Department of Transport and Regional Services

Australian Transport Safety Bureau

INVESTIGATION REPORT
B98/166

Systemic Investigation into the Class G Airspace Demonstration

When the ATSB makes recommendations as a result of its investigations or research, safety (in accordance with its charter) is its primary consideration. However, the Bureau fully recognises that the implementation of recommendations arising from its investigations will in some cases incur a cost to the industry.

Readers should note that the information in ATSB reports is provided to promote safety: in no case is it intended to imply blame or liability.

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This report was produced by the Australian Transport Safety Bureau (ATSB), PO Box 967, Civic Square ACT 2608.

ATSB – *Combinining the strengths of:*

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ABBREVIATIONS, TERMS AND DEFINITIONS

Abbreviations

AATA	Australian Air Transport Association
ADF	Australian Defence Force
AGL	Above Ground Level
AIP SUPP	Aeronautical Information Publication Supplement
Airservices	Airservices Australia
AMATS	Airways Management Air Traffic Systems
AOPA	Aircraft Owners and Pilots Association
ATC	Air Traffic Control
ATSB	Australian Transport Safety Bureau
ATS	Air Traffic Services
BASI	Bureau of Air Safety Investigation
CAA	Civil Aviation Authority
CAIR	Confidential Aviation Incident Reporting
CASA	Civil Aviation Safety Authority
CEO	Chief Executive Officer
CTAF	Common Traffic Advisory Frequency
DTI	Directed Traffic Information
FS	Flight Service
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
MASC	Minimum Airspace Safety Criteria
MBZ	Mandatory Broadcast Zone
MTA	Mandatory Transponder Area
MTAF	Mandatory Traffic Advisory Frequency
NAF	National Advisory Frequency
NATS	National Air Traffic Services
NDB	Non-Directional Beacon
NOTAM	Notice to Airmen
NORAD	No Radio
NPRM	Notice of Proposed Rule Making
PCG	Project Control Group
RAAA	Regional Airlines Association of Australia
RAAF	Royal Australian Air Force
RAS	Radar Advisory Service
RIS	Radar Information Service
RPT	Regular Public Transport
SAR	Search and Rescue
SARTIME	Search and Rescue Alerting Time
TAAATS	The Australian Advanced Air Traffic System
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

Terms

Bureau	Means Bureau of Air Safety Investigation unless otherwise identified.
Chairman	Means the Chairman of the Board of the Civil Aviation Safety Authority during the period leading up to and including the demonstration, unless otherwise identified.
Department	Means the Department of Transport and Regional Development prior to 18 October 1998, then Department of Transport and Regional Services after that date.
Minister	Means the Minister for Transport and Regional Development prior to 18 October 1998, then Minister for Transport and Regional Services after that date.

Definitions

Airspace 2000	Airspace 2000 is a project designed to reform Australia's airspace management and air traffic services arrangements. The objectives of the project are to: • improve safety through a more effective allocation of resources; • assist Australia to benefit from new technology; • reduce costs so that more people can fly. The project resulted in the development of an airspace model known as 'Airspace 2000'.
RAS	A Radar Advisory Service is a service provided by air traffic controllers (not flight service officers) to IFR aircraft in those sections of Class G airspace within radar coverage. RAS provides traffic information based primarily on radar-derived data, as well as traffic information on other known traffic. RAS also assumes other flight service functions, such as IFR flight following and the provision of flight information (such as meteorological updates). The controller also provides radar-derived traffic information to VFR aircraft on request.
RIS	A Radar Information Service providing traffic information on radar-identified aircraft, on a controller workload permitting basis. It does not include procedural based traffic information or a flight information service.
TAAATS	The Australian Advanced Air Traffic System is a fully integrated national airspace management and air traffic control system which provides facilities for all ATC environments, including control towers, terminal area control and en-route control, whether in radar airspace, non-radar continental airspace or oceanic airspace. TAAATS unites computer, radar and communications technologies in a system that makes all flight information available to all air traffic controllers. A key element of the system is the amalgamation of Australia's six previous Flight Information Regions into two, with all en-route air traffic control consolidated to centres in Brisbane and Melbourne.

ICAO airspace classifications (from ICAO Annex 11)

Class	*Type of flight*	*Separation provided*	*Services provided*	*Radio communication required*	*Subject to an ATC clearance*
A	IFR only	All aircraft	Air traffic control service	Continuous two-way	Yes
B	IFR	All aircraft	Air traffic control service	Continuous two-way	Yes
	VFR	All aircraft	Air traffic control service	Continuous two-way	Yes
C	IFR	IFR from IFR IFR from VFR	Air traffic control service	Continuous two-way	Yes
	VFR	VFR from IFR	1) Air traffic control service for separation from IFR; 2) VFR/VFR traffic information (and traffic avoidance advice on request)	Continuous two-way	Yes
D	IFR	IFR from IFR	Air traffic control service including traffic information about VFR flights (and traffic avoidance on request)	Continuous two-way	Yes
	VFR	Nil	Traffic information between VFR and IFR flights (and traffic avoidance on request)	Continuous two-way	Yes
E	IFR	IFR from IFR	Air traffic control service and traffic information about VFR flights as far as practical	Continuous two-way	Yes
	VFR	Nil	Traffic information as far as practical	No	No
F	IFR	IFR from IFR as far as practical	Air traffic advisory service; flight information service	Continuous two-way	No
	VFR	Nil	Flight information service	No	No
G	IFR	Nil	Flight information service	Continuous two-way	No
	VFR	Nil	Flight information service	No	No

INTRODUCTION

The Australian Transport Safety Bureau (ATSB) is responsible for investigating accidents, serious incidents, incidents, and safety deficiencies involving civil aircraft operations in Australia, as well as participating in overseas investigations of accidents and serious incidents involving Australian-registered aircraft. The ATSB also conducts investigations and studies of the aviation system to identify underlying factors and trends that have the potential to adversely affect safety. A primary concern is the safety of commercial air transport, with particular regard to fare-paying passenger operations.

ATSB investigations seek to determine the factors that led to an accident, incident or safety deficiency.

The results of those determinations form the basis for safety recommendations and advisory notices, statistical analyses, research, safety studies and ultimately accident prevention programs. To produce effective recommendations, the information collected during the investigation, and the conclusions reached, must be analysed in a way that reveals the relationship between the individuals involved, and the design and characteristics of the system within which those individuals functioned. As with equivalent overseas organisations, ATSB has no power to implement its recommendations.

The ATSB performs its functions in accordance with the provisions of the *Air Navigation Act 1920*, Part 2A. Section 19CA of the Act indicates that the object of an investigation is to determine the circumstances surrounding any accident, serious incident, incident, or safety deficiency to prevent the occurrence of other similar events.

The term 'safety deficiency' is defined in section 19AD of the Act as follows:

> A *safety deficiency* is constituted by any situation related to aviation that can reasonably be regarded as having the potential to affect adversely the safety of aviation.

It is not part of the object of an investigation to determine blame or liability. However, it does need to be recognised that an investigation report must contain factual material of sufficient weight to support the analysis and conclusions reached. That material will at times contain information reflecting on the performance of individuals and organisations, and how their actions may have contributed to the outcomes of the matter under investigation. At all times the ATSB endeavours to balance the use of material that could imply adverse comment, with the need to properly explain what happened, and why, in a fair and unbiased manner.

EXECUTIVE SUMMARY

Class G airspace (or uncontrolled airspace) has the lowest level of service and the fewest restrictions on aircraft operations. In Australian Class G airspace, third-party directed traffic information is provided to pilots of aircraft operating under the instrument flight rules.

There have been a number of attempts to change the operation of Class G airspace since its introduction in 1995. As part of the Airspace 2000 program, the Civil Aviation Safety Authority (CASA) decided to conduct a 'Class G demonstration' featuring:

- implementation of a national advisory frequency;
- provision of a conditional radar information service;
- cessation of directed traffic information.

The demonstration commenced on 22 October 1998 in the airspace between Canberra and Ballina below 8,500 ft. An end date was not specified; rather, the Authority intended that the demonstration airspace procedures should be extended throughout Australia in June 1999.

The demonstration was conducted in the highest traffic density area of Class G airspace in Australia. The timing and location of the demonstration placed significant pressures on the Civil Aviation Safety Authority to ensure that consultation, safety analysis and education activities were comprehensively addressed.

Following receipt of over 70 air safety incident reports BASI concluded that a safety deficiency existed and commenced an investigation on 5 November 1998 into the systemic issues associated with the development and operation of the Class G airspace demonstration.

The Bureau identified a number of operational deficiencies that contributed to an increased safety risk for users of the demonstration airspace. Following an interim recommendation issued by BASI on 8 December 1998, the demonstration was terminated by the Authority on 13 December 1998.

In addition to the operational deficiencies already noted, a number of organisational factors adversely affected the ability of CASA to effectively manage the Class G airspace demonstration project. Moreover, the division of roles and responsibilities between CASA and Airservices Australia regarding the design and regulation of airspace was not clearly defined.

Safety deficiencies identified during the course of the investigation formed the basis for safety recommendations developed by BASI. The recommendations called for a review of program management policies and procedures for current and proposed changes to the aviation system; a review of corporate governance issues; and clarification of the roles and responsibilities of respective organisations in relation to the regulation, design and management of airspace to ensure the safety integrity of the aviation system.

A full description of these safety actions can be found in Part 4 of the report.

1. FACTUAL INFORMATION

1.1 Responsibility For Airspace In Australia

1.1.1 Legislative and administrative arrangements

The legislative framework for the management of Australian airspace is contained in the *Civil Aviation Act 1988* and the *Air Services Act 1995*.

Under the *Air Services Act 1995*, Airservices Australia (Airservices) is responsible for airspace design, designation of airspace, design of airspace procedures and the provision of air traffic services within Australian airspace, in accordance with standards set by CASA. In order to provide air traffic services, Airservices has a number of specific powers, loosely described as 'airspace management' which are set out in part 2 of the Air Services Regulations. Those powers relate to:

- designating air routes and airways in Australian administered airspace, and determining conditions of use;
- giving directions, relating to the safety of aircraft, in connection with the use or operation of a designated air route or airway, or air route or airway facilities;
- making controlled aerodrome and various airspace determinations;
- particulars of air traffic services;
- providing notice of unavailability of air traffic services;
- declaring prohibited, restricted or danger areas; and
- designating flying training areas.

CASA is responsible for setting airspace design and operating safety standards. In accordance with the *Civil Aviation Act 1988*, regulations can be made in respect of 'standards relating to the establishment and use of airspace' (section 98(3)(r)); however, no Civil Aviation Regulations setting standards for airspace have been made. Although CASA has no specific legislative basis to give directions to Airservices regarding airspace, regulations could be made under the *Civil Aviation Act 1988* to enable the Authority to give such directions.

While CASA has not set formal standards, criteria for the establishment of airspace are contained in the *Manual of Operational Standards*, which is a CASA internal document. Proposals for changes to the Minimum Airspace Safety Criteria are published in accordance with the Notice of Proposed Rule Making process.

CASA is also responsible for the safety regulation of the airspace management activities of Airservices Australia. A memorandum of understanding (MOU) developed in 1995 between CASA and Airservices broadly outlined the arrangements for the safety regulation of Airservices' operations by CASA. The MOU included a timeframe for the establishment of appropriate regulatory oversight arrangements for Airservices' activities, including airspace management. It also covered the regulatory interface arrangements between the two organisations, including airspace and procedure design. More detailed arrangements for CASA's safety oversight of Airservices were stated in the document, *Final Draft Regulatory Arrangements and Standards for the Safety Regulation of Airservices Australia and Aerodrome Rescue and Fire Fighting Service Providers* (April 1996).

Both Airservices and CASA are required by their respective Acts to consult with government, commercial, industrial, consumer and other relevant bodies and organisations in the performance of their functions and the exercise of their powers.

A significant coordinating and consulting infrastructure for processing airspace changes exists, and includes the Air Coordinating Committee, which is jointly chaired by Airservices and the Deputy Chief of Air Force. The Air Coordinating Committee has subcommittees on airspace and procedures, documentation, systems, training, and regional subcommittees on airspace. Industry consultative forums include the Regional Airspace Users Advisory Council and the National Airspace Users Advisory Council.

1.1.2 Proposed amendments to legislative responsibility

On 17 September 1997, a meeting was held between the Minister and senior officers from CASA, Airservices, and the Department. During the discussions, consideration was given to whether airspace functions should be transferred from Airservices to CASA.

In a letter to the CASA Board on 18 September 1997, the Minister stated that CASA had had sufficient time to develop the necessary regulatory framework and expertise to effectively regulate the activities of Airservices. In that context, he indicated that he would be further considering options for responsibility within the portfolio for undertaking the regulator's role on the allocation of airspace, and questioned whether that function, presently with Airservices, should be held by CASA. He invited the views of the CASA Board on that matter.

On 26 September 1997, the CASA Board discussed the subject of transferring responsibility for airspace from Airservices to CASA. The following discussion was included in the Board minutes of that meeting:

> The [Acting] Chairman said that, one week ago, the Minister advised that he would transfer responsibility for airspace from Airservices to CASA because CASA's performance is better. The Chairman said that if you are really going to manage these things it should have been transferred one a [*sic*] year ago.

