7.5.1)

$k_{(Metric)} = h^2 \times 10^{-5.1} = 10^6 \times 10^{-5.1} = 7.94$ (7.5.2)

Generally, for an aircraft approaching or leaving the point vertically above the point of observation [zenith]:

$I_p(r) = k I_{AC} r^{-2}$ ……. (7.6)

Therefore : $r^{-2} = (1/k) \times 10^{\{dB(r) / 10 - dB_{AC} / 10\}}$;

As shown above, for a 747-200 this is $(1/k) \times 10^{\{dB(r) / 10 - 12.1\}}$

Therefore : $dB(r)/ 10 = 12.1 + \log (kr^{-2}) = 12.1 + \log k - \log r^2$ (7.7)

For this aircraft in imperial distance units, k = 85.50 ; log k = 1.93; (7.7.1)

For this aircraft in metric distance units, k = 7.94; log k = 0.90. (7.7.2)

Time Average Sound Level at Observation Point during flyover:

Substituting for r in Eqn. (7.7) from Eqn (7.1), and interpolating for time:

$dB(t) /10 = dB(r) /10 = 12.1 + \log k - \log\{h^2 + V^2 [T/2 - t]^2\}$

Therefore: $dB(t) = 121 + 10 \log k - 10 \log\{h^2 + V^2 [T/2 - t]^2\}$ (7.8)

Average Intensity over T/2:

$I_{ave} (T/2) = 1/T \int_o^{T/2} 10^{\{dB(t) / 10\}} * dt$

Average Intensity over T: $I_{ave}(T) = 2/T \int_o^{T/2} 10^{\{12.1+\log k - \log [h^2 + V^2 (T/2 - t)^2\}} * dt$

Average Sound Level in Decibels during flyover:

$dB_{ave} = 10 \log(I_{ave} / I_o)$

Checksum for directly overhead position: h = 1 km = 1000m, then k =7.94

For a sound level at ground level of 70 $dB(A)_{max}$

$I_p(h) / I_o = 10^7$

$I_{AC} = (h^2 / k)\, I_p(h) = (h^2 / k)\, I_{pmax} = (h^2 / k) \times I_o \times 10^7$

Generally $dB_{AC} = 10 \log\{ h^2 \times 10^{(dBmax/10)} \} - 10 \log k$

For h = 1000 m and $dB_{max} = 70$, then : $I_{AC} = 10^6 \times I_o \times 10^7 / 7.94 = 10^{13} \times I_o / 7.94$;

Calculating back to the noise level at the aircraft:

$dB_{AC} = 10 \log\{I_{AC} / I_o\} = 10 \log\{10^{13} / 7.94\} = 121$ db(A) (7.9)

For Average dB(A) and dB_{ave} for various situations [e.g. V = 300 km/hr = 83.3 m/s] see Table K.5 [*flyovers.pdf]*

K.7.2 Example of Computed Data :

K.7.2.1 TABLE OF JET NOISE APPROACH AND DEPARTURE TIME COURSE PROFILE

The data in Table K.5 are calculated using the corrected formula for dB(t) including an inverse-square law constant k. The sound level data is normalised for 70 dB(A) max at 1000 m with the constant of proportionality k, using the formula:

$dB(t) = dB_{Eng} + 10 \log k - 10x \log\{h^2 + v^2 [T/2 - t]^2\}$ (7.10)

For a 747 - 200 at 4.5 km from take-off roll, $dB_{Eng} = 112$ [AS2021-1994, Table 3.6] for each engine.

Adding three sources [for one (1) plus three (3) [= four (4)] engines at 3dB(A) per source [Berglund et al (1995) Table 1 p. 25], we obtain:

$dB(t) = 112+9 +10 \log k - 10x \log\{h^2 + v^2 [T/2 - t]^2\}$ (7.11)

For V = 300 km /hr, a reasonable takeoff flying speed, V = 300,000 m/hr ie 83.33 m/s

From Eqn. 7.5.2 (above) k = 7.94 for h = 1 km or 1000m.

P.T.O.

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TABLE K.5 JET NOISE FLYOVER NOISE TIME COURSE PROFILE

	Resultant Calculated Instant L_{max} dB(A)					**Calculated Instant Intensity**			
Altitude of Flyover	**H=1000m**	**H=500m**	**H=304m**	**H=152m**		**H=1000m or 3281 FT**	**H=500m or 1640 FT**	**H=304m or 1000 FT**	**H=152m or 500 FT**
	3281 FT	1640 FT	1000 FT	500 FT		30 s flyover	30 s flyover	30 s flyover	30 s flyover
t [seconds]	dB(t)	dB(t)	dB(t)	dB(t)		'10^(dB(t)/10)	'10^(dB(t)/10)	'10^(dB(t)/10)	'10^(dB(t)/10)
1	66.27	67.93	68.38	68.59		4,235,497	6,208,527	6,882,128	7,227,009
2	66.63	68.47	68.98	69.22		4,600,725	7,026,120	7,901,320	8,359,312
3	66.99	69.03	69.62	69.9		4,999,933	8,001,814	9,156,944	9,777,783
4	67.35	69.63	70.3	70.64		5,433,701	9,173,840	10,724,930	11,586,595
5	67.71	70.25	71.04	71.44		5,901,135	10,590,088	12,712,456	13,941,374
6	68.06	70.9	71.84	72.33		6,399,198	12,309,423	15,273,317	17,082,454
7	68.4	71.58	72.7	73.3		6,921,920	14,401,422	18,631,455	21,395,587
8	68.73	72.29	73.64	74.4		7,459,572	16,941,988	23,116,023	27,528,513
9	69.03	73.01	74.66	75.64		7,997,974	19,999,734	29,209,232	36,627,775
10	69.3	73.73	75.75	77.06		8,518,197	23,604,540	37,594,244	50,849,824
11	69.54	74.42	76.91	78.72		8,997,001	27,687,679	49,134,655	74,525,818
12	69.74	75.05	78.1	80.68		9,408,318	31,991,895	64,545,266	116,836,929
13	69.88	75.56	79.2	82.93		9,725,919	35,988,002	83,179,978	196,538,621
14	69.97	75.9	80.03	85.22		9,926,986	38,903,678	100,607,708	332,719,914
15	70	76.02	80.34	86.36		9,995,868	39,983,471	108,161,658	432,646,631
16	69.97	75.9	80.03	85.22		9,926,986	38,903,678	100,607,708	332,719,914
17	69.88	75.56	79.2	82.93		9,725,919	35,988,002	83,179,978	196,538,621
18	69.74	75.05	78.1	80.68		9,408,318	31,991,895	64,545,266	116,836,929
19	69.54	74.42	76.91	78.72		8,997,001	27,687,679	49,134,655	74,525,818
20	69.3	73.73	75.75	77.06		8,518,197	23,604,540	37,594,244	50,849,824
21	69.03	73.01	74.66	75.64		7,997,974	19,999,734	29,209,232	3,662,775
22	68.73	72.29	73.64	74.4		7,459,572	16,941,988	23,116,023	27,528,513
23	68.4	71.58	72.7	73.3		6,921,920	14,401,422	18,631,455	21,395,587
24	68.06	70.9	71.84	72.33		6,399,198	12,309,423	15,273,317	17,082,454
25	67.71	70.25	71.04	71.44		5,901,135	10,590,088	12,712,456	13,941,374
26	67.35	69.63	70.3	70.64		5,433,701	9,173,840	10,724,930	11,586,595
27	66.99	69.03	69.62	69.9		4,999,933	8,001,814	9,156,944	9,777,783
28	66.63	68.47	68.98	69.22		4,600,725	7,026,120	7,901,320	8,359,312
29	66.27	67.93	68.38	68.59		4,235,497	6,208,527	6,882,128	7,227,009
30	65.91	67.42	67.81	68		3,902,730	5,518,767	6,044,671	6,309,112