The CASA Deputy Chairman subsequently wrote to the Acting Minister and informed him that under the current division of responsibilities, only Airservices Australia had the statutory power to determine airspace, and that the Board considered that the determination of airspace was properly a function of CASA. The Board also considered that:

- It would be appropriate for the power to determine airspace under the Air Services Regulations be transferred to CASA through an appropriate amendment to the Air Services Regulations and the Civil Aviation Regulations.
- CASA should be provided with appropriate resources to properly perform the transferred function.
- As an interim step, Airservices should explore the possibility of delegating the existing powers in the Air Services Regulations to determine airspace, to relevant officers in CASA, and that a supporting memorandum of understanding between the two organisations be implemented in relation to airspace determination.

On 29 October 1997, the Chairman of the Board of Airservices Australia wrote to the Minister and advised that the Airservices Board had agreed with the proposed transfer of legislative responsibilities. However, to conduct the transfer, it would be necessary for amendments to be made to the *Air Services Act* and Regulations and the *Civil Aviation Act* and Regulations. The Airservices Chairman also noted that existing legislative arrangements did not allow for delegation of those functions.

A small task force was established in December 1997 to review the proposals of the Boards of CASA and Airservices, regarding the regulatory arrangement for airspace management. The task force consisted of representatives from the Department, Airservices, CASA, and Defence. The role of the Department was to consider the policy implications of the transfer of responsibilities and to provide appropriate advice to the Minister.

The Australian Government Solicitor advised the Department on 9 January 1998 that it would be necessary to amend the *Civil Aviation Act 1998* to confer the airspace management function onto CASA, and to amend the *Air Services Act 1995* to clarify the interaction between the airspace management function and the provision of air traffic services.

On 15 January 1998, the new Minister for Transport and Regional Development wrote to the Chairmen of CASA and Airservices. He indicated that any decisions about a transfer of powers should await the outcome of a structural review of Airservices being undertaken by a study team from the Department and Airservices, together with the report of the airspace task force set up by CASA to identify what arrangements would be necessary were such a transfer to occur. The Minister said that he would welcome the views of both Boards once the reports had been considered.

The task force completed its report in February 1998, and stated the following, regarding the reasons for a transfer of responsibility:

> The Airspace Task Force was established to review a proposal from the Boards of both CASA and Airservices Australia to transfer regulatory responsibility for airspace management from Airservices Australia to CASA. The respective boards believe that this proposal is consistent with the original intent with the split of the then Civil Aviation Authority, and will remove the potential for a possible conflict of interest as Airservices moves to a more commercial footing.

The task force accepted the advice of the Australian Government Solicitor and concluded that:

- The transfer of function was feasible and supportable from both a technical and legislative point of view.
- In terms of actual management of the airspace, the proposed transfer should not incur any loss of efficiency in airspace management.
- Because of the required changes to the respective Acts, the transfer would most likely not be achievable before July 1999.

On 20 March 1998, the Minister sent a charter letter to the CASA Board. In a section titled 'standards to enable competition in air traffic services' the letter stated:

> The current structural review of Airservices Australia will identify a number of other areas—for example, the provision of alternative service providers for air traffic control—which require standards development before competition could be introduced. This is a priority for the Government.
>
> My preference is for CASA to develop the required standards; however, timelines are likely to be tight. I expect to be able to provide further advice on this issue before the end of June…
>
> Once I have reviewed the report from the Airspace Taskforce on the possible transfer of the airspace management function from Airservices Australia to CASA and considered the implications I will write to you again specifically on this issue.

The CASA Board was presented with the findings of the taskforce during its 20 March 1998 meeting. There was no record found of any further discussion on the transfer of airspace responsibility by the CASA Board until the meeting of 27 November 1998, when the Board noted:

> That there are issues that need to be resolved between CASA and Airservices Australia regarding the legal aspect of the designation of airspace and the relationship between the two bodies.

On 8 July 1998, the Minister wrote to the Chairman of CASA to inform him of the Government's intention to amend the Civil Aviation Regulations to allow for alternative service providers of air traffic services. The proposed changes only dealt with the provision of terminal-based services as opposed to en-route services. The amendment was subsequently disallowed by the Senate.

As part of its investigation into the Class G airspace demonstration, BASI issued an interim recommendation to the Department (IR 980256), CASA (IR 980261) and Airservices (IR 980257) on 8 December 1998, to review and clarify the roles and responsibilities of the respective organisations in relation to the regulation, design and management or airspace (see section 4). In response to that recommendation, the Minister directed the Secretary of the Department to conduct a review of those issues.

Legislative bids to effect the transfer of responsibility for airspace to CASA were under consideration, but were subsequently withdrawn in the light of the Secretary's review. The Secretary's report was passed to the Minister on 22 December 1998, and was subsequently released on 4 November 1999 (see section 4.1).

1.1.3 Changes in functional responsibility

Despite the fact that no legislative changes had occurred, CASA assumed the lead role for the development, management and implementation of airspace reform by taking charge of the Airspace 2000 program at the end of 1997. The new roles of both organisations were not clearly outlined in any document, although mention was made of those roles in *CASA's Program Definition* Plan for Airspace 2000. No changes were made to CASA's internal processes to ensure that its airspace reform activities were subject to formal review mechanisms.

During the investigation, CASA stated that by taking over functional responsibility for airspace, they were 'operating within the political imperatives of the day'. It noted that both the CASA and Airservices' Boards had decided it was appropriate to transfer airspace functions to CASA, and that former Ministers had been contemplating the issue of transferring that responsibility. CASA also noted that the government had proposed to allow competition in the provision of air traffic services through amendments to the Civil Aviation Regulations. As a result, CASA stated it would be clearly inappropriate for Airservices to have a regulatory function such as airspace design and regulation without giving competitors the same powers.

However, the investigation did not identify any document that provided a direction or instruction to CASA to take over functional responsibility for airspace issues. Senior departmental officers subsequently confirmed that the government had been contemplating competition issues in the provision of air traffic services during 1997 and 1998. However, no decision had been made on the issue of transferring responsibility for airspace from Airservices to CASA. The officers confirmed that the government had only made a decision to allow alternative service providers in the provision of air traffic services at terminals. That competition could only be introduced where CASA had established personnel licensing standards. It was noted that CASA was still working on this task in mid-1999.

Departmental officers indicated that the Department's view in early 1998 was that CASA had much work to do before it could take over responsibility for airspace. They also did not believe that CASA had adequate resources at the time to take on that responsibility, and that Airservices' support under resource sharing would be vital. The Department and CASA agreed that the Minister should be briefed on CASA's intention to proceed with Airspace 2000 as the lead agency.

Senior Airservices personnel stated that after CASA had decided to defer Airspace 2000 in September 1997, the attention of Airservices shifted to the introduction of The Australian

Advanced Air Traffic System (TAAATS). Airspace reform consequently became a secondary priority. Airservices believed that the Class G airspace system at the time was 'safe', so there was no urgent need for reform on safety grounds. Due to previous difficulties in implementing Airspace 2000, Airservices was content to let CASA take the dominant role in managing airspace changes while they concentrated on TAAATS implementation.

1.1.4 Airspace standards

During the investigation, the CASA General Manager Airways and Airspace Standards Branch indicated that when CASA took over leadership of the Airspace 2000 program, it used the International Civil Aviation Organisation (ICAO) airspace classification system as its basis for airspace standards. That position was heavily influenced by the views of the CASA Chairman. For each class of airspace, there would be set service requirements. There could be no deviations from those requirements, unless the class of airspace was changed. However, a certain area of airspace, such as Class E airspace, could be upgraded to a higher class of airspace, such as Class C airspace, if industry was willing to pay for the upgrade, or the upgrade was justifiable in terms of safety analysis.

The General Manager stated that there were two types of problems associated with allowing a service provider such as Airservices Australia to vary the level of service within a certain class of airspace. Firstly, problems with standardisation might arise for operators encountering different rules in different locations. Secondly, public equity problems might emerge. If certain aircraft operators requested a higher level of service within a class of airspace, that upgrade could place additional restrictions on other operators.

An alternative view was provided during the investigation by the Department, which advised that CASA should only set standards that related to aviation safety. In effect, they should only set the minimum standards required for each class of airspace. A service provider, such as Airservices Australia, should be able to provide a higher level of service than the minimum required standard in order to meet customer needs. For example, if a certain area was classified as Class G airspace and Airservices' customers wanted a higher level of services than the specified requirements of Class G airspace, then CASA would have no basis for refusing the upgrade of services, unless it was on safety grounds. Public equity issues were matters of policy that could conflict with safety and were the concern of the government, not CASA.

1.2 Class G Airspace

1.2.1 Description of Australian Class G airspace

In Australia, Class G airspace (or uncontrolled airspace) covers those volumes not otherwise classified as Class A, B, C, D or E airspace, or as general aviation aerodrome procedures (GAAP) zones. Class G exists below controlled airspace in most areas of Australia. It extends from ground level up to flight level 200 (20,000 ft) in many areas, but the upper limit is lower in areas closer to major aerodromes.

Flights operating in accordance with the instrument flight rules (IFR) and visual flight rules (VFR) are permitted in Class G airspace, but no separation service is provided. Pilots of IFR flights are required to submit a flight plan, and air traffic services provide a flight information service, which includes a traffic information service on other IFR flights. The service is known as Directed Traffic Information (DTI), and is not generally provided in terminal areas. Pilots of IFR aircraft are also provided with a 'flight following' service i.e. the progress of the flight is monitored by air traffic services, and pilots are required to make regular position reports. All IFR aircraft are provided with a SAR alerting service, as are VFR aircraft on request. Pilots of VFR aircraft receive a flight information service if requested.

Mandatory broadcast zones (MBZs) and common traffic advisory frequency (CTAF) zones are established at some locations to allow pilot-to-pilot communications on a discrete frequency. The term 'mandatory broadcast zone' replaced 'mandatory traffic advisory frequency' (MTAF) zone in 1994, but the dimensions of the zone and the procedures remained the same.

Air traffic services are required to provide pilots of IFR aircraft descending from controlled airspace into Class G airspace (within radar coverage) with information on radar-observed traffic to at least 2,000 ft below the base of controlled airspace. Radar information is also used on an informal basis to assist aircraft in Class G airspace in certain situations, such as when a pilot requires navigational assistance. Occasionally controllers will pass information to flight service officers or pilots on radar-observed traffic in Class G airspace.

In 1995, a radar advisory service (RAS) was introduced to replace directed traffic information in the uncontrolled airspace around a number of locations in Australia, including areas near Perth, Adelaide, Melbourne and Brisbane.

During the same year, the Civil Aviation Safety Authority developed a series of eight 'minimum airspace safety criteria' (MASC), based on existing airspace design policy and criteria. Criteria 7 and 8 were relevant to Class G airspace:

7. For all high capacity, high performance RPT operations (and, subject to CASA risk analysis, other RPT and IFR operations) an IFR/VFR alerted see and avoid operating environment is required in the terminal areas, provided by any of the following means, selected subject to traffic density, complexity and/or risk analysis:

   • A class of airspace providing separation services (Classes A, B, C or D)

   • Pilot broadcast procedures (for example MBZ)

   • Electronic means.

   Note: For the purpose of this requirement, the normal terminal area is assumed to be the volume of airspace contained in an area not less than 15 NM radius from the aerodrome up to and including 5000 ft AMSL.

8. For RPT and IFR operations, minimum of an IFR/IFR, ATS provided, en-route and terminal traffic information service is required (this requires mandatory flight notification for each such operation).

1.2.2 History of change to Class G airspace

There have been three recent attempts to either introduce or change Class G airspace in Australia. The first was part of the then Civil Aviation Authority's (CAA's) planned 1993 airspace changes. The second was the airspace change proposal known as Airspace 2000, which was planned for introduction in February 1998 but deferred in September 1997. The third attempt was the Class G airspace demonstration. All of those planned changes involved the replacement of directed traffic information with other services.

Various reasons have been provided for changing Class G airspace in Australia, including:

- safety issues associated with the current Class G airspace (1.2.3);
- the costs of directed traffic information (1.2.4);
- non-compliance with ICAO requirements (1.2.5);
- differences between Australian Class G airspace and overseas systems (1.2.6); and
- incompatibility of the current Class G airspace with The Australian Advanced Air Traffic System (1.2.7).

1.2.3 Safety issues associated with current Class G airspace

1.2.3.1 Reliance on see-and-avoid procedures

Within Class G airspace, the primary defences against collision with another aircraft are radio-alerted see-and-avoid procedures, or in some cases such as non-radio VFR aircraft, unalerted see-and-avoid procedures.

In 1991, the Bureau of Air Safety Investigation published a report which summarised the physiological and psychological limitations of human vision, and considered their effects on the application of the see-and-avoid principle as a means of separating aircraft. In the report, alerted see-and-avoid (in which the observer is aware of the presence and general position of the conflicting traffic before beginning the search), was differentiated from unalerted see-and-avoid. The former was found to be much more successful in identifying the traffic than the latter. The report recommended that the CAA:

> …should take into account the limitations of see-and-avoid when planning and managing airspace and should ensure that unalerted see-and-avoid is never the sole means of separation for aircraft providing scheduled services.

The Chairman suggested, during the investigation, that this BASI recommendation was an unrealistic requirement in all situations as it did not consider the issue of traffic density. BASI has found no reason to change its recommendation because:

- the limitations of unalerted see-and-avoid are significant;
- an alerted see-and-avoid environment would have a significant safety benefit over an unalerted see-and-avoid environment; and
- an alerted see-and-avoid environment can be provided as a minimum requirement at low cost.