SUMMARY TABLES:

TIME AVERAGED SOUND LEVEL IN dB(A)					|| ***TIME AVERAGED SUM OF INTENSITIES***			
	dB(A)	**dB(A)**	**dB(A)**	**dB(A)**		**Cumulative Energy**	**Cumulative Energy**	**Cumulative Energy**	**Cumulative Energy**
TIME AVERAGES	68.55	72.8	75.45	78.83		7,165,024.92	19,038,657.86	35,051,521.32	76,298,358.64

Note 1 : Although the Time Averaged Energy per event, above show lower dB(A) values than the Maximum dB(A) for the event, Hede & Bullen [# 24] showed that in many cases the measured variation is very much less - at the most about 2-3 dB(A). For some aircraft it was shown that the noise reduces with distance from the zenith point and for others it stays the same [eg. B747], and it may actually be greater [eg. DC10] .

[24] "Aircraft Noise in Australia" NAL Report No. 88, Chapt 4, Figs. 4.2 - 4.3 , 1982

Calculation of estimated Source Noise for Engines outputting dB(Eng) in dB(A).

A reality check for the above derivations and results can be made by back-calculating the Aircraft Engine noise in dB(A) assuming a constant L_{max} of 70 dB(A) on the ground for different altitudes in the formula (Eq. 7.9):

$dB_{Eng} = 10 \log(I_a/I_o) = 10 \log [h^2 \times 10^7] - 10 \log k = 10 \log h^2 + 10 \log 10^7 - 10 \log k$

The results are listed in the following Table:

TABLE K.6 L max (Engines)

h (m)	h (FEET)	Est Source Noise dB_{Eng}
152	**500**	**104.64**
304	**1,000**	**110.66**
500	**1,640**	**114.98**
1,000	**3,281**	**121.00****

Note that the dB_{Eng} result for the selected aircraft [B747-200] at 1000m is 121 dB(A) [= 112 + 3 x 3 from Eq. 7.5.2], which corresponds to the figure in Table K.6 , above.

K.8. SUMMARY TABLE OF METRIC COMPARISONS:

In Table K.7 (below) it is assumed that the sound level L_{max} is 70 dB(A), each flyover lasts 30 seconds, and the time average dB(A) used for computing each metric [excepting ANEF & N70] is obtained from the outcome in Table K.5 (Section K.7.2.1) , ie 68.55 dB(A).

TABLE K.7 COMPARISON OF METRICS MAXIMUM SOUND LEVEL 70 dB(A)
[anefdnl4.wk4]

EVENTS PER HR	INTERVAL Mins	MOVEMENTS PER DAY	ANEF	N70	DNL ***	CNEL	LA eq [1 hour]	LA eq [15 min]
			dB(A)	PER DAY	N> 65	N>65		n>45 #1
2	30	34	13.06	34	52.41	52.76	50.77	**50.77**
4	15	68	16.07	68	55.42	55.77	53.78	**53.78**
6	10	102	17.83	102	57.18	57.53	55.54	**55.54**
8	7.5	136	19.08	136	58.43	58.78	56.79	**56.79**
10	6	170	20.05	170	59.4	59.75	57.76	**57.76**
20	3	340	23.06	340	62.41	62.76	60.77	**60.77**
30	2	510	24.82	510	64.17	64.52	62.53	**62.53**
40	1.5	680	26.07	680	65.42	65.77	63.78	**63.78**
50	1.2	850	27.04	850	66.39	66.74	64.75	**64.75**
60	1	1,020	27.83	1,020	67.18	67.53	65.54	**65.54**
80	0.75	1,360	29.08	1,360	68.43	68.78	66.79	**66.79**
120	0.5	2,040	30.84	2,040	70.19	70.54	68.55	**68.55**
[1] #1 All Unacceptable at night per NSW EPA & WHO								

Notes:
1. dB(A) max per event 70.00 dB(A)
2. Time Average dB(A) per event ** 68.55 dB(A)

ANEF /N70 RELATIONSHIP FOR 80 dB(A) Events

As it has been suggested by The Department of Transport [DOTARs] [#25] that the parameter "N(70)" be employed for the purposes of "communicating noise information" more realistically to affected residents, Table K.8 shows the effect of increasing the flyover maximum decibel level from 70 to 80 dB(A) on both the N70 and ANEF for the hypothetical constant maximum overflight model employed above.

TABLE K.8 ANEF & N70 FOR MAXIMUM 80 dB(A) FLYOVERS:
[anefn70.wk4]

EVENTS PER HR	INTERVAL Mins	MOVEMENTS PER DAY	ANEF dB(A)	N70 PER DAY
1	60	17	20.05	17
2	30	34	23.06	34
3	20	51	24.82	51
5	12	85	27.04	85
10	6	170	30.05	170
15	4	255	31.81	255
20	3	340	33.06	340
30	2	510	34.82	510
45	1.33	765	36.58	765
60	1	1,020	37.83	1,020
100	0.6	1,700	40.05	1,700

It should be noted that while the N70 remains the same as in Table X6.2.4 -8.1 for the same number of events per hour, the ANEF increases significantly, ie from 20 dB(A) for ten(10) events per hour at 70 dB(A) max, to 30.05 dB(A) for ten(10) events per hour at 80 dB(A) max.

This illustrates the dangerous potential of the N70 to further mislead residents [whether currently residing or potentially purchasing] into a false sense of security through the use of the N70 parameter as a means of communicating aircraft noise levels to the public, unless qualified by reference to the incidence of all events from 70 dB(A) and above.

L_{eq} and ANEF Variation With Different Levels of Maximum Ground Noise:

To further Facilitate comparisons, the values of L_{eq} and ANEF for sequence of overflights of different constant maximum decibel levels are shown in Figures K.9 & K.10 respectively.

P.T.O.

[25] "Expanding Ways to Describe and Assess Aircraft Noise, DOTARS March 2000, D. Southgate et al.

TABLE K.9 COMPARISON OF L_{eq} FOR VARIOUS MAXIMUM GROUND NOISE LEVELS

	dB(A) max	**50dB(A)**	**55dB(A)**	**60dB(A)**	**65dB(A)**	**70dB(A)**	**80dB(A)**
EVENTS PER HR	**N{Db(A)} PER DAY**	**LA eq [15 min]**	**LA eq [15 min]**	**LA eq [15 min]**	**LA eq [15 min]**	**LA eq [15 min]**	**LA eq [15 min]**
	(= N70 for > =70dB(A)						
2	34	30.77	35.77	40.77	45.77	50.77	60.77
4	68	33.78	38.78	43.78	48.78	53.78	63.78
6	102	35.54	40.54	45.54	50.54	55.54	65.54
8	136	36.79	41.79	46.79	51.79	56.79	66.79
10	170	37.76	42.76	47.76	52.76	57.76	67.76
20	340	40.77	45.77	50.77	55.77	60.77	70.77
30	510	42.53	47.53	52.53	57.53	62.53	72.53
40	680	43.78	48.78	53.78	58.78	63.78	73.78
50	850	44.75	49.75	54.75	59.75	64.75	74.75
60	1,020	45.54	50.54	55.54	60.54	65.54	75.54
80	1,360	46.79	51.79	56.79	61.79	66.79	76.79
120	2,040	48.55	53.55	58.55	63.55	68.55	78.55

TABLE K.10 COMPARISON OF ANEF FOR VARIOUS MAXIMUM GROUND NOISE LEVELS

	dB(A) max	**50dB(A)**	**55dB(A)**	**60dB(A)**	**65dB(A)**	**70dB(A)**	**80dB(A)**
EVENTS PER HR	**N{Db(A)} PER DAY**	ANEF	ANEF	ANEF	ANEF	ANEF	ANEF
	(= N70 for > =70dB(A)						
2	34	-6.94	-1.94	3.06	8.06	13.06	23.06
4	68	-3.93	1.07	6.07	11.07	16.07	26.07
6	102	-2.17	2.83	7.83	12.83	17.83	27.83
8	136	-0.92	4.08	9.08	14.08	19.08	29.08
10	170	0.05	5.05	10.05	15.05	20.05	30.05
20	340	3.06	8.06	13.06	18.06	23.06	33.06
30	510	4.82	9.82	14.82	19.82	24.82	34.82
40	680	6.07	11.07	16.07	21.07	26.07	36.07
50	850	7.04	12.04	17.04	22.04	27.04	37.04
60	1,020	7.83	12.83	17.83	22.83	27.83	37.83
80	1,360	9.08	14.08	19.08	24.08	29.08	39.08
120	2,040	10.84	15.84	20.84	25.84	30.84	40.84

END

APPENDIX L NOISE ABATEMENT PRACTICE AT OVERSEAS AIRPORTS [#26]

Introduction:

This section is included for the purpose of answering the question: *"What noise abatement procedures and/or regulations are in place at similar airports around the world?"*

We surveyed published airport noise abatement procedures, curfews and noise policies for 59 well-established airports in the "western" and "neo-western" world. The original data on "Noise Abatement Regulations" is conveniently collected together in one place by aircraft manufacturer Boeing[#27].

The survey shows that airports may be divided into approximately geographical groupings based on whether flight path altitude and "attitude", or "noise impact control" is employed primarily for the purpose of noise abatement. In some cases a combination of control elements is in use (ie Noise abatement flight paths & noise level control - with or without penalties). In others, penalties are invoked for breaches of either flight path conformity, or for exceeding regulation noise impacts either on a case by case basis, or by way of generalised noise taxes and surcharges.

While some of the penalties are significant [ie. $25000 at KSA for failure to follow set allocated flight tracks; $5000 at Washington National for breach of a 72 max dB(A) departure noise level], others however are merely nominal. Typical surcharges are expressed either "per tonne" or "per aircraft type" and apply mainly at European & British airports. In addition to a surcharge at French airports [eg. Le Bourget, Paris, & Marseille] fines of up to FF80,000 per airline and FF10,000 per pilot may additionally be imposed for breaches of noise procedures.

L.1. Noise Abatement Operating Procedures:

L.1.1 The ICAO-A & B Noise Abatement Procedures [#28]:

The most commonly recognised of these are those published by the International Civil Aviation Organisation [ICAO] known as ICAO-A and ICAO-B. ICAO-A requires an initial climb to 1500 ft after takeoff and before reducing thrust and thus permitting turns to be made to facilitate noise spreading. ICAO-B has a corresponding initial climb procedure to 1000 ft. ICAO-A is stated to be suitable for minimising noise impacts further away from the airport, while ICAO-B is said to be designed for minimising impacts closer to the airport runway.

L.1.2 The FAA "Advisory Circular AC 91-53A" Procedures [#29]:

These were developed independently by the US Federal Aviation Administration which regulates air safety and flight path procedures in the United States. There are two published so-called NADP's or "Noise Abatement Departure Profiles", namely the "Close-in Community Profile" and the "Distant Community Profile".

Both profiles mandate thrust reductions at no less than 800 feet, the only discernible difference between the protocols being that in the "close-in" profile thrust cutback is initiated prior to flap or slats retraction, whereas in the "distant" profile initial thrust cutback is initiated after flap or slats retraction has taken place.

It is claimed by FAA that these profiles significantly benefit residents under flight paths in the two area categories, although to the amateur they appear almost indistinguishable. Following flap retraction and thrust reduction in both cases the profiles mandate a thrust setting enabling a slow altitude gain to 3000 ft, and thereafter to an "enroute climb configuration".

L.1.3 Specific Aircraft Manufacturer Noise Abatement Procedures:

It is possible that these are numerous, but access has been provided to instructions for the Boeing 747 (-100, -200 & -SP) which show that a minimum initial climb to 1000 ft is recommended at V_2 + 10k at 15 degrees climbing at 15 degrees to the horizontal. After 1000 ft the pitch angle is reduced and flaps are retracted with acceleration to V_2 + 80 k at from 500 -1000 ft/ minute, until 3000 foot is reached, after which the plane should accelerate to cruising altitude at 250 knots (ie 470 km /hr).

L.1.4 New ICAO [post-1/11/2001] Procedures (Replacing ICAO-A & -B):

Two "Noise Abatement Departure Procedures" [NADPs] are now suggested by ICAO in place of the former ICAO-A & -B [#30] . Both require that noise abatement procedures should not be initiated at less than 800 feet. The first (NADP 1) is designed to facilitate noise reduction for noise sensitive areas close to the airport, while NADP 2 is designed for noise reduction in areas more distant from the airport. The procedures are intended to be developed

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26 Research by P.S. Lingard

27 See http://www.boeing.com/commercial/noise

28 ICAO Procedures for Air Navigation Services "Aircraft Operations" DOC 8168 Part V Chapt 3

29 Federal Aviation Adnministration (USA) , Noise Abatement Departure Profiles, AC 91-53A, 22/7/1993

30 ICAO PANS-OPS Doc. 8168 Vol. 1 "Aircraft Operations - Flight Procedures" ; Part V Chapt 3 Appendix

"by the operator for each aeroplane type and agreed to by the State of the Operator [31] .