1.2.3.2 Reliability of directed traffic information

A number of incidents have occurred in Class G airspace where directed traffic information was not provided or was provided incorrectly by flight service, as evidenced by the following two incidents.

> Summary of BASI investigation report on occurrence 9701187
>
> On 16 July 1997, a Piper Chieftain on a flight from Bankstown to Coffs Harbour was flying the Williamtown to Taree track at 9,000 ft. A de Havilland Dash 8 that had taken off from Taree, climbed through 9,000 ft, passing just in front of the Chieftain. Traffic information had not been passed to the respective pilots because the flight service officer incorrectly assessed that the two flights would not conflict.

Occurrence 9702957 also demonstrated that flight service could become more unreliable as the traffic levels become significant. It also highlighted the hazards associated with aircraft operations during the transition between frequency boundaries.

> Summary of BASI investigation report on occurrence 9702957
>
> On 10 September 1997, a de Havilland Dash 8 on a flight from Armidale for Sydney was climbing initially to flight level (FL) 125 while waiting for a clearance from air traffic control to enter controlled airspace. A Royal Australian Air Force Hercules was on a flight from Richmond for Walcha on a reciprocal track to the Dash 8 at FL 130. The pilot of the Hercules had been cleared to leave controlled airspace on descent, and was aware that the Dash 8 was opposite direction traffic below him. The Hercules pilot decided that he would remain at FL 130 until he could establish contact with the Dash 8 pilot to ensure separation. During this period the Dash 8 pilot had been preoccupied with

ascertaining the position of other traffic outside controlled airspace on the flight service frequency. The flight service frequency was overloaded due to the volume of traffic (21 IFR aircraft) making communication very difficult.

The Dash 8 pilot then changed to the Brisbane Centre frequency approaching FL 125. The radar controller advised the Dash 8 pilot that the Hercules was now 12 NM ahead of the Dash 8, and that the aircraft appeared to be maintaining FL 130. The Dash 8 pilot was aware of the presence of the Hercules at FL 130, and had descended to FL 120 for vertical separation. At about this time, the flight service operator advised the Hercules pilot that he could disregard the Dash 8, as this aircraft was now well in controlled airspace (above the level of the Hercules). At the same time, the radar controller was warning the flight service coordinator that the Dash 8 was still at FL 125 and was directly ahead of the Hercules at 8 NM. The Hercules pilot commenced descent and at about the same time, the radar controller advised the Dash 8 pilot that the Hercules was directly ahead of him at 3 NM and suggested that he return to the flight service frequency. The aircraft passed at FL 120 within 400 m of each other in the cloud tops.

Following occurrence 9701187, BASI conducted an analysis of traffic conflict incidents which had occurred outside controlled airspace between January 1995 and July 1997. That analysis indicated that there had been approximately 30 incidents within radar coverage, and that the aircraft involved were being managed via procedural air traffic management methods. Use of radar in those areas would have assisted the air traffic service operators in the conduct of their task, and may have averted some of the incidents. During the same period, there were nine incidents within the airspace controlled by Coffs Harbour Tower that were probably within radar coverage. Again, the provision of radar would have assisted the controllers.

On 14 July 1997, BASI issued Interim Recommendation IR970112 which recommended that Airservices Australia review the provision of air traffic services to maximise the use of currently available radar coverage, particularly on routes used by regular public transport aircraft. The recommendation did not include, nor did it imply, the removal of all directed traffic information services. Airservices provided a response dated 17 October 1997, stating that the Airspace 2000 program would have addressed that issue, but the CASA Board had deferred making a decision on that program. Regardless of Airspace 2000, Airservices intended proceeding with three initiatives to enhance radar services on 26 February 1998. One of those initiatives was the introduction of radar Class E airspace in the Canberra–Ballina region between 8,500 ft and 12,500 ft. BASI accepted the response and closed the recommendation.

1.2.3.3 Issues associated with uncontrolled terminal areas

Prior to December 1991, aerodrome flight information zones (AFIZs) were established around a number of uncontrolled aerodromes, principally those with significant traffic levels. Within an AFIZ, pilots were provided with information on all traffic by an air traffic services unit located at or near the aerodrome. On 12 December 1991, AFIZs were replaced with MTAF zones and the air traffic service units carrying out that function were disbanded. In the following 18 months, the Bureau received many reports of safety concerns for operations within MTAF zones.

In late 1993, BASI published a research report (RP/93/01) on safety occurrences involving regular public transport aircraft within MTAF zones. During a 6-week period, every reported incident involving regular public transport aircraft within those zones was investigated in depth. The report made a number of conclusions, including the following:

- For the majority of regular public transport flights in MTAF zones, pilots successfully obtained traffic information and arranged separation.

- All 17 of the safety occurrences related to communications difficulties in obtaining accurate traffic information.
- The MTAF system relied more heavily than the previous AFIZ system on the judgment and procedural compliance of pilots. Some pilots did not comply with procedures for a variety of reasons including lack of traffic assessment ability, avoidance of landing fees, a reluctance to broadcast and the non-carriage of current flight publications.
- The safety of the MTAF system could have been improved by additional pilot training in traffic assessment and re-emphasis of the importance of MTAF procedural requirements.

Summary of BASI investigation report on occurrence 9701646

Two turboprop regular public transport aircraft (Shorts 360 & Brasilia), followed by an IFR Beechcraft Bonanza were inbound to Bundaberg over a 20-minute period in instrument meteorological conditions. All pilots were given traffic information on the other aircraft by air traffic services. The crew of the Shorts 360 commenced a non-directional beacon (NDB) approach but was unable to establish visual flight and so made a missed approach. The crew of the Brasilia then commenced an NDB approach but also made a missed approach. The crews of both aircraft attempted to contact the Bonanza pilot on both the MBZ frequency and the flight service frequency without success. The Shorts 360 crew made a second instrument approach but again failed to become visual and diverted to Brisbane. The Brasilia crew made a second approach, became visual and landed. While backtracking on the runway, the Brasilia crew observed the Bonanza on short final approach. It was later determined that the Bonanza pilot was using an old frequency and was not aware that two other aircraft were flying the same instrument approach.

Following that incident in 1997, BASI recommended (IR970110) that CASA and Airservices consider:

- providing pilots with confirmation of the correct selection and operation of a CTAF or MBZ frequency;
- a requirement for the operation of a traffic alerting service at aerodromes during regular public transport operations; and
- providing additional radar coverage at Bundaberg and other locations serviced by regular public transport operations.

As a result of the investigation of that occurrence, a notice to airmen (NOTAM) was issued requiring pilots to advise air traffic services of the MBZ/CTAF frequency to which they were changing. In 1998, CASA started developing legislation to require a traffic alerting service at aerodromes during operations by regular public transport aircraft with a capacity to carry more than 10 passengers.

1.2.3.4 Issues associated with the radar advisory service

At some locations, the radar control service for aircraft in controlled airspace and the radar advisory service for aircraft in Class G airspace below the controlled airspace were provided on the same frequency. At other locations, the two services were provided by the same controller on two frequencies. At locations where both services were provided on the same frequency, pilots of aircraft in Class G airspace used that frequency for pilot-to-pilot communication.

During the 1996 audits of Airservices' units by CASA, non-compliance notices were issued for two air traffic control sectors concerning the use of the same frequency to provide a radar advisory service and a control service. CASA auditors believed that the use of a control frequency for pilot-to-pilot communication did not meet the ICAO standard for 'direct, rapid, continuous and static-free two-way communication' between a controller and pilots. No system was in place to avoid frequency congestion/interference problems when separating

aircraft in controlled airspace, (e.g. use of a 'reject' facility which reduced the volume of a frequency, or the ability to transfer the radar advisory service frequency to other controllers' consoles). Such systems were in place at other Airservices' locations.

As a result of the investigation of two radar advisory service related incidents near Perth, BASI issued a recommendation in May 1996 that Airservices Australia re-assess the provision of a radar advisory service operating in conjunction with a radar control service. Specifically, the Bureau held some concerns about the air traffic controllers' workload and task-complexity when simultaneously providing a radar control service and a radar advisory service. However, a significant number of incident reports have shown that the radar advisory service has been used to prevent situations developing into serious safety problems.

1.2.4 Cost of directed traffic information

Senior Airservices personnel stated to BASI that the expected savings from removing directed traffic information would be less than $15 million. They also noted that discussions about the cost of directed traffic information during the development of Airspace 2000 were of figures significantly higher than $15 million.

1.2.5 Compliance with ICAO requirements

The ICAO airspace classification system uses letters of the alphabet, ranging from 'A' to 'G', to designate the services and restrictions relating to aircraft operating within that airspace. Class A airspace has the greatest range of services and Class G airspace the least. The details of each classification are published in appendix 4 of ICAO Annex 11 *Air Traffic Services – International Standards and Recommended Practices* (see viii).

The standards and recommended practices for Class G airspace include the provision of a flight information service to both IFR and radio-equipped VFR aircraft, as well as information relating to:

- significant meteorological (SIGMET) events such as thunderstorms;
- volcanic eruptions;
- serviceability of navigation aids;
- serviceability of aerodromes;
- forecast weather conditions at aerodromes;
- collision hazards; and
- any other information likely to affect safety.

ICAO Annex 11 paragraph 4.2.2 states:

> Flight Information Service provided to flights shall include…the provision of information concerning...collision hazards to aircraft operating in airspace classes C, D, E, F and G.

A note to that requirement stated that collision hazard information included only 'known' aircraft and would sometimes be incomplete.

At its meeting on 27 November 1998, which focused on Class G airspace issues, the CASA Board resolved that Australian airspace would become ICAO compliant by 31 December 1999. Exactly why the Board considered that Australian Class G airspace did not comply with ICAO requirements was not stated.

During the investigation, a number of senior officers from Airservices Australia described the current Australian airspace system, including Class G airspace, as being 'ICAO compliant'. They stated that the services currently provided in Australian Class G airspace met or exceeded all the requirements for ICAO Class G airspace.

The issue of whether Australian Class G airspace was ICAO compliant is discussed further in the analysis (section 2.3.7).

1.2.6 Comparison with overseas systems

1.2.6.1 The operation of Class G airspace in some overseas systems

As part of the investigation, various aspects of Class G airspace in Australia were compared with those in Canada, New Zealand, the UK and the USA. Relevant features examined were:

- the extent of Class G airspace;
- the provision of directed traffic information;
- the use of a national advisory frequency;
- radar coverage; and
- radar-based services.

1.2.6.2 The extent of Class G airspace

ICAO documents do not contain data to determine the need for air traffic services, and therefore the class of airspace, in any given area or at any specific location. That responsibility lies with the airspace management authority in each country.

In the USA and Canada, IFR aircraft rarely operate in Class G airspace. In the USA, Class G airspace only exists below 1,200 ft above ground level, or in areas of very low traffic density. In Canada, there are extensive areas of Class G airspace; however, low-level airways of Class E airspace extend from 2,200 ft above ground level to 18,000 ft above mean sea level, and Class E control zones extend down to ground level around major regional airports. A large proportion of the airspace in the UK and New Zealand is Class G airspace. Most of that airspace is within radar coverage.

1.2.6.3 Provision of directed traffic information

In general, directed traffic information is not provided in other countries to the same extent as it is in Australia. No such service is provided for aircraft in Class G airspace in the USA. In the UK, the flight information service available to aircraft in Class G airspace includes details of known conflicting traffic. Known traffic information is restricted to that in radar coverage. In Canada, at some non-tower airfields in Class G airspace, flight service stations provide details of traffic known to be operating at or near the airfield.

In New Zealand Class G airspace, IFR aircraft (and VFR aircraft that have submitted a flight plan) are provided with a directed traffic information service in areas beyond radar coverage.

1.2.6.4 Use of a national advisory frequency

Under the Airspace 2000 program developed for Australia in 1996, pilot-to-pilot en-route broadcasts in Class G airspace were to be made on a national advisory frequency. The use of that frequency was to be the primary mitigator for the removal of directed traffic information.

In Canada, IFR aircraft in Class G airspace are required to use 126.7 MHz in a similar manner to the proposed Australian national advisory frequency. In Class G airspace in the USA, the UK and New Zealand, there is no equivalent frequency or procedure.

1.2.6.5 Radar coverage and services

In Australia, radar coverage is limited to the east coast from Cairns to Adelaide, as well as regions surrounding Perth and Darwin. A radar advisory service is only provided at certain locations.

Evidence obtained from a variety of sources indicated that radar services in the USA and the UK are usually available to aircraft down to the minimum safe altitude (the altitude at which an IFR aircraft will begin an instrument approach). In Canada, approximately one-quarter of the land area, mainly the more densely populated southern and eastern areas, is under radar coverage, while large areas of low population density in the centre and north are not. In New Zealand, approximately 60% of the Class G airspace is covered by radar, although over much of the east coast of the North Island the base of radar coverage is at or above 9,500 ft.

In the USA, the UK, New Zealand and Canada, a radar information service is available to all aircraft in Class G airspace within radar coverage. In the USA, New Zealand and Canada, that service is available on a controller workload-permitting basis. In the UK, dedicated controllers provide the radar service.