L.1.4.1 *ICAO NADP 1* :
This requires a power reduction "at or above" the "prescribed minimum altitude" [ca. 3000 ft] , and delay of flap/slat retraction until a prescribed maximum altitude has been attained at V_2 + (10-20) kt, whereupon flaps are retracted and normal climb speed is resumed. In Australia this corresponds to the Australian AIP ENR 1.5 Para 11.1.7 procedure, where the initial "minimum" altitude is stated to be 1000 feet.

L.1.4.2 *ICAO NADP 2*:
This requires power reduction and retraction of flaps/slats at the "minimum prescribed altitude" [eg. min. 800 ft] , with an initial climb speed of V_2 + (10 - 20) kt. The aircraft body angle is decreased at the minimum altitude, with a positive rate of climb maintained at V_{zf} + (10-20) kt. After 3000 ft (the "maximum prescribed altitude") the aircraft should transitioned to normal en-route climb. In Australia this corresponds to the AIP ENR 1.5 Para 11.1.6 procedure where the initial "minimum" altitude is stated to be 1500 feet. This was formerly known as ICAO-A.

L.2. Noise Abatement Takeoff Flight Path Control:

Among airports using noise abatement take-off flight paths, there are basically three subgroups:

(i) Those mandating ICAO-A takeoff profiles or similar (19/59 airports);
(ii) Those mandating significantly better profiles than ICAO -A . Better being defined here as mandating greater commencing ascent gradient targets than ICAO -A (10/59 airports); &
(iii) Those mandating compliance with a standard "inferior" to ICAO-A (8/59), eg. FAA AC91-53A.

L.**2.1 ICAO-A or Similar Noise Abatement:**

Table L.2.1 lists those airports out of the 59 requiring conformity to ICAO-A or similar

TABLE L.2.1 AIRPORT GROUP (i) - ICAO-A OR SIMILAR (/< 1500ft)

AIRPORT	**COUNTRY**	**DEPARTURE CLIMBOUT ALTITUDE**	**NOISE PENALTY OR SURCHARGE (Y/N)?**	**NOISE QUOTA (Y/N)**
Melbourne	Australia	AIP 1500 ft	N	N
Belfast	IRELAND	500, 1500, -3000	N	N
Dublin	Ireland	1500,3000	N	N
Glasgow	UK	1,500	Y	N
Schiphol/Amsterdam	Netherland		Surcharge/ tonne	N
Ostende	Belgium	1500,3000	Surcharge	N
Stuttgart	Germany		Surcharge/ Noise Cat	N
Koln/Bonn	Germany	1,500		
Berlin/Tegel	Germany	1500,3000	Surcharge/ tonne	N
Berlin/Tempelhof	Germany	1,500	Surcharge/ tonne	N
Lyon-Satolas	France	1500,3000	Surcharge & Tax	N
Orly Paris	France	1500,3000	Y	Y
Degaulle Paris	France	1500,3000; Min Dep Grad 6.5 degrees (10%) ; Nil Chapt 2;	Y	Y
Cape Town	S. Africa	1500,3000	N	N
Durban	S. Africa	1500,3000	N	N
Johannesburg	S. Africa	1500,3000	N	N
Regina Sask	Canada	1500,3000	N	N
San Franscisco	USA	800, 1500	Y	N
Washington -National	USA	1500 + 500 fpm + reduced power from 2-10nm DME	Y	N
Narita Tokyo	Japan	1500,3000	N	N
Bengurion Tel Aviv	Israel	1500,3000	N	N

[31] ICAO PANS-OPS Doc. 8168 Vol. 1 "Aircraft Operations - Flight Procedures" ; Part V Chapt 3.3.

L.**2.2 Better than ICAO-A Noise Abatement:**

Table L.2.2 lists those airports offering better than ICAO-A protection:

TABLE L.2.2 AIRPORT GROUP (ii) BETTER THAN ICAO-A

AIRPORT	**COUNTRY**	**DEPARTURE CLIMBOUT ALTITUDE**	**NOISE PENALTY (Y/N)?**	**NOISE QUOTA (Y/N)**
Canberra	Australia	4500	N	N
Brisbane	Australia	5,000	N	N
Bristol	UK	3,000	N	Y (depends on a/c)
Athens	Greece	3,000	N	None
Brussels	Belgium	1700,3200	Surcharge	Night
Liege	Belgium	2100,3600	Y	N
Calgary	Canada	6500 (Ch. 2)	N	N
Oslo (Gardermoen)	Norway	3,700		
Helsinki	Finland	2,000	Surcharge(Night)	N
Chicago (OHare)	USA	3000 OR SID	N	N
Indianapolis	USA	800 (AC91-53); 2500 (optional)	N	N
Seattle SeaTac	USA	3000,4000 (Rwy)	N	N
Nagoya ??	Japan	"Steepest Climb"	Surcharge	N
Osaka ??	Japan	"Steepest Climb"	N	N

L.**2.3 Lesser Standard than ICAO-A Noise Abatement:**

Table L.2.3 lists those airports requiring a lesser initial climb standard than ICAO-A.

TABLE L.2.3 AIRPORT GROUP (iii) INFERIOR TO ICAO-A

AIRPORT	**COUNTRY**	**DEPARTURE CLIMBOUT ALTITUDE**	**NOISE PENALTY (Y/N)?**	**NOISE QUOTA (Y/N)**
Auckland	NZ	500, 2000, 3000	N	N
Sydney	Australia	Nom ICAO-A but SIDs 500, 600, 800, 1000, 1500	Y	N
Bournemouth	UK	1,000	N	N
Heathrow	UK	1,000	Y + Surcharge	N
Liverpool	UK	500/ 1000	N	N
Manchester	UK	1000+ 500FT/MIN	Y (+ Track penalty)	N
Indianapolis	USA	800, 2500 (optional)	N	N
Minneapolis-St Paul	USA	800	Surcharge	N
Changi	Singapore	Y, Unspecified SIDs	N	N
Fiumicino Rome	Italy	Nil Runway Spec	Y	N

It is the SACF Inc position that the FAA's AC91-53A (see 1.2 above) is inherently less suitable for noise abatement purposes than ICAO-A or -B, due primarily to its requirement of a lower thrust reduction altitude [800ft cf. 1000 ft for ICAO -B], and the finding at many overseas airports that the faster a jet aircraft reaches above 4-5000 feet the less serious will be the generalised ground noise impact. This finding was confirmed in the Sydney Government SACF sponsored ICAO-A tests carried out in 1998, when it was found that noise levels over the east and north west were perceptibly less with ICAO-A than with the pre-existing position. In the USA, several airports report (eg.

Raleigh Durham; Indianapolis) a community preference for higher altitude initial climb targets, but owing to FAA and airline influence were forced to resort to those of AC91-53A.

Some, Scandinavian, European and even North American Airports have adopted a *"better than ICAO-A"* position, initial climb altitudes specified varying from 1700 - 6500 ft. Although in a minority of those studied, certain US airports have *"better than ICAO"* initial climb targets, these being Seattle /Tacoma -SeaTac (at 3000 ft), Chicago O'Hare (at 3000 ft) , the highest target being that at Calgary in Canada at 6500ft. Bristol (UK) and Athens (Greece) tie with a specified climb out altitude of 3000 ft, while the majority of European airports comply with ICAO-A and those in Britain with ICAO -B. A former San Franscisco NADP requiring a climb to 6000 feet [Quiet Two] for departures east over residential areas, appears more recently to have been changed to an *"either ICAO-A or AC91-53A"* position.

Even within Australia, Canberra, Melbourne and Brisbane have better noise abatement climb procedures than those operated at Sydney Kingsford Smith Airport.

Of thirty-three (33) of the 52 surveyed airports prescribing specific noise abatement flight paths, eight (8) also impose a penalty or quota system on flights deviating from specified paths or noise limits, and ten (10) impose a surcharge. Penalties are not generally imposed where a surcharge is routinely levied.

L.3. No Flight Path Climb Procedure Control

Nine (9) out of the fifty -nine (59) airports studied had apparently no noise abatement protocols at all and of these five (5) relied on imposing a noise surcharge and/or noise tax [5/59 airports - See Table L.3], although these were not the only airports imposing such a tax.

TABLE L.3 ***AIRPORT GROUP (iv) NO CLIMB PROCEDURE SPECIFIED***

AIRPORT	**COUNTRY**	**DEPARTURE CLIMBOUT ALTITUDE**	**NOISE PENALTY (Y/N)?**	**NOISE QUOTA (Y/N)**
Edinburgh	UK	NS [#1]	N	N
Leeds/Bradford	UK	NS	N	N
Rotterdam	Netherland	NS	Surcharge+ Tax/tonne	N
Frankfurt	Germany	NS	Surcharge /tonne & type	N
Munich	Germany	NS	Surcharge/ AC type	N
LeBourget/Paris	France	NS	Y+Surcharge/tonne	N
Marseille	France	NS	Surcharge & Tax	N
Lapeenranta	Finland	NS	N	N
Raleigh *** NC	USA	NS	N	N
Fiumicino Rome	Italy	N	Y + Surcharge /tonne 500,000-20,000,000L, for breach of procs	N

[1] NS = Not specified

L.4. Minimum City Overflight Altitudes:

Some cities (mainly in Scandinavia and New Zealand) prescribe minimum altitudes for the overflight of cities, although none apply a penalty for failure to comply. Even Canberra, Brisbane and Melbourne (Tullamarine) impose noise critical altitudes for residential areas of from 3000 - 7000ft.
Table L.4.1 lists some examples of these requirements from the 59 airports surveyed.

TABLE L.4.1 MINIMUM ALTITUDE OVER CITY

AIRPORT	**COUNTRY**	**ALTITUDE OVER CITY**	**DEPARTURE CLIMBOUT ALTITUDE**	**NOISE PENALTY (Y/N)?**	**NOISE QUOTA (Y/N)**
Brisbane	Australia	3000 min , 5000	5000 (over residential	N	N
Canberra	Australia	7000 (jet); 5000ft (non jet)	4,500	N	N
Melbourne	Australia	5000 (jet) , 3000(non jet)	AIP NADP		
Auckland	NZ	5,000	500, 2000, 3000	N	N
Sydney	**Australia**	1000 CASA min ; 1500-3000 norm for 20-30km	Nom ICAO-A but SIDs at 500,600,800, 1000,1500	Surcharge/ passenger	N
Oslo (Gardermoen)	Norway	4000-5000	3,700	Surcharge/tonne	N
Helsinki	Finland	2,000	2,000	Surcharge(Night)	
Lapeeranta	Finland	2,000		N	N
Athens	Greece	Adv . Never/ 3000 min	3,000	N	N
Brussels	Belgium	Avoid city!	1700,3200	Surcharge	Night

In Australia the standard *CASA* "minimum" for safe aircraft overflying cities of 1000 ft is a disgrace, though in fairness it does not purport to represent a noise abatement criterion. However, Brisbane Canberra and Melbourne all have minimum noise critical altitudes for residential areas which put Sydney Airport to shame. In this regard, Canberra excels with a noise critical altitude for jets over the city of 7000 ft. Finnish Airports with an overflight altitude of 2000 ft set a better example, while Auckland (NZ) at 5000 ft, and Oslo-Gardermoen at 4000-5000 ft excel.

L.5. Noise Impact Penalty Control Group :

A list of airports imposing penalties for breaches of either noise limits, or for failure to comply with noise abatement flight paths is provided in Table L.5.

TABLE L.5 AIRPORTS IMPOSING NOISE ABATEMENT PENALTIES

AIRPORT	COUNTRY	NOISE PENALTY (Y/N)?	PENALTY AMOUNT	NOISE LEVEL +UNITS	NOISE BOUNDARY LEVELS & UNITS	NAB PROC (Y/N)
Sydney	Australia	Y	$25,000.00	For breach of procedures	25ANEF	Y
Glasgow	UK	Y	£250.00	> 110/102 EPNdB(d/n)	97DB(A)[d] & 89dB(A) [n]	Y
Heathrow	UK	Y	£900.00	> Lmax 94 (d) 87 (n) dBA	87[n]-94[d] dB(A)	Y
Manchester	UK	Y (+ Track penalty)	£500.00	>105/100 EPNdB (d/n) at 3.5nm plus £150/ 1 EPNdB		Y
LeBourget/Paris	France	Y+Surcharge/ tonne	FF80,000 [a/l] & 10000 [pilot]	For breach of procedures		Y
Orly Paris	France	Y+Surcharge/tonne & Noise Tax	E180 + 8/t FF80,000 / al & FF10,000 / pilot			Y
Degaulle Paris	France	Y+Surcharge/tonne & Tax	FF80,000 / al & FF10,000 / pilot	Global Noise ref. 1998		Y
Liege	Belgium	Y	200-7500E	> 77[n]-87 [d] dB(A) LAeq,1s,max		Y
Fiumicino Rome	Italy	Y + Surcharge /tonne	500,000-20,000,000L, for breach of procs	Ldn related		N
Washington -National	USA	Y	$5,000.00	> 72(dep) & 85(arr) dB(A)		Y
John F Kennedy	USA	Y	$250 >115EPNdB			Y
La Guardia	USA	Y	$0 - Letter	> 112PNDdB		Y ?
Logan Boston	USA	Y	$50 - $500+$100/d	> 74 dBA (dep); 78 dBA (arr) + NPSI limit		Y
Newark NJ	USA	Y	$0 Letter	> 112PNDdB		Y
San Franscisco	USA	Y	(1) Letter; (2) $1000; (3) $2000; (4) $3000	For Breach of NAB procedures ICAO-A & AC91-53A		Y