1.2.7 Compatibility with The Australian Advanced Air Traffic System

The original specifications for TAAATS did not include any provision for flight service. However, when the introduction of Airspace 2000 was deferred in September 1997, Airservices started planning for the retention of flight service functions after the implementation of TAAATS.

Upon learning that CASA was recommencing work on Airspace 2000 initiatives, the General Manager Air Traffic Services in Airservices wrote to the Acting Director of CASA on 24 February 1998, noting that an opportunity now existed to examine the current requirements for the provision of directed traffic information. He noted that TAAATS was not designed to incorporate the current flight service structure and that some difficulties were being encountered in assimilating that function. Rather than make potentially expensive changes to TAAATS, it would be sensible to accommodate amendments to directed traffic information requirements.

Work was conducted by Airservices and CASA on further development of those proposals during March to May 1998. One of the proposals was an earlier than scheduled removal of directed traffic information in the less densely trafficked areas of Australia. That proposal was rejected by CASA. Such a change was to be accompanied with an offer to establish Class E corridors where industry desired; however, CASA was not in a position at the time to do that.

Airservices also proposed the removal of the provision of directed traffic information for taxiing aircraft where a common traffic frequency existed, changes to SAR alerting procedures, and a reduction in the parameters for traffic information outside radar coverage. Those changes were accepted by CASA for a national introduction during 1998. Although Airservices viewed the changes as being minor in nature, they were not implemented due to concerns from some parts of the industry. Following the rejection of the proposed changes, Airservices developed plans to ensure that the existing directed traffic information functions could be retained after TAAATS was introduced.

1.3 Airspace 2000

1.3.1 Origins of Airspace 2000

In April 1995, the Board of the CAA took several decisions regarding Australia's airspace which led to the introduction of ICAO airspace Classes A, C and G in December 1995. The April 1995 Board decisions also included the following statement:

> …further development of Australian airspace is to be pursued progressively and as soon as practicable on a timescale structured to meet the practical limitations and requirements of education, training, chart production, risk analysis, technology improvements and other factors.

In July 1995, the government restructured the Civil Aviation Authority to form a regulatory body, the Civil Aviation Safety Authority, and a service provider, Airservices Australia. To assist Airservices in pursuing the airspace vision previously set by the CAA Board, an Airspace Steering Group was established in February 1996. The purpose of the group was to coordinate the multiple suggestions for airspace reform which were being aired by various bodies at that time, and to provide advice to Airservices about the future directions for airspace management in Australia.

One of the reasons for addressing airspace reform at that time was the impact of TAAATS on the way airspace could be managed in the future.

The steering group, which comprised senior representatives from Airservices, CASA, the Defence force, and representatives from a broad cross-section of the aviation industry, initially took an incremental approach to airspace reform. In terms of Class G airspace, efforts were directed to collecting data on traffic levels in the 'low density traffic area' of Australia. That area excluded those regions along the east coast of Australia. Based on an analysis of the data, there were discussions regarding the possibility of removing directed traffic information from the low-density traffic area.

The CEO of Airservices announced on 21 May 1996 that he had invited a member of the steering group (a former Chairman of the CAA from 1990 to 1992) to put forward a proposal on airspace design to the steering group meeting on 4 June 1996. He was invited to lead a small team and coordinate with industry and other interested parties in the development of that proposal. Subsequently, the steering group unanimously approved, in principle, the team's outline of a proposed 'Airspace 2000' model.

The Airspace 2000 design team leader was concerned that the incremental approach to airspace reform taken by the steering group was too slow and offered to develop concepts in a more holistic fashion in a short time frame, provided he was given a 'group of good people'. The steering group accepted the offer and gave him 6 weeks to deliver a preliminary report.

1.3.2 Overview of the Airspace 2000 model

The Airspace 2000 design team's report *Airspace 2000: A Plan for the Future Management of Australian Airspace* was completed in July 1996. The document was released for public comment in August 1996.

With regard to the objectives of Airspace 2000, the introduction to the document stated the following:

> The Airspace 2000 project has three prime objectives. These are to:
>
> - improve safety through a more effective allocation of resources
> - assist Australia to benefit from new technology
> - reduce costs so that more people can fly.

The document stated that safety was the first priority, and that:

> A comprehensive overhaul of Australia's airspace management and air traffic services arrangements will allow a reallocation of resources across the entire system to where they will provide the most safety benefit.

Features of the Airspace 2000 concept are detailed in attachment A. The main changes relevant to Class G airspace included:

- replacement of directed traffic information with a national advisory frequency for en-route operations;
- introduction of a third-party traffic information service in uncontrolled (Class G) terminal areas;
- replacement of mandatory broadcast zones with common traffic advisory frequency zones;
- introduction of a radar information service on a controller workload permitting basis;
- upgrading of Class G airspace to Class E airspace where traffic densities require, or at the request of industry; and
- removal of the requirement for VFR aircraft to carry radio in Class E and Class G airspace above 5,000 ft.

The Airspace 2000 design team leader was interviewed during the investigation in his subsequent capacity as Chairman of CASA. He stated that Airspace 2000 was essentially based on a policy produced by the Australian Aviation Industry Association (AAIA). On 29 September 1998, the Chairman wrote to the CASA Director and stated:

> The AAIA 1 May [1995] policy was negotiated by [names withheld] and it had the full unequivocal agreement and support of all the members of the AAIA including the Australian Air Transport Association and the Regional Airlines Association. As you can see, the proposal incorporated the provision that a directed traffic service would not be provided in Class G airspace…

Excerpts from the Australian Aviation Industry Association policy relating to Class G airspace include:

> When in Class G airspace, IFR aircraft will receive a full Flight Information Service in accordance with ICAO recommendations.
>
> Within radar coverage this will include advisories on all known traffic. Outside radar coverage 'self announce' procedures will apply…
>
> When approaching the terminal area, IFR traffic will call ATS [air traffic services] which is controlling the traffic in the airspace above. ATS will provide information of any known traffic. The aircraft would then broadcast on the aerodrome frequency and arrange separation with known traffic.

The Chairman of the Australian Aviation Industry Association at the time the policy was developed was an Australian Air Transport Association (AATA) representative. He later explained, when interviewed, that the AAIA policy was a compromise position of the 10 organisations involved. However, the policy did not specify the removal of directed traffic information or third-party traffic information services, and the airlines had not agreed to any such removal. As the member organisations could not agree on issues relating to directed traffic information, the subject was not specifically referred to in the policy. In terms of the 'self announce' procedures, the airlines envisaged that a similar arrangement to existing procedures with flight service would remain in areas outside radar coverage.

In a CAA briefing paper dated 23 May 1995, the following was stated:

> In 1993, several pilots within the RPT [regular public transport] sector of the industry objected to the loss of that service [DTI] on safety grounds. As a result of a further review by CAA, we have determined that to maintain the current level of safety for the travelling public, that service must be retained. That position was also supported by AAIA and several other professional representative organisations.

1.3.3 Initial safety analysis of Airspace 2000

In part 4 of the document *Airspace 2000: A Plan for the Future Management of Australian Airspace* (August 1996), the Airspace 2000 design team discussed the issue of recognised safety assessment procedures. Further details of that discussion, and the results of the design team's safety analysis activities, are presented in attachment B.

1.4 Development Of Airspace 2000 By Airservices Australia

1.4.1 Introduction

The Airspace Steering Group met in September 1996 to consider industry comments on the Airspace 2000 proposal. The comments received about the proposed model covered a number of aspects that required resolution so that changes to Australian airspace could be progressed. The steering group also decided that ownership and responsibility for further development of Airspace 2000, beyond the base proposal, should pass to Airservices.

Airservices' stated intent with respect to the development of the Airspace 2000 model was to update the airspace proposals, taking into consideration those concerns expressed by the industry, and to provide answers to both general and specific queries that arose during the first phase of the consultation process. The updated proposals were then to be recirculated to the aviation industry as part of the ongoing consultation process.

The steering group was of the general opinion that there would be a conflict of interest due to Airservices conducting not only the re-design of airspace, but also the associated risk analysis and safety assessment. Those issues were argued to be more closely aligned with standard setting and airspace design criteria rather than with the provision of services. As a result, the CEO of Airservices wrote to the Director of CASA in September 1996 and suggested that it may be appropriate for CASA to conduct the safety analysis task. However, that suggestion was not accepted and Airservices undertook the safety assessment, ultimately known as the *Airspace 2000 Safety Case*. The safety case was finalised in July 1997.

At the steering group meeting on 11 February 1997, it was noted that industry had concerns regarding the proposed changes to Class G airspace under Airspace 2000. Those concerns related to:

- third-party directed traffic information;
- mandatory broadcast zones;
- universal communications operators (unicoms) at terminal areas;
- radio broadcast procedures; and
- use of a national advisory frequency.

There were also more generalised industry concerns about Airspace 2000 costings and an associated education program.

On 21 March 1997, the Board of Airservices endorsed the Airspace 2000 proposals for implementation on 4 December 1997.

An electronic memorandum from the General Manager Air Traffic Services to all Airservices staff on 25 March advised of the main features of Airspace 2000. The memorandum also stated that the proposals would be subject to the most stringent safety analysis process yet utilised for changes to Australian airspace. Moreover, it stated that Airservices had prepared a comprehensive safety case, which was with CASA at that time for consideration and endorsement. In addition, the Airservices Board had instructed that the safety case be audited by an external independent and internationally recognised authority in air safety. The Board's endorsement of the Airspace 2000 proposals was contingent upon a satisfactory outcome to the independent audit process, and CASA endorsement.

A number of aviation associations, including the Australian Air Transport Association, the Regional Airlines Association of Australia and the Australian Federation of Air Pilots, did not believe that Airspace 2000 was acceptable as the model stood in May 1997. One of the main concerns related to directed traffic information, which the industry groups stated should be either retained or replaced by an equivalent system. As it was not possible to achieve agreement by all parties that the pilot procedures proposed for Class G airspace would provide an adequate level of safety, Airservices set up a working group to examine the issues relating to the possible removal of directed traffic information. The group was comprised of representatives from Airservices, industry and CASA. The operation of the Class G working group is discussed later in the report.

In July 1997, Airservices decided that the removal of directed traffic information would occur on 26 February 1998.

The proposed February 1998 procedures involved:

- no third-party directed traffic information;
- all flights operating in Class G airspace utilising a national advisory frequency instead of the current flight service frequency;
- the provision of a radar information service by air traffic controllers to flights in Class G airspace on a workload-permitting basis (as an 'add-on' service);
- no 'flight following' service for IFR aircraft; and
- revised SAR alerting procedures.

In the safety case for Airspace 2000, Airservices stated that the national advisory frequency was the primary mitigator for the removal of directed traffic information. A radar information service was described as being an 'add on' service in areas within radar coverage. That service would be provided subject to controller workload.

1.4.2 Airservices Australia safety case

To provide assurance that risks are being managed appropriately, organisations in some safety critical industries are required to prepare a 'safety case' for new systems, existing systems, or for changes being made to existing systems. In the document *Systematic Safety Management in the Air Traffic Services* (1995), Richard Profit of the UK National Air Traffic Services (NATS) stated the following regarding safety cases:

> The Director General of the UK Health and Safety Executive has defined a safety case as 'a properly structured and comprehensive presentation of the hazards resident in any plant, their importance in terms of the risks of occurrence and their likely effect, and the means whereby they are to be managed'. The essential features of a safety case are that it should fully describe the system or

> operation, identify the hazards, assess the risks, identify the measures in place to mitigate or control the risks and explain the safety management arrangements for the system or operation...The safety case is thus an important management tool…What the safety case concept does is provide a structured approach to managing safety issues and it needs to be maintained as a living document.

In April 1996, CASA published the document *Safety Regulation of Airservices Australia and Aerodrome Rescue and Fire Fighting Service Providers—Final Draft Regulatory Arrangements and Standards*. Attachment A to the document was concerned with the safety regulation of Airservices, and included section 6 ('General safety regulatory standards'). Section 6.3 was concerned with change management and contained requirements for safety analysis activities associated with changes to the air traffic system. Details of those requirements, and relevant safety analysis guidelines, are presented in attachment C to this report.

The *Airspace 2000 Safety Case* was the first safety case developed by Airservices, and was based on the approach advocated in the *Systematic Safety Management in the Air Traffic Services* document. The first version of the safety case was completed on 7 February 1997. Revised versions were then issued on 27 February, 25 March and 5 June. Minor amendments to the 5 June version were issued on 10 July 1997.

In subsection 2 of section 1 of the safety case document, the following was stated:

> The objectives of this safety case are:
>
> a. to detail the airspace architecture and procedures associated with the current airspace system;
>
> b. to detail the airspace architecture and procedures associated with the Airspace 2000 system;
>
> c. to identify changes associated with the new architecture and procedures, and detail the way in which the new airspace system will operate;
>
> d. to identify potential safety issues and hazards and to assess the risks associated with those hazards;
>
> e. to identify safety requirements in place or to be established to control those risks; and
>
> f. to explain the safety management arrangements for the new airspace system.
>
> In meeting these objectives, the safety case will provide assurance that the changes proposed by Airspace 2000 will not significantly increase risk, provided that the identified mitigating actions and safety requirements are put in place.

The safety analysis process basically involved identifying hazards and categorising the risks in terms of their likelihood and severity. For each hazard, mitigations and safety requirements were also identified. Judgments were made by a panel of three air traffic services specialists. Attachment C provides a detailed overview of Airservices' *Airspace 2000 Safety Case*.