Some airports have seemingly quite strict regulations requiring conformity to noise impact guidelines for flight paths over residents, and can impose significant penalties [Eg.. Boston Logan, $50-$500 > 70 dB(A) for departures; 78 dB(A) for arrivals]. However, in many cases where penalties are in force, the requirement is far too easy to meet [Eg. Manchester UK, £500.00 > 105/100EPNdB at 3.5 n. mi [# 32]]. It is interesting to note that in the USA it is Washington National (Reagan) airport which has the highest individual penalty for breach of the lowest noise limits [$US 5000 > 72(d) & 85(a) dB(A)]. One may comment that at least the politicians of federal America know how to look after themselves when they are directly affected by aircraft noise.

[32] EPNdB = "Estimated Perceived Noise in dB" which is the LA max + (approx) 13 dB.

Sydney (KSA) Airport publishes a particularly strict penalty for breaches of flight path corridors and/or instructions [$25,000], but has no regulations governing noise impacts on the ground, and no data are available of the provision being enforced. Some US airports impose an incrementing scale of charges, increasing with the number of breaches of noise levels (eg. Boston Logan) or procedure failures (eg. San Franscisco), sometimes commencing with a cautionary note. At San Franscisco, the penalties start with a letter [1st breach] , then $1000.00 [2nd], $2000.00 [3rd] and so-on.

L.6. Noise Abatement Surcharge Regimes:

Table L.6.1 lists those airports which, in lieu of a specific noise penalty, impose a standard noise surcharge or noise tax which it is claimed by some is applied to local noise insulation programs in suburbs around the airport.

The surcharges imposed are frequently based on "MTOW" or maximum take-off weight in tonnes for the aircraft concerned, but often there is an additional component determined by the aircraft type and intrinsic noise rating. Sometimes, however, the charge can be based on aircraft type alone [eg. See Stuttgart, Munich].

Jet Aircraft are divided by ICAO into groups determined by their Effective Perceived Noise Level in Decibels [EPNdB] with engines running in various situations [eg. noise immediately below, sideline etc][#33]. In this scale, so-called "Chapt. 2" jet aircraft are currently the most inherently noisy, and although some have been fitted with "hush-kits", they are still considered inferior to the less noisy, more recently introduced, aircraft which are assigned to Chapts. 3 & 4 respectively.

Most European Airports have banned flights by ICAO- Annex 16 Chapt 2. jet aircraft, and only Chapt. 3 or better by noise rating are permitted to use the airports, as did Australia from 22/3/2002. At at least one airport (Schiphol) even Chapt. 3 aircraft are prohibited for landing or takeoff in the evening or night if the engine bypass ratio differs from a prescribed threshold.

TABLE L.6.1 AIRPORTS IMPOSING A NOISE SURCHARGE AND/OR NOISE TAX

AIRPORT	**COUNTRY**	**NOISE SURCHARGE (Y/N)?**	**AMOUNT**	**NAB PROC (Y/N)**
Sydney	Australia	Y	ca. $10 /passenger	Y
Heathrow	UK	Surcharge / aircraft type & weight	up to £900 / >50 tonnes	Y
Rotterdam	Netherland	Surcharge + Tax/tonne	E127+E 9/t	N
Schiphol/Amsterdam	Netherland	Surcharge/ tonne	Weight & Noise level based	Y
Brussels	Belgium	Surcharge by formula	/ complex formula incl weight & noise type	Y
Ostende	Belgium	Surcharge	2-3E/tonne	Y
Frankfurt	Germany	Surcharge	/ tonne & by type	Y
Koln/Bonn	Germany	Surcharge/ tonne	/ tonne & by type	Y
Munich	Germany	Surcharge/AC type	240-360E/b752	Y
Stuttgart	Germany	Surcharge/ Noise Cat	/ by type	Y {Ch. 2 only}
Berlin/Tegel	Germany	Surcharge/ tonne	/ tonne & by type	Y
Berlin/Tempelhof	Germany	Surcharge/ tonne	/ tonne & by type	Y
LeBourget/Paris	France	Y+Surcharge/ tonne	FF80,000 [a/l] & FF10000 [pilot]	Y
Lyon-Satolas	France	Surcharge & Tax	Noise & Weight	Y
Marseille	France	Surcharge & Tax Noise& Weight	FF80,000 [a/l] & FF10000 [pilot];	Y
Oslo (Gardermoen)	Norway	Surcharge/ tonne	NK51/tonne	Y
Helsinki	Finland	Surcharge (Night)	ACN related	Y
Minneapolis-St Paul	USA	Surcharge	Per Op on Ch 2 & Ch3 planes	Y

[33] ICAO Annex 16

A typical example of a "simple" European surcharge regime governed by aircraft takeoff weight and noise is shown in Table L.6.2:

TABLE L.6.2 TYPICAL EXAMPLE OF SURCHARGE/NOISE TAX REGIME FRANKFURT GERMANY

Landing Charge		
Calculation: (Basic Price + (Degressional Value x (400 - MTOW))x MTOW		
Prior to multiplication with MTOW, rounding off to 10/100		
Jet and non-Jet Aircraft	Basic Price per t. for 400t MTOW	
Chapter 3	**Day-time**	**Night-time**
included in Bonus List	DEM 10.90	12.60
not included in Bonus List	DEM 14.50	19.70
Chapter 2	DEM 36.00	108.00
Chapter 3	Value of Degression per t. MTOW	
	Day-time	**Night-time**
included in Bonus List	0.02142744	0.02458309
not included in Bonus List	0.02816750	0.03801838
Chapter 2	0.06667963	0.20275504

Notes:
1. Day-time: 0500-2100 (0400-2000 during legal summer time) Night-time: 2100-0500 (2000-0400 during legal summer time)
2. If the landing or take-off of the aircraft is at night, 12,000 kg will be taken as the minimum charge independent of the actual maximum take-off weight.
3. If the landing takes place during the day, and the ensuing take-off at night, a fixed night price will be used to calculate the landing charge (increased MTOW rate).
4. All cargo flights will be granted a 25% reduction of the daily price (fixed landing charge) from Mondays to Fridays if the take-off AND landing take place at day time.
5. Landing charges will be calculated on a DEM basis and subsequently converted to EURO at the rate of EURO=DME 1.95583

Other regimes employ seemingly complex econo-acoustic calculations to arrive at the surcharge/tax to be imposed (eg. Brussels).

L.7. Curfews:

Curfews hours are prescribed for most of the airports studied, with varying effect.