A number of the identified hazards listed in the safety case were relevant to Class G airspace, including the replacement of directed traffic information with enhanced radio broadcast procedures. The analysis of that hazard involved collecting data on traffic levels in Class G airspace, and then using the airspace risk model to calculate the level of risk associated with the current system compared to the proposed system.

Based on that safety analysis work, the following conclusions were stated in appendix 1 of the safety case:

> The level of IFR to IFR collision risk within the existing Class G airspace is extremely low, given the current traffic loadings. The removal of the FS [flight service] directed traffic information service does not significantly increase the level of risk within Class G airspace, and overall the level of risk remains extremely low.

> In those areas where the risk is slightly higher – ie those FS sectors around Sydney – the increase in risk should be effectively mitigated by the introduction of a radar information service.

Attachment D to this report provides further information on the airspace risk model, and the risk modelling work conducted for the Airservices *Airspace 2000 Safety Case*. Attachment E outlines BASI's observations and conclusions in relation to the risk modelling data.

1.4.3 Audit of the Airservices safety case by UK National Air Traffic Services

Airservices contracted an independent organisation, the National Air Traffic Services (NATS) of the UK, to conduct an audit on the *Airspace 2000 safety case*. The purpose of the audit was to provide advice on the extent that the safety case met its objectives. The consultancy agreement stated that, in conducting its assessment, NATS was to consider:

- The appropriateness of the methodology used.
- Whether or not the methodology has been applied in an appropriate, logical manner which encompasses the totality of the changes proposed.
- The appropriateness of the risk assessment tools to the methodology applied.
- The validity of the data gathering methods.
- The validity of the relationship between the data, risk assessment tools and outcomes.
- Whether or not the Safety Case provided sufficient information, in a suitable form to enable appropriate decisions to be taken.

The auditing agency was to check the process used in developing the safety case, but not review the technical accuracy of the material used to support the safety case. However, they did make general comments about some of the technical details. NATS had significant experience in preparing safety cases on airspace issues in the UK, and was recognised by both Airservices and CASA as a leader in that field.

NATS produced a report on the March 1997 version of the safety case which listed 19 recommendations for improvement. The following was stated in the conclusions of the report:

> We have found no evidence that the changes proposed by the Airspace 2000 project will significantly increase the probability of a collision occurring, *providing the mitigation measures and resulting safety requirements can be implemented effectively* [emphasis included in original].
>
> Thus, even in its current form, the Safety Case and its supporting appendices contain sufficient information to enable appropriate decisions to be made and this is a significant attribute. However, it is our opinion that the March 1997 issue of the Airspace 2000 Safety Case does not yet fully meet its objectives and it requires some further development to achieve this aim.
>
> The real issue now is how to introduce the proposed changes in a safe and effective way and, in our opinion, pursuing this is likely to give a greater contribution to safety than further attempts to identify absolute risks, given the absence of any statistical data other than zero accidents.

The 19 recommendations were substantially addressed in the June 1997 version of the safety case. Some residual problems were noted by NATS in their second report of 12 June 1997, including:

- The safety case panel may not have been sufficiently representative to identify some hazards. A recommendation on that issue for the March version was not addressed in the June version.
- The safety case stated that the level of risk associated by the replacement of directed traffic information with a national advisory frequency was 'very low' or 'extremely low', but such

words were not qualified or defined. The extent to which the risks were tolerable to Airservices was also not clearly stated.

- The implications of the changes for TAAATS transition could be explained in more detail.
- The hazard log was not completed for hazard 14, based on the conclusions of the analysis.

Overall the audit determined that the June 1997 version of the safety case was 'sound', with 'clear scope and presentation, traceability of arguments and consistency'. In conclusion, the following was stated:

> We believe that the Safety Case has now become a 'living document' which should serve Airservices Australia well in going forward with Airservices [Airspace] 2000 and should facilitate the safe transition of the new system to operation and beyond.

1.4.4 Review of the Airservices safety case by CASA

According to the *Final Draft Regulatory Arrangements and Standards* document, CASA was required to assess Airservices' safety analysis activities associated with changes to the airspace system. CASA continually reviewed the safety case during its development, and a number of meetings were held for that purpose between personnel from CASA and Airservices.

In April 1997, the CASA Director wrote to the CEO of Airservices and stated the following:

> The Airspace 2000 Safety Case is being subjected by CASA technical staff to thorough and rigorous examination. This is essential because it is evident that some of the 39 changes identified in the Safety Case would require CASA to amend its minimum airspace safety criteria in the Manual of Operational Standards (MOS).
>
> CASA analysis of the Safety Case at its current state of development…suggests that the risk levels associated with some of the airspace changes may be in the realm where risks should be made As Low As Reasonably Practical (ALARP), which is the realm of benefit:cost analysis…it seems likely that Airservices may have to prepare a benefit:cost analysis on some of the proposed changes.

The results of CASA's continuing assessment of the safety case were sent to Airservices on 19 June 1997 in a letter from the CASA Director to the CEO. The letter stated:

> In general the Safety Case is a comprehensive and useful document which has been considerably improved as a result of cooperative effort between our organisations. Nevertheless, in a few areas it does not yet provide sufficient justification for some of the proposed changes. Our assessment is that with a little further work it could be refined to the stage where CASA would have a sound basis on which to consult with industry on the changes to the Minimum Airspace Safety Criteria needed to implement the Airspace 2000 system. The principal area where some further work is required is in the removal of directed traffic information from G airspace as well as the action on Radar E airspace which I am proposing in this letter.

A report attached to the letter provided brief comments on specific aspects of the Airspace 2000 proposal. The report noted that replacement of third-party directed traffic information may be acceptable on the grounds of relative risk. However, the report stated that more work should be done in conjunction with Airservices and the risk consultant on the relative risk en-route. The report also noted that more information was required on the 'enhanced radio-alerted see-and-avoid procedures'. In terms of other Class G airspace issues, the removal of the radar advisory service and the establishment of a radar information service were accepted. The removal of mandatory radio requirements for VFR flights operating above 5,000 ft in Class G airspace was also accepted, but the reclassification of mandatory broadcast zones as common traffic advisory frequency zones was not accepted, pending further information to enable criteria to be developed.

The Airspace and Global Navigation Satellite System Projects Group within CASA produced a report on Airservices' safety case on 9 July 1997. It stated that the major area of concern was that the safety case had not fully addressed Class E radar airspace en-route and above terminal areas, Class E procedural airspace above terminal areas en-route, and the removal of directed traffic information services to IFR aircraft in Class G airspace. One reason for that conclusion was that the composition of Airservices' risk assessment panel was inadequate in that it did not represent the industry, and that all hazards associated with each change may therefore have not been identified. Another reason was that the level of risk was dependent on procedures and training, and those procedures had not yet been finalised.

The project group's report noted that the airspace risk model work in the safety case indicated that directed traffic information reduced the risk of mid-air collision by less than 10%. The report also noted that the benefits of directed traffic information enroute may have been greater than the safety case stated because the safety case did not consider that the effectiveness of unalerted see-and-avoid would be reduced enroute. Risk modelling on that issue was not completed at the time. Overall, the report noted that a cost-benefit analysis on directed traffic information 'would probably show that the provision of DTI was not cost-beneficial', assuming that a directed traffic information service cost $20 million per year to provide.

During May to July 1997, CASA staff raised with Airservices and the risk engineering consultants a number of concerns regarding the risk-modelling data on Class G airspace. However, there were no changes made to the safety case.

CASA staff who reviewed the risk-modelling work stated during the investigation that adapting a terminal area risk model to the en-route application by adjusting the probabilities of some factors was a simplistic approach. They noted that an en-route model would require a different structure, and that many different factors would need to be considered. They also stated that the risk modelling presented in the safety case did not provide a valid basis for any comparisons between the current Class G airspace and Airspace 2000 airspace. Furthermore, they stated that their review task was complicated by the fact that components of the Airspace 2000 model had increased from 39 to 55 during the course of 1997. In addition, a hazard log summarising the main features of the safety case did not appear until the June 1997 version.

As part of this investigation, BASI reviewed the risk-modelling work in the safety case. The results of this analysis are presented in attachment E.

1.4.5 Review of the Airservices safety case by the airline industry

In order to ensure that 'specific details of airspace reclassification reflect industry concerns', the Australian Air Transport Association and the Regional Airlines Association of Australia commissioned a risk engineering consultant

> …to assist industry to review and appraise the Safety Case for Airspace 2000 prepared by Airservices Australia.

The review was conducted by a team including the risk engineering expert and an airline pilot who had been involved in previous airspace change forums. Their report, which was finalised on 6 August 1997, made a number of observations and conclusions about the Airspace 2000 safety case, including the following:

- The presentation of the hazard identification complied with relevant standards, but the qualitative evaluation of hazards required further work. The definitions of the terms used to describe frequency were not adequate.
- The risk analysis was not based on an appropriate physical model of airspace, which properly considered communication issues and pilots' lines of defence.

- The airspace risk model was based on a well accepted type of methodology.

However, stated concerns included:

- the lack of sufficiently detailed elaboration of the factors in the fault trees;
- the presence of common mode failures which were not addressed;
- the presentation of results as a single point rather than a range of values;
- the lack of data on 'unknown' VFR flights and their influence on conflicts with other VFR and IFR flights;
- the failure to incorporate a large body of knowledge on visual acquisition, collision probabilities and near-miss conflict ratios; and
- specific concerns about the probabilities used for some factors, and the lack of consideration of other factors.

Technical background on some of those issues is presented in attachment D.

The review recommended that the Australian Air Transport Association (AATA) and the Regional Airlines Association of Australia (RAAA)

> …have high regard for the credentials of the U.K. National Air Traffic Services to act as an Auditor in Safety Case process and development.

CASA staff who had worked on the development of the airspace risk model stated during the investigation that they were aware of the views of the AATA/RAAA risk engineering consultant. They noted that some of the concerns had already been addressed (e.g. common mode failures), whereas other concerns added unnecessary complexity.

1.4.6 Class G working group

The Class G working group was an Airservices initiative involving Airservices, CASA, AATA and RAAA representation. The aim of the working group was to review the level of service provided in Class G airspace, with a view to providing an adequate level of safety should the elimination of third-party directed traffic information be recommended. If the complete elimination of that service was not recommended, then the working group was to provide advice to Airservices on where the service should be continued, what form the service should take, and alternatives to those services.

The group met on two occasions—in June 1997 and July 1997. A note in the minutes of the meetings stated that while the conclusions and recommendations of the working group were considered to be those of the working group members, they were not necessarily the views of Airservices, the AATA/RAAA or CASA.

The group concluded that the Class G airspace model as presented in the Airspace 2000 proposal could be introduced contingent on the fulfilment of a number of requirements, including:

- Mandatory broadcast zones should be retained and additional ones may need to be established. The dimensions of mandatory broadcast zones should also be reviewed.
- A radar information service should be provided on a continuous basis, and current radar coverage used to the maximum extent.
- Additional Class E areas should be established to capture traffic in higher density areas.
- Establishment of criteria for mandatory broadcast zones and Class E airspace should be developed.

The work of the group ceased after CASA convened an Airspace Technical Expert Panel to examine issues with the Airspace 2000 safety case.

1.4.7 Airspace Technical Expert Panel

To resolve outstanding issues with the Airspace 2000 safety case, CASA convened an expert panel under the auspices of Technical Committee Number 4 of the CASA Regulatory Framework Program. Membership of the panel included representatives from industry, the Defence force, Airservices, and CASA. BASI attended as an observer. The panel met three times in July and August 1997.

The purpose of the Airspace Technical Expert Panel was not to reassess all of the safety case, but to conduct hazard analyses on particular issues. The priorities set for the panel were to:

- conduct a hazard analysis for radar Class E airspace;
- conduct a hazard analysis for procedural Class E airspace; and
- conduct a hazard analysis for the removal of directed traffic information from Class G airspace.

The panel was to identify all hazards associated with those issues, consider if the hazards had been appropriately addressed by the safety case, and then assess any additional hazards. The panel was to also consider what modifications, if any, were required to the minimum airspace safety criteria.

The following paragraph was included in the terms of reference for the panel:

> It is understood that CASA and Airservices will work together outside this process to ensure that the final version of the safety case contains the justification of all changes associated with Airspace 2000. This final version will be the only approval mechanism for changes from the existing system to Airspace 2000 and the MASC [minimum airspace safety criteria] will be changed on this basis.

The output of the panel was to be two notices of proposed rule making (NPRM), one for Classes A, B, C, D and E airspace (NPRM 9701RP) and one for Class G airspace (NPRM 9702RP). The target date for completion of those tasks, including amendments to the minimum airspace safety criteria and issue of the two notices of proposed rule making, was 15 August 1997.

In order to categorise hazards, the Airspace Technical Expert Panel used classifications for the frequency of occurrence (frequent, probable, occasional, remote, and improbable) and for the severity of consequences (catastrophic, critical, marginal and negligible). The factors were then combined in a matrix to produce four types of risk—R1 (unacceptable), R2 (must control or mitigate), R3 (acceptable with review by panel), and R4 (acceptable without review). More detail on the rating system, together with a hazard log produced by the panel, is presented in attachment F.