In South Africa, no jet aircraft at any airport may use a runway between the hours of 8:00pm and 4:00am. Similarly at Stuttgart, Germany (10:00 pm - 7:00 am) . However, many airports operate at night under different rules such as applying a stricter maximum noise criterion, or banning particular aircraft types (eg. Chapt. 2), or imposing maximum takeoff weight restrictions (eg. Rotterdam). Some operate at night with runway selection restrictions that are not applied in day-time [eg. Sydney, Australia, Calgary, Canada]. Los Angeles only permits departures and arrivals over the coast at night time (00:00a - 06:00a) in a "SODPROPs" -style operation, similar to the *"pseudo-SODPROPS"* Mode 1 curfew operation in Sydney, but employing two runways. Schiphol in the Netherlands, only permits Chapter 3 jet aircraft of bypass ratio less than 3, to operate between 6:00 pm and 8:00 am.

Still others require special permits to be obtained from the airport manager on a case-by-case basis. Yet again, others operate with a "night quota" system, each airline having to apply for a "night-slot quota" annually (eg. Brussels, Heathrow, Liverpool, Manchester). Washington National (Washington DC, USA) has a curfew between 10:00 pm and 7:00 am with an aircraft type specific [FAA Part 33.3] noise limit for departing aircraft of 72 dB(A), and that for arriving aircraft of 85 dB(A). Washington DC is its own jurisdiction and, unlike other States in the US, is not subject to FAA or international rules.

L.8. Noise Level Regimes [Metrics]:

A variety of noise metrics are used among the surveyed airports for defining exceedances which are used in prescribing penalties, or noise surcharges, or merely for the purposes of notification. Some of these are listed in Table L.8 :

TABLE L.8 SOME NOISE METRICS USED BY AIRPORTS

METRIC UNIT	**DESCRIPTION**	**COMMON UNIT**	**LEVEL**	**Airports**
PNdB	Perceived Noise in dB	dB(D) max + 9	112	La Guardia , Newark NJ
EPNdB	Effective Perceived Noise in dB	dB(A)max +13	105/100(M) or 110/102(G) or 115 (JFK)	Glasgow, Manchester, JF Kennedy
Lmax	Peak noise level in dB(A)	dB(A)	87(n) - 94(d) [#1]	Heathrow
SEL	Sound Equivalent Level	dB(A)	75-90d; 70-80n (B); 90 (M)	Brussels, Minneapolis,
dB(A)	A-weighted sound level in dB	dB(A)	74 (dep) & 78(arr) (BL); 72(d) & 85(a) [WN]; 75(M)	Boston, Washington National, Munich
LAeq, 1sec	1sec max Equivalent level in dB(A) averaged over 10 sec	dB(A)	77 (n)-87 (d)	Liege
Ldn	Day and Night Level	dB(A)	65(d) & 55(n)	Auckland, Christchurch NZ, Rome
Leq	Similar to LA eq /defined as average over certain time	dB(A)	65	Belfast
ANEF	Complex formula inAS2021 averaged over one year	dB(A)	25	Sydney , Land Use Planning

[1] Note: (d) = daytime; (n) = nightime value.

It is clear from Table L.8 that there is very little commonality between airports as to the acoustic units employed in defining aircraft noise exceedances which are used in the prescription of penalties. Mostly the "A-" filtered decibel unit is employed, but occasionally, in the USA (eg. La Guardia & Newark) , one sees the "D-" filtered scale being employed. Then again, aircraft are often assessed in various units of so-called "Perceived Noise Levels" [PNL], or Effective Perceived Noise Levels [EPNL] in decibels, which are complex averages of sound levels filtered across different defined spectra which can be converted to common parlance by subtracting the relevant constant [9 or 13] from the level. At London Heathrow a departure L_{max} of 94 dB(A) by day and 87 by night is imposed beyond the 6.5 km /1000 ft altitude mark. Local Authorities in the London area consider these limits to be insufficiently strict [# 34]

[34] "Noise Limits for aircraft departing from Heathrow, Gatwock and Stansted Airports: Decision of December 2000", Para 37

Thus "112 PNdB" reduces to a maximum measurable L_{max} = 103 dB (ie 112-9) . SEL ANEF and LAeq are obtained in a more complex manner by averaging impacts over varying periods, but may be derived from a known maximum impact level for a given duration in their respective units. The "day night" level or L_{dn}, is obtained by averaging noise from an airport over 24 hours, and often on a yearly basis, applying a night time loading of 10 dB(A) between 22:00 and 07:00 hrs.

L.9. Conclusions:

It is difficult indeed for the common man to understand the meaning of much of the airport environment jargon he is presented with. Among MBA-type Management Circles a lot of emphasis these days is placed on the concept of "world's best practice". First we consider the range of noise metric system employed by the above airports, asking ourselves which system provides the greater protection for the human environment, then we consider what approaches worlds best practice.

Airport Noise Metrics:

The most straight forward metric, and the most easily understood by communities used to the sound of machine tools and such like is the maximum noise level experienced in decibels on the "A-" weighted scale.

TABLE 8.1.4 in Section 8.1.4 (Vol 1) translates a commonly experienced situation of a repeated sequence of aircraft noise impacts, each of a given maximum decibel level (70 dB(A)) , into the parameters L_{dn}, L_{eq}, L_{max}, and ANEF.

The use of broadly averaged indices such as the DNL [= L_{dn}] , and the ANEF is difficult for the man-in-the-street to comprehend, and in many cases does not reflect his annoyance and disturbance level with overflying aircraft one little bit. The ANEF as currently employed in Australia was heavily criticised in submissions to the Senate Select Committee Enquiry into the failure of Sydney's Third Runway EIS [# 35].

The Noise Abatement Regulation for Oslo [Gardermoen] airport refers to the fact that the "noise critical altitude" for jet aircraft with noise certification in excess of 88 EPNdB at departure is 5000 ft. While for jet aircraft with lower noise certification levels, the noise critical altitude is 4000 ft and states that above the noise critical altitude the planned departure route (SID) may be deviated from. The Regulation also states that when air traffic capacity allows, a noise critical altitude of 5000 ft AMSL shall be applied to all jet aircraft operations. At night Oslo applies a noise critical altitude of 7000 ft to all jet operations. This appears to be the most enlightened discussion of aircraft noise impacts in relation to the influence of altitude among the 59 airports studied.

Thus it appears that the Boston Logan - Washington National - Munich strictures [of between 74 & 85 dB(A) maximum levels] for noise penalties appear to provide the best protection among the airports cited for residents on the ground below.

In the case of Washington this is coupled with a suitably large penalty ($5000) for exceedances, and the provision of suitable noise monitoring equipment, which coupled with the adoption of a sensible residential curfew [10:00 pm to 8:00 am] and an ICAO-A 1500 ft mandated initial climbout along the Potomac River, ensures that the city is optimally protected from undesirable aircraft noise.

Boston Logan claims to achieve a similar result by trying to ensure that certain noise impact levels are not exceeded. This implies, as argued in the SACF Inc submission on the need for legislative protection from the noise of overflying aircraft [# 36] , that departing aircraft ***must*** follow a flight track trajectory suitably configured for this outcome by ensuring that aircraft altitudes are sufficiently elevated that noise levels on the ground are suitably low.

Munich does not levy a noise penalty as such, but imposes a surcharge, based on aircraft type, which in turn depends on the monitored noise levels for those aircraft. In the case of Munich, the noise levels are monitored at numerous locations around the airport, in units of dB(A), and it is these noise levels which the city uses to calculate the impacts of given aircraft for the purposes of its Noise Surcharge.

Airports which adopt a criterion based only on the noise certification level for each aircraft type such as PNdB or EPNdB, without also enforcing adherence to a properly designed flight path system which assures a minimum level of noise exposure on the ground are only paying lip-service to the cause of noise abatement.

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35 The Parer Report, "Falling on Deaf Ears" July 1955, AGPS.

36 The Way Forward from Sydney's Airports Quagmire, SACF Inc, July 1999.

What is World's Best Practice:

Reading the recent previews of the so-called environmental "Master Plan" which Sydney Airport Corporation Ltd [SACL] must present to the Minister for Transport by 31 December 2003, one could be forgiven for thinking that they believe they have already reached the status of "World's Best Practice". It is submitted that an airport corporation which puts itself forward as providing *"worlds best practice"* without either justification or adjudication, must be abhored. Merely repeating the chant "we are a worlds best practice airport" does not make it one.

But what is "world's best practice" for the environmental management of the human environment of an airport which is as close to heavily settled residential areas and as near to the ocean as KSA?

One can immediately propose five essential paradigms:

1. ***The noise impact over residential areas must actually be minimised;***

2. ***The noise impact which <u>must unavoidably occur</u>* over residents, after *<u>all efforts</u>* have been made to put it elsewhere, should be fairly and equitably shared. Noise sharing should NOT BE for its own sake. ie as in to masochistically share the detriment;***

3. ***Pollution impacts over heavily populated residential areas should also be minimised. This means (a) flying the aircraft over water wherever possible, and (b) flying them as high as possible as soon as possible after take off, and also minimising engine use by aircraft during descent;***

4. ***<u>Whenever possible</u>, aircraft movements should be over water, and more especially take-offs, because these are both the most polluting and produce the greatest noise;***

5. ***There must be a respectable "noise critical altitude" specified over residential areas below which jet aircraft may not fly.***

Because of the great variety of international noise abatement practices encompassed in this review, and the absence of a suitable internationally recognised standard, this Review will focus instead on the better practices observed than to presume than any is offering "best" practice, per se. Keeping in mind the paradigms stated above, we therefore ask which airports could be said to be in the "world's better practice" league?

Some of those which are controlling and penalising noise using a maximum direct impact parameter [ie dB(A), or dB(D) max] have in this view approached a better practice paradigm, where the noise level is set at a reasonable level from the standpoint of the hearer. Of the foreign airports surveyed above, candidates would include Boston Logan, Munich and Washington National.

Also those which practice steeper take-off paths over residential areas to reach inaudible altitude levels as quickly as possible must also come close to being in the "better practice" league. So must airports which place an altitude limit below which residential overflying is prohibited. Among such airports are Oslo, Auckland, Athens and Brussels, and to a lesser extent Lapeeranta, and Helsinki [Table L.4.1].

Within Australia, Canberra, Melbourne and Brisbane have better noise abatement climb procedures than those operated at Sydney Kingsford Smith Airport. However, Brisbane Canberra and Melbourne all have minimum noise critical altitudes for residential areas which put Sydney Airport to shame. Canberra excels with a noise critical altitude for jets over the city of 7000 ft. Of the overseas airports, Auckland (NZ) at 5000 ft, and Oslo-Gardermoen at 4000-5000 ft excel.

Those using Noise Metrics which *<u>average</u>* impact so as to make it appear that an individual aircraft's impact (however loud) does not matter, must be considered to be substandard. Using standard "surcharges" , ostensibly contributing to noise insulation programmes - but often used for "forced draft relocation" programs [ie Minneapolis -St. Paul and (formerly) Sydney], can only really benefit a local policy purpose of inhibiting the use of the noisiest airplanes. That this has occurred in the case of the ICAO Annex 16 Ch. 2 type plane in Europe, and some places in the USA, is laudable, but by the time sufficiently large areas have received noise insulation, or the targetted offending aircraft type has disappeared, much social damage can be done.

Penalties would be more useful, if they enforced a pattern of adherence to strict noise guidelines, as in the case of Washington National or Boston Logan, but not if they are mainly honoured in the breach, or if the penalty is merely nominal and on the books for cosmetic or other reasons [ie . Newark NJ, See Table L.5] .
END #

APPENDIX M LETTER FROM KEN McLEAN ACKNOWLEDGING ARRIVAL CEILING.

AIRSERVICES AUSTRALIA

26 February 2002

Mr Kevin Hill
15 Silver Beach Road
KURNELL NSW 2231

Dear ~~Mr Hill~~ Kevin

I refer to the letter from Mr Phillip Lingard that you tabled at the last meeting of the IMC concerning aircraft departure ceilings. The IMC agreed that Airservices would investigate Mr Lingard's letter and reply directly to you.

Mr Lingard's letter indicates that he believes there is an airspace ceiling for departures to the northwest and east (departures during 34 parallel operations) resulting in jet aircraft flying low over large tracts of residential land.

In short, Mr Lingard is correct in his belief that an altitude restriction applies to departures, although he is incorrect in his assumption that this restriction results in departing aircraft being held low over residential areas.

In situations where departing aircraft are overflown by arriving aircraft – an unavoidable situation during runway 34 parallel operations – then a minimum vertical separation standard of 1000ft applies.

To give effect to this separation standard during runway 34 parallel operations, airspace arrangements are such that departures 'own' the airspace up to 5,000ft and approach 'owns' the airspace down to 6,000ft. Thus, in effect, there is an altitude restriction of 5,000ft for departures during runway 34 parallel operations.

However, in practice, departing jet aircraft, particularly heavy jets, rarely reach the 5,000ft altitude prior to crossing the airspace boundary that allows uninterrupted climb. So, in essence, most jet aircraft undertake an uninterrupted climb on departure. Aircraft departure profiles from the Flight Path Monitoring System bear this out.

The minimum climb gradient for departures over Ashfield is 5.6 to 5.9%, with the general climb gradient for a medium performance jet being around 6.5%. Those aircraft that cannot make this climb gradient proceed on runway heading (which, you will recall, has been the subject of discussion at the SACF and IMC on a number of occasions).

I trust this information will be useful. If Mr Lingard has any additional questions, he is welcome to contact me directly on (02) 9556 6600.

Yours sincerely

Ken McLean
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Manager Sydney Operations

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