The panel discussed Class G issues at its third meeting. The minutes of the meetings outlined the variety of issues that were discussed for each hazard. Removal of directed traffic information was not rated overall, but in terms of a series of component hazards. The mitigating components for the removal of directed traffic information were stated as being a radar information service (workload permitting), Class E routes, and a segregated route structure (to help separate IFR and VFR aircraft).

The level of risk and suitability of those mitigators was not agreed upon by all of the panel, particularly by the industry representatives. However, any dissenting views were recorded in the minutes of the meetings. Ultimately, CASA formed the opinion that all relevant hazards had been identified, addressed and reviewed.

1.4.8 Notice of proposed rule making

There were 730 responses to NPRM 9702RP 'Airspace Designation and Standards (Airspace Classification G)' received by the due date. The responses were categorised according to their subject content. After reviewing the responses, the Airspace and Global Navigation Satellite System Projects Group produced a draft final rule for Class G airspace.

1.4.9 Draft final rule for Class G airspace

The draft final rule for Class G airspace was produced in September 1997. The draft was reviewed to the level of the Director, but was not considered by the CASA Board. The document was never publicly released as the Board decided to defer Airspace 2000 later in the same month.

The draft final rule incorporated a number of changes arising from the public responses to the notice of proposed rule making, including the linking of Class E airspace to mandatory broadcast zones, so that high-capacity RPT aircraft could operate in a mandatory radio environment. In addition, although the draft final rule noted many respondents considered that the national advisory frequency proposal would fail in practice, because of serious frequency congestion, CASA considered that the proposal should proceed. However, that was on the condition that Airservices had a contingency plan in place that could be implemented quickly in the event of such congestion.

1.4.10 CASA's decision to defer Airspace 2000

On 8 September 1997, the CASA Director sent a facsimile to the Board members to advise that there was a problem with the interpretation of data relating to procedural (non-radar) Class E airspace which had been presented to the Airspace Technical Expert Panel. CASA had requested a comprehensive presentation of the traffic data from Airservices, and produced a significantly different analysis of the data. In particular, CASA's analysis suggested there were many more VFR flights in the airspace than had been advised to the Airspace Technical Expert Panel.

The Director stated he believed that the disparity between the limited data considered by the expert panel, and the more comprehensive data subsequently provided by Airservices, could undermine the entire safety analysis process. His view was based on the fact that the Airspace Technical Expert Panel had been divided on the issue of non-radar Class E airspace and the integrity of the data on traffic levels. Accordingly, he recommended that the proposals for non-radar Class E airspace not be endorsed until a quantitative risk analysis was conducted.

The Director's recommendation was to proceed with the proposals set out in NPRM 9701RP 'Airspace Designation and Standards (Airspace Classification, A, B, C, D and E)', with changes made as a result of public comments. However, the non-radar Class E airspace should not be approved for implementation until Airservices provided CASA with a quantitative risk analysis that took account of traffic mix and density in the airspace. The Board ultimately decided that a decision on the draft final rule on Classes A to E airspace would be deferred until the Board meeting on 25–26 September 1997 when the full airspace package would be considered.

At the Board meeting on 25–26 September, discussions about delaying the introduction of Airspace 2000 related to the need for quantitative risk analysis for non-radar Class E airspace. There were also concerns that the program was being rushed, and that there might be insufficient time for appropriate education before the 4 December 1997 to 6 February 1998 implementation. The Board decided to delay the implementation of Airspace 2000 until 1999, and agreed that CASA would now formulate the program to implement Airspace 2000.

On 25 September 1997, the Director tendered his resignation. Later that day, the Chairman and another Board member also resigned. The Board meeting continued on 26 September, with the Deputy Chairman acting as Chairman.

In a letter to the CEO of Airservices on 30 September 1997, the Acting Director of CASA stated the following:

> The Board decided to continue its consideration of the Airspace 2000 proposal. However, as its safe introduction depends on the completion of the pilot education and training program, and to ensure that TAAATS is introduced in a stable environment, the Board considers it should not be implemented until after the first quarter of 1999 following completion of the TAAATS transition.

He also advised that the Board had agreed that the introduction of radar Class E airspace should be immediately progressed to replace Class G airspace in those areas having higher levels of traffic density. It was noted that this would represent a significant safety enhancement.

In a letter to the Chairman of Airservices on 2 October 1997, the CASA Acting Chairman stated that the CASA Board had 'agreed to continue consideration of the Airspace 2000 proposal'. He also stated:

> However, we decided the proposal would be initially assessed against proven safe international practices and would only be introduced after full qualitative and quantitative evaluation by technical experts, and would be further cross-checked by an independent expert panel.
>
> In addition, the Board will insist that extensive consultation, education and training programs will be undertaken.
>
> The Board regrets that the introduction of Airspace 2000 will have to be delayed for up to 12 months to allow further safety assessment and education to take place.
>
> In making these decisions, the Board wanted to ensure that CASA followed a rigorous technical approach to decision making, with safety as its priority.

1.4.11 Class E airspace trial

The proposed introduction of Class E airspace was to occur between 8,500 ft and 12,500 ft in an area within radar coverage between Canberra and Ballina. CASA considered that the safety justification for the introduction of that airspace had been adequately addressed within the Airspace 2000 safety case and NPRM 9701RP, and that further safety analysis was unnecessary. CASA undertook to make the necessary changes to the standards, as proposed under NPRM 9701RP, to permit the establishment of radar Class E airspace. The airspace was subsequently introduced on 26 February 1998.

1.5 The CASA Airspace 2000 Program

1.5.1 Airways and Airspace Standards Branch*

Following the decision of the CASA Board on 25 September 1997 that the Authority should formulate the program to implement Airspace 2000, the Airways and Airspace Standards Branch was created within CASA in early December 1997. The role of the Branch, as stated in the CASA Annual Report (30 June 1998), was reviewing, developing policy and promulgating standards, procedures and guidance material relating to:

- air traffic management;
- airspace management;

Note:

*Reference to Airways and Airspace Standards Branch staff includes staff employed in the Airspace 2000 Branch subsequent to its establishment.

- rescue and firefighting services;
- air route and airways facilities;
- aviation communication and navigation services;
- aerodrome services; and
- licensing standards for persons engaged in such activities.

Surveillance and regulation activities were the responsibility of the Airways Surveillance Branch.

During the CASA Board meeting on 12 December 1997, the Acting Director informed the Board that the new Branch would assist the Chairman with the direction of the Airspace 2000 project. Those activities commenced in February 1998 with the appointment of a program manager for Airspace 2000 activities. During 1998, seven other professional staff within the branch became involved in various Airspace 2000 activities.

1.5.2 CASA Airspace 2000 program planning workshop

The first significant Airspace 2000 program activity was a planning workshop conducted on 16 and 17 February 1998. The purposes of the workshop were to review the Airspace 2000 design document, 'agree the scope' of the project, and set the framework for the implementation plan. CASA participants were the Chairman, the General Manager Airways and Airspace Standards Branch, the General Manager Aviation Safety Promotion Branch, the Airspace 2000 program manager, and an administrative officer. Other participants were a communications consultant, an air traffic control consultant, and an airline pilot.

The participants agreed on the following objective for the Airspace 2000 project:

> To achieve the implementation of a complete new airspace system following proven safe procedures and standards from leading aviation countries to maximise the safety and efficiency of new technology by 31 December 1999.

Other key outputs from the workshop included a recognition that the program needed to be managed pro-actively, and that the program should be implemented in phases. Following the workshop, the Airways and Airspace Standards Branch commenced work on a number of activities, including a concept plan, a communications strategy and a promotional video on Airspace 2000.

1.5.3 CASA Airspace 2000 program definition plan

A concept plan for the overall project was developed in accordance with CASA's Project Management Manual. The plan was subsequently renamed the *Airspace 2000: Program Definition Plan*, which is presented in attachment G. The final version of the plan was produced on 30 April 1998.

In a section titled 'Corporate Impact' on page 5 of the *Program Definition Plan*, the following was stated:

> This will be a very high profile program which will put CASA's reputation on the line. It is critical to CASA's perception in the aviation industry and in the wider community, both of which are sensitised to these issues as a result of failures in the past.

To address such concerns, a risk management strategy was developed. Key elements were listed as being:

- Careful and comprehensive planning, to ensure that the program proceeds in a structured and coordinated manner, and adheres to project management disciplines; and

- A communications strategy, which includes a strategic issues management process to ensure that CASA maintains the initiative, and does not begin to act in an ad-hoc, reactive, and ultimately self-defeating manner.

The document also stated:

> It may be expected that the program will bring into focus issues related to the division of responsibility between Airservices Australia and CASA.

A program risk assessment was conducted for the Airspace 2000 program. Five main risks to the program were identified:

- opposition to proposed changes by stakeholders (e.g. major airlines, pilot unions, air traffic controllers, flight service officers);
- political opposition to the program at local, state or federal level;
- industry apathy;
- slow, faltering or uncoordinated implementation of changes; and
- rapid, ad-hoc and uncoordinated implementation of changes.

Stated actions which would be used to reduce those risks included:

- development of a communications strategy;
- active engagement of management and unions in the change process;
- a vigorous education campaign; and
- timely planning and adherence to project management discipline.

The 'fall back' position if the opposition from stakeholders could not be reduced was to:

> …proceed with implementation without support of stakeholder groups, so that acceptance and support builds as experience with the new procedures is built-up.

1.5.4 CASA Airspace 2000 program elements

One output of the project planning workshop was an initial list of program elements and a draft implementation schedule. A Class G airspace demonstration, then termed the 'trial of the NAF', was scheduled for August 1998. Four program elements were scheduled for December 1998, including 'Class E and NAF to replace existing RAS from Melbourne to Cairns.' Directed traffic information was to be removed from other Class G airspace and replaced with Class E airspace where necessary in December 1999.

Following discussions between Airservices and CASA about achievable schedules, the 10 program elements and implementation schedule listed in the *Program Definition Plan* were produced. The Class G airspace demonstration was listed as the first program element. The rollout of Class E airspace and the new Class G airspace between Melbourne and Cairns was to now occur in June 1999.

The reason for the phased implementation of program elements was presented on page 2 of the *Program Definition Plan*:

> It is intended that the program elements will proceed as a group of largely separate projects, with different implementation dates and timescales. This is so that the less contentious changes can proceed, and critical dependencies, with the potential for further delay, are not created by the need to confront the more contentious changes. The aim is to avoid putting elements together on the same critical path wherever possible.

1.5.5 CASA Airspace 2000 program management structure

On 5 February 1998, the General Manager Airways and Airspace Standards Branch wrote to the Acting Director regarding the Airspace 2000 program. In terms of project management arrangements, he noted:

> …given the Chairman's intense interest in the project, I propose that the project be oversighted by a Board Management Committee, comprising the Chairman, yourself and other Board members as required.

A key component of the program management structure stated in the *Program Definition Plan* was the Program Control Group (PCG). Initially the group consisted of the Chairman, the Director, selected other CASA Board Members, and an 'Airservices Australia representative'. The group reported to the program sponsor, who was the Chairman.

At that time the *Program Definition Plan* identified the role of the Chairman as follows:

> The Chairman, as overall program sponsor:
>
> - will make key decisions
> - champion the project in the Board and senior management team
> - be available for regular review of progress and objectives
> - will act as "front man" for media and high-level industry consultation
> - attend project team meetings as required
> - may stop the project if necessary.

Based on discussions with Airservices management during a strategic planning meeting on 25 March 1998, the membership of the program control group was changed to comprise the CASA Chairman, the CASA Director, the Chairman of the CASA Board Safety Committee, the Chairman of the Airservices Board Safety Committee, the Airservices Chief Executive Officer, and the Airservices General Manager of Air Traffic Services.

On 17 April 1998, the current version of the *Program Definition Plan* was presented to the CASA Board. The Board noted the plan, but requested that various changes be made to the program management structure. Those changes were to remove the role of program sponsor, to remove the Board members from the program control group, and to have the plan demonstrate more clearly how industry would be involved.

The composition of the program control group was changed in response to the recommendation of the Board, and the role of the Chairman as program sponsor was removed. No changes were made to describe how industry would be more involved, but due to industry concerns an industry involvement plan was developed in early June 1998.

1.5.6 Initial involvement of Airservices Australia

On 24 February 1998, the Chairman of CASA wrote to the Chairman of Airservices, informing him that CASA had commenced working on Airspace 2000, had formed a new team, and was now preparing a plan to proceed. He asked if some Airservices' personnel could be provided to assist with the project.

The Airservices' Chairman replied on 27 February. He noted that the CASA Acting Director had informed Airservices that Airspace 2000 should not be implemented until after the first quarter of 1999, following completion of the TAAATS implementation. He also indicated that the CASA Chairman had informed Airservices in October 1997 that Airspace 2000 would be deferred for at least 12 months. Airservices was now fully committed to achieving TAAATS implementation and other programmed activities, and it would be unwise to redeploy

resources away from those projects. Moreover, he noted that the elements of the Airspace 2000 program would be best dealt with as separate initiatives, and that the TAAATS system should not be used as the justification for any airspace changes. He also felt that the name of the program should be changed from 'Airspace 2000' due to the negative perceptions of many in the industry about that program. The provision of certain staff to assist with the project was agreed upon.

Two Airservices staff started working with CASA staff on various aspects of the proposed program in early March 1998. The main activities were examining the viability of the proposed implementation schedule, development of a promotional video, and tasks associated with the Class G airspace demonstration.

On 25 March, a joint strategic planning meeting was held involving the CASA Acting Director, the CASA General Manager Airways and Airspace Standards Branch, the CASA Airspace 2000 program manager, and senior management from Airservices. The objective of that meeting was to review the current *Program Definition Plan* and obtain agreement on implementation dates, responsibility for tasks, and the program management structure.

During the meeting, it was emphasised by Airservices that there should be no late changes during the program and that deadlines, once agreed upon, had to be adhered to. Airservices were not opposed to the proposed implementation dates, but needed to consider them in more detail in terms of their impact on TAAATS implementation. Further discussions resulted in the schedule outlined in the *Program Definition Plan* (see attachment G). As a result of discussions on scheduling, the following program assumptions were included in that plan:

- Once decisions have been made on policy and procedures, they will be no late, ad hoc changes.
- Once implementation dates have been agreed, they will not be changed or cancelled.
- Once changes have been implemented, they will not be reversed.

In terms of other aspects of the Program Definition Plan, Airservices' management reiterated that TAAATS should not be used as a rationale for the changes. They also stated that care needed to be taken with any discussion on the reallocation of resources as a result of the program. Where directed traffic information was being withdrawn, flight service would be terminated without any reallocation of that funding. Airservices also made the point that the risk model would need to be updated continuously and that this should be part of the issues management process.

1.5.7 Initial involvement of the program control group

The first meeting of the program control group was held on 24 April 1998. The working arrangements, roles and responsibilities of the group were finalised to those contained in the final version of the *Program Definition Plan* (see attachment G).

The proposed Airspace 2000 program and other aspects of the *Program Definition Plan* were also reviewed.

Minutes of the meeting stated that the group would not act as a decision-making body. Decisions, where required, were to be referred to the management of the appropriate organisation.

1.5.8 CASA Airspace 2000 communications strategy

Due to the problems encountered in past attempts to introduce airspace changes, the need to pro-actively manage communication issues was recognised during the initial Airspace 2000 planning workshop in February 1998. Work then commenced on two activities: developing a promotional video on Airspace 2000, and developing a communications strategy.

On 18 February 1998, the Chairman wrote to the Acting Director about the planning workshop, and noted the following:

> It was unanimously agreed by the participants that CASA must urgently proceed with a video which explains the need for change to Airspace 2000 and the links with TAAATS. I support this decision, as the greatest problem with introducing new airspace changes is the fact that the industry simply does not understand the urgent need to use radar—using international procedures wherever possible.

Immediately after that workshop, the Chairman, the General Manager Airways and Airspace Standards Branch, and the Airspace 2000 program manager started developing a video script. The promotional video was completed in April 1998.

On 20 March, a program status report noted a major risk at that time was that the communications strategy was not in place, and CASA was not yet pro-actively managing issues. A communications consultant, who had already been working on the CASA Airspace 2000 program, was formally appointed to develop the communications strategy, which was subsequently finalised on 14 May.

The stated goal of the communications strategy was

> …to support the successful introduction of an improved air traffic management system into Australia. It will achieve this by assuring prudent issues management, partnership with stakeholders and the delivery of effective communications initiatives.

Proposed themes were:

- a focus and bias towards the future;
- integrated system safety (emphasising benchmarking against world-best practice and simplicity of system usage);
- improved access to radar services;
- a strategic approach to implementation to afford industry sufficient time to prepare for the changes; and
- the intention of CASA and Airservices to partner industry throughout the change process.

The strategy outlined the key challenges to the Airspace 2000 program as

> …assuring consistent messages are transmitted to the appropriate stakeholders; and managing issues, before the issues start dictating the project direction.

A key component of the strategy was 'strategic issues management'. That was to be implemented through the formation of an Issues Control Team, comprised of the CASA General Manager Airways and Airspace, the Airservices Manager Airspace and Air Routes, and the Defence Liaison Officer, together with the communications consultant. It was envisaged that the group would meet on a regular basis to review progress with identified issues. The strategy also stated that 'corporate governance will require the Issues Control Team to pass reports and advice about issues management to the Program Control Group', who were then to determine whether to inform the CASA Board of the issues.

Other key components of the communications strategy were an industry education campaign, an external relations strategy, and an internal relations strategy. The external relations strategy included the issues management process, as well as briefings for major airlines, the Minister, and the media. The internal communications strategy consisted of a variety of activities designed to ensure that CASA and Airservices employees understood the rationale and elements of the Airspace 2000 program.

1.5.9 CASA Airspace 2000 initial briefing activities

During the latter half of May 1998, CASA provided briefings on their Airspace 2000 program to personnel from the Department, the Australian Federation of Air Pilots, major airlines, the Australian International Pilots Association, the RAAA and the AATA. The briefings were essentially an overview of parts of the *Program Definition Plan*. It was explained that an extensive amount of industry consultation had already occurred since 1991, and that further consultation would be undertaken but be limited to checking and confirming detailed procedures. It was also indicated that the final outcome of the consultation process was unlikely to result in total, unanimous acceptance of all aspects of the Airspace 2000 program.

The General Manager Airways and Airspace Standards Branch provided a report on the industry briefings to the Acting Director on 26 May. Industry reactions were summarised as follows:

- There is a legacy of mistrust, anger and suspicion about previous attempts to introduce changes.
- Of particular concern is a universal perception Airspace 2000 policy has not been honourably consulted and therefore the process is still subject to challenge. As a direct result industry in general are challenging the validity of outcomes from the process. This is predominantly with respect to 1997, but also in response to more recent events.
- A perception 'deals' have to be made to advance change, rather than allow safety assessment and due process to prevail.
- There is general perception that CASA is being driven by the agenda of recreational airspace users, to the detriment of the interests of the airlines and the travelling public they serve.
- There is a belief CASA's decision-making processes are perhaps tainted by its willingness to accommodate changes to procedures in order to support technical peculiarities of the TAAATS system.
- There is a willingness to cooperate with the process.

It was also reported that, in terms of the first program element (Class G airspace demonstration), industry had questioned the logic in demonstrating the withdrawal of directed traffic information in a high traffic density area. The report noted that achieving sustained cooperation from industry would be a challenge to the program, and that

> …a demonstration of goodwill and a close, productive and transparent working relationship with the airline industry will go a long way in healing previously opened wounds.

It was suggested that the report be promptly communicated to the CASA Board; however, there was no evidence found to indicate that was carried out.

On 26 May, the AATA wrote to CASA to confirm that the association was satisfied with the manner in which CASA proposed to progress a number of elements of their program, stating that further consultation was required on the remaining elements (including the Class G airspace demonstration). The RAAA sent an identical letter on 28 May.

CASA provided the Minister with a briefing on the program on 28 May 1998.

1.6 Planning Of The Class G Airspace Demonstration

1.6.1 Overview

1.6.1.1 Purpose of the demonstration

The Class G demonstration was the first of 10 elements of CASA's implementation plan for the Airspace 2000 program. Initial documentation, including draft copies of CASA's *Airspace 2000: Program Definition Plan*, and correspondence between CASA and Airservices, referred to this program element as the 'trial of NAF Canberra to Ballina (increase radar usage)'. That was consistent with previous statements, including those in the Airservices' *Airspace 2000 Safety Case*, that the primary mitigator for the removal of directed traffic information was the introduction of enhanced radio broadcast procedures, or the national advisory frequency.

However, there was a greater emphasis placed on the extension of radar services from around 26 March 1998 when the Chairman wrote, in a memorandum regarding articles for a newsletter:

> …Say that this [maximising use of radar] follows a recommendation from (put in who) to use radar wherever possible.

That shift in emphasis was highlighted again on 14 April 1998, when the Chairman brought BASI recommendation 970112, relating to maximising the use of currently available radar coverage, to the attention of the General Manager Airways and Airspace Standards Branch. The Chairman stated:

> This is the reason for our August demonstration!

On 19 May 1998, the Chairman wrote to the Minister, noting that

> …there are still extensive areas of airspace in radar coverage below 8,500 ft where aircraft are precluded from receiving a radar service.

The letter also stated that to rectify the problem, directed traffic information would cease in that airspace, and a radar-based service for IFR aircraft would be introduced.

The CASA safety case for the demonstration (see section 1.6.4.5) defined the 'Class G demonstration' as the

> …proposed extension of radar services in Class G airspace and the demonstration of the national advisory frequency as described in Aeronautical Information Publication Supplement (AIP SUPP) 48/98.

It also stated that the demonstration would be used to trial new airspace design features and operating procedures. The AIP SUPP H48/98 (see attachment H) did not provide a purpose for the demonstration, but stated that the demonstration

> …responds to BASI recommendations to maximise the use of available radar coverage for the provision of air traffic services, particularly in areas used by Regular Public Transport aircraft.

In September 1998, the UK Civil Aviation Authority conducted a review of the demonstration. The final report of that review stated:

> The reason for the demonstration is not understood by industry. It is planned as a full introduction of Class G, and yet the final NPRM has not been issued; indeed CASA consideration of the 25 issues raised by industry to the first draft has not been published even though many of the issues raised therein are the same as those being raised today. We draw an implication from this that the demonstration is a trial in all but name, although it has not been published as such. There is no mention of it in the safety case, and it has not been regarded as a necessary part of the assurance strategy. It appears that CASA regard the demonstration as a means of winning industry confidence in the changes to Class G airspace prior to rolling out the full program.

1.6.1.2 Location and timing of the demonstration

In broad terms, the demonstration was to be conducted in the airspace between Canberra and Ballina below 8,500 ft, excluding Class C airspace. That is, it would be mainly located below the Class E airspace introduced on 26 February 1998. The demonstration area and associated flight service sectors are shown in fig. 1.

Melbourne flight service sector 17 and Sydney flight service sectors 3, 4, 5 and 6 were in the demonstration airspace. Table D4 of the Airspace 2000 safety case rated those five sectors as having the highest estimated traffic conflicts per annum compared with other flight service sectors in Australia.

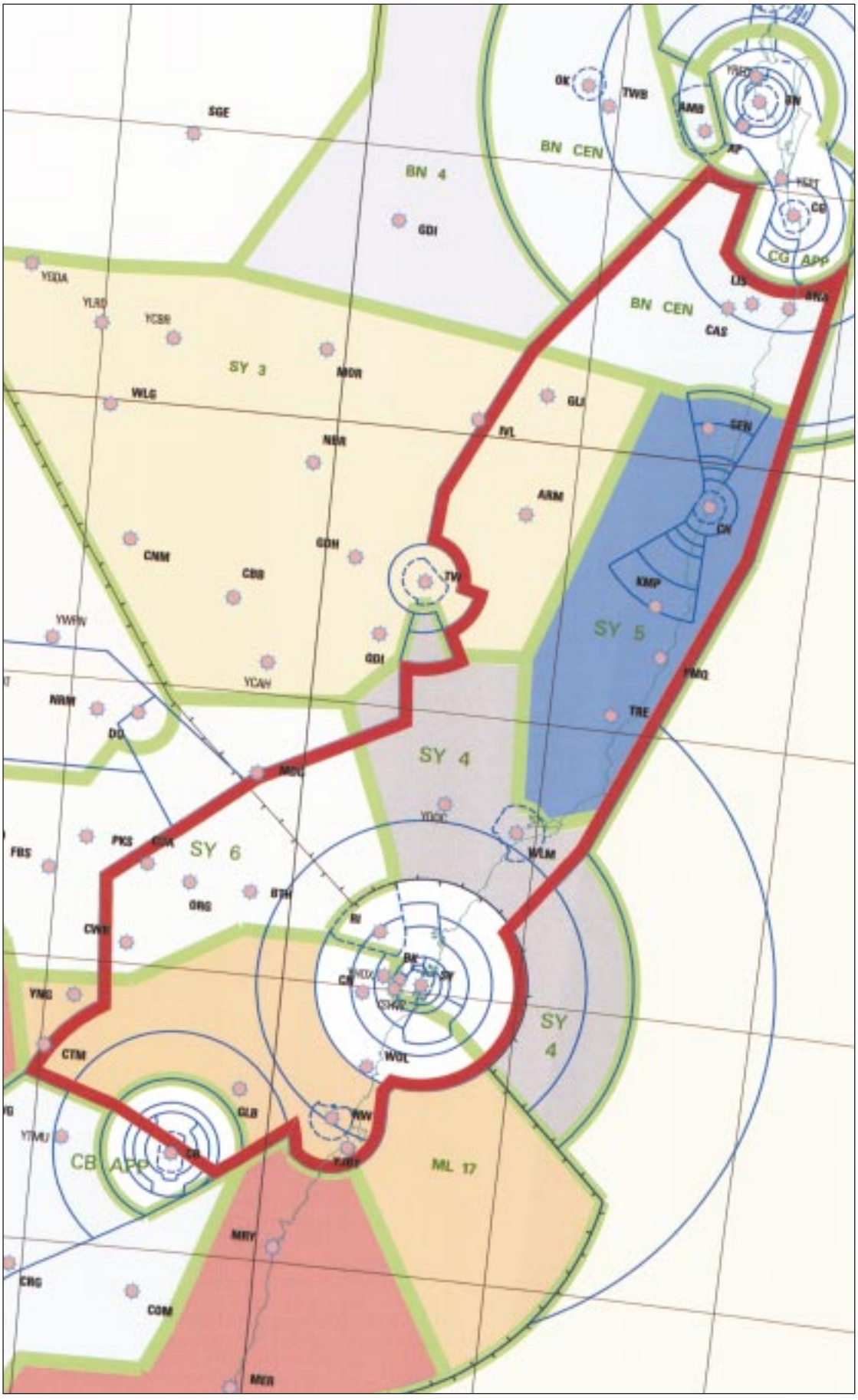
During the investigation, CASA staff were asked why the demonstration was conducted in the Canberra–Ballina region, known to be one of the busiest areas of Class G airspace in Australia. They stated that the location of the demonstration was directed by the Chairman. Several staff members suggested that one reason for the demonstration was to address the BASI recommendation (IR970112) to Airservices on using radar where it was available. It was also stated that the demonstration area was the last area of Class G airspace in which radar coverage was not being utilised, and that the demonstration mainly aligned with the recently introduced area of Class E airspace.

No documented evidence was found during the investigation regarding consideration of increasing the use of radar in this or other areas. Such options could have included the greater use of a radar advisory service, or Class E radar airspace below 8,500 ft. Interviews with CASA staff revealed that no one could recall there being any debate or consideration of such issues during CASA's initial program development. An airspace design consultant to CASA stated that, due to the traffic levels, most of the demonstration area would be designated as Class E airspace, if located in the USA and Canada. The primary distinction between Class E and G airspace is that in Class E airspace, IFR aircraft receive an air traffic control service, and traffic information about VFR flights as far as practical.

The demonstration was planned to start on 8 October 1998, but actually commenced at 0200 Eastern Standard Time on 22 October 1998. An end date was not specified; however, on 8 April 1998, the General Manager Airways and Airspace Standards Branch had written to Airservices, stating that

> …it is our intention that at the conclusion of this demonstration there will be no reversing back to the previous system in which DTI was provided.

FIGURE 1
Flight service sector areas of responsibility within the demonstration airspace



1.6.2 Development of procedures and requirements

1.6.2.1 Initial planning activities

At the CASA Airspace 2000 project planning workshop on 16–17 February 1998, it was agreed that one of the guiding principles would be to use the design document *Airspace 2000: A Plan for the Future Management of Australian Airspace*, dated 1 August 1996, as the baseline.

Meetings were held involving Airservices and CASA on 18–19 March 1998 to produce and develop 'work breakdown structures for the implementation of initial Airspace 2000 objectives'. Action items arising from those meetings included the need to:

- organise a meeting with the Chairman to clarify requirements;
- determine the status of the draft final rule for Class G airspace; and
- review the risk model to determine timelines for risk analysis, and initiate the risk analysis for the proposal to change the standard.

1.6.2.2 Amended draft final rule for Class G airspace

Several iterations of the draft final rule for G airspace were developed by CASA between March and 30 June 1998. Development of the final rule beyond the September 1997 version was a collective effort involving Airways and Airspace Standards Branch staff, the CASA Chairman, and a representative from Airservices.

The draft final rule required that Airservices provide a radar information service on demand. However, the position of Airservices throughout the development of procedures for the demonstration was that a radar information service could only be provided on a workload-permitting basis until the introduction of TAAATS. To avoid placing Airservices in a non-compliance situation, a final rule was not promulgated by CASA. As a consequence, feedback on the 730 industry responses to the Notice of Proposed Rulemaking process of 1997 was never provided to industry. In addition, the minimum airspace safety criteria were never amended to reflect the changed safety requirements in the demonstration airspace. However, as the criteria were only an element of a CASA internal document, it was not essential for them to be modified for a demonstration.

1.6.2.3 Aeronautical information publication supplement 48/98

Initial development of the AIP SUPP H48/98 primarily involved the Chairman and an Airservices representative in March 1998. Further development was an iterative process that also involved Airways and Airspace Standards Branch staff. The basis for the pilot procedures for the AIP SUPP came from the Airspace 2000 design document and the draft final rule. Use was also made of the work previously done by Airservices for the stalled 4 December 1997 to 26 February 1998 introduction of Airspace 2000.

The AIP SUPP was to be finalised by 1 July to allow sufficient time for the development of appropriate training materials. Minor changes were made to the supplement after that date. The 1 July date was specified to also allow time for the document to be processed for distribution on 13 August 1998, in order to comply with the ICAO-recommended notice of procedural changes (56 days). The supplement was issued on 13 August 1998.

The main aspects of the demonstration procedures detailed in AIP SUPP H48/98 were:

- provision of a radar information service where radar coverage existed (on a controller workload permitting basis);

- cessation of directed traffic information;
- implementation of a national advisory frequency;
- revision of pilot position report and broadcast requirements;
- revised flight notification requirements; and
- revised SAR alerting procedures.

1.6.2.4 Other development and planning activities

CASA had already identified that congestion of the national advisory frequency was a potential problem. Towards the end of April 1998, Airways and Airspace Standards Branch staff devised a proposal to determine the potential effectiveness of such a facility. It was intended that a simulation activity be conducted at an aviation training academy at Tamworth, utilising the communications training laboratory. Participants were to be drawn from CASA flying operations inspectors, and academy instructors if available, with industry to be invited once the process reached an appropriate level of maturity. Through that process it was anticipated that CASA could raise the level of industry confidence in a national advisory frequency. However, senior CASA personnel did not regard a pro-active evaluation as necessary. Consequently, the simulation did not proceed beyond initial planning.

A major concern held by industry was with the workload implications of the revised procedures. During the investigation, CASA personnel stated that analyses of pilot tasks for the demonstration were conducted in a limited fashion by the education cadre (section 1.6.3.5) and again when specific scenarios were analysed with the regional airlines. However, there was no comprehensive and systematic analysis of pilot tasks that included an examination of the combined effects of the changes on workload, situational awareness and crew coordination.

The availability of a radar information service during the demonstration was subject to controller workload and radar coverage. Throughout much of the demonstration airspace the existing radar facilities had been installed to provide an en-route radar service at medium and high altitudes. The base of radar coverage varied considerably from one location to another. For example, it was reported that at Armidale, the base of radar coverage was at ground level, while at Tamworth, aircraft could be radar identified down to altitudes of 5,000 ft. However, at Casino and Lismore, radar coverage was only reliable at altitudes above 8,000 ft. Radar coverage was also known by CASA and Airservices staff to be variable from day to day in the demonstration area. Maps showing predicted radar coverage in the demonstration area at 3,000 ft, 5,000 ft and 8,500 ft are presented in attachment I.

No information on the lower limits of radar coverage within the demonstration airspace was published before or during the demonstration. There was no evaluation made of radar coverage or the extent to which a radar information service would be available in the demonstration area, including limitations brought about through radar display configuration.

1.6.2.5 Involvement of Airservices Australia

Airservices was not in a position to provide a full-time team to support the CASA airspace initiatives, but the organisation did offer to assist by providing advice and technical input on the proposals developed by the Airspace 2000 project team. In addition, the Chairman of Airservices made two staff members available for 1 day per week for up to 6 months.

A crucial issue for Airservices was that the procedures for the Class G airspace demonstration be in accordance with those originally intended for the 26 February 1998 replacement of directed traffic information with the national advisory frequency. An internal Airservices

memorandum from the Manager Airspace and Air Routes to the Deputy General Manager Air Traffic Services on 27 May 1998 raised concerns that the latest version of the procedures, planned by CASA for the Class G airspace demonstration, included substantial changes. He stated that these changes fundamentally changed the operational concept. The changes were as follows:

- All flights (IFR and VFR) submitting flight notification and requesting a service would, as a first priority duty, receive an on-going radar information service.
- Those aircraft not flight-planning could request a radar information service on a controller workload-permitting basis.

Whether a radar information service would be provided on a 'workload-permitting' basis or as a 'first priority' duty was one of industry's main concerns.

On 11 June 1998, a report on the viability of implementation dates for the Class G airspace demonstration was sent to the CEO of Airservices by the Manager Airspace and Air Routes. The report indicated that 8 October may be possible, provided CASA could deliver to Airservices agreed procedures based on the original 26 February procedures. Additional provisos were that:

- industry had agreed to the procedures;
- pilot education could be delivered; and
- no changes to procedures would occur between 1 July 1998 and the 8 October implementation.

In addition, Airservices was concerned that CASA's timeline was no longer viable because:

- consultation on procedures had not started in earnest;
- air traffic services procedures were not completed;
- pilot procedures were not completed;
- validation of pilot procedures had not commenced; and
- the safety case for the interface between existing procedures and the new procedures had not been completed.

The concerns held by Airservices, and assurances required, were communicated in a memorandum from the Manager Airspace and Air Routes to the CASA General Manager Airways and Airspace Standards Branch on 12 June 1998 for urgent consideration. In addition to the concerns regarding the provision of a radar information service, the memorandum stated that controllers would not hold SAR alerting responsibility in Class G airspace, and flight following would not be accommodated by air traffic control. Those changes effectively meant that pilots would now be required to actively request a SAR service when entering uncontrolled airspace, whereas under the previous system that request was made automatically by air traffic services and was 'transparent' to the pilots.

The CASA General Manager Airways and Airspace Standards Branch responded that he believed a workload-permitting service may be acceptable to the airlines, but did not express any concern about the reduction in services. The Manager Airspace and Air Routes responded that Airservices required a cast-iron guarantee that industry as a whole, and not just the major airlines, would support the demonstration.

On 1 July 1998, the General Manager Airways and Airspace Standards Branch wrote to the Airservices Manager Airspace and Air Routes and attached the approved AIP SUPP for the demonstration. The memorandum stated that the policy and procedures contained in the

supplement had been finalised, and would not be amended. The draft final rule for Class G airspace was also attached with the caveat that it was not intended to finalise the rule until:

- the demonstration was evaluated;
- the full implementation was completed; and
- Airservices were in a position to supply the mandated service levels; or
- it was necessary for legal reasons to finalise a rule to support the demonstration.

On 1 September 1998, the Airservices CEO wrote to the CASA Director and observed that industry still had concerns regarding the demonstration proceeding. He noted that continued industry opposition might compromise one of the UK NATS' recommendations concerning the Airservices' Airspace 2000 safety case, which stated that it was essential that all affected parties work together to ensure that appropriate education and training was in place as a safety mitigator.

On 2 October 1998, the CEO again wrote to the CASA Director, emphasising that despite the fact that 'final' procedures were provided to Airservices on 1 July 1998, Airservices had been required to accommodate a number of changes since then. The letter stated that issues raised by industry were threatening the planned implementation of the demonstration. Those issues, which had not been part of the originally agreed procedures, were principally the 'transparency of SAR' and the availability of a radar information service. Negotiations for a resolution of the SAR issue that did not require amendments to already promulgated procedures had proved unsuccessful. To circumvent the issue, the CEO stated that he had directed that some concessions on SAR, at least for regular public transport operations, be made. He also stated that while it was not possible to provide 100% assurance of radar information service availability, it would be 'consistently available'.

The issue of radar information service availability was raised on numerous occasions in correspondence between CASA and Airservices, and at industry forums prior to and during the demonstration. Airservices' position on the availability of a radar information service in the demonstration area was resolute: Airservices could not provide such a service on a mandatory basis until after the introduction of TAAATS. Indeed, the Airservices CEO stated, in a letter to the CASA Director on 6 August 1998, in regard to the provision of a radar information service:

> I am not aware of any major State which mandates the provision of radar information services in Class G airspace, and I believe that this would be inconsistent with the general thrust of Airspace 2000; that is, to implement world's best practice.

1.6.2.6 Involvement of the Australian Defence Force

In early April 1998, after becoming aware that Airspace 2000 had been 're-activated', and that a Class G airspace demonstration was being considered, the Australian Defence Force learned unofficially of the establishment of the program control group. The Deputy Chief of Air Force subsequently made representations to CASA to ensure that the military was a group member. Their participation in the planning and implementation of the demonstration also involved membership of the issues control team, the education cadre, and the Class G safety monitoring group. They were also involved as a user of airspace. Defence personnel later reported that they had been concerned that they were often not included in the consultation process by CASA, and that in many cases information relating to significant airspace changes was only obtained informally.

During the planning and implementation phases of the Class G airspace demonstration, Defence force officers, in particular the Deputy Chief of Air Force, expressed concern on a number of occasions, with regard to the following issues:

- the removal of directed traffic information;
- traffic alerting and avoidance for low-level, fast jet operations;
- cockpit workload and aircraft speed adversely 'militating' against self-announcement; and
- a military requirement to conduct 'no communication' procedures for certain operations was inconsistent with radar information service and national advisory frequency communication requirements.

On 2 July 1998, the CASA General Manager Airways and Airspace Standards Branch advised Airservices and the Defence force that from 8 October, the provision of directed traffic information in Class G airspace would cease within the demonstration area. That advice acknowledged the loss of directed traffic information for military low jets had been identified as an issue by the Defence force. Those issues were discussed at a meeting of the issues control team on 6 July 1998.

On 9 July 1998, the Deputy Chief of Air Force wrote to the CASA General Manager Airways and Airspace Standards Branch and requested that CASA convene an extraordinary meeting of the program control group. The purpose of the meeting was to discuss proposals being developed by the military to mitigate against the removal of directed traffic information in the demonstration area. Those proposals included various options for the provision of traffic information to other aircraft on military low jets, and enhanced notice to airmen (NOTAM) information.

The issues control team considered the Defence force proposals on 21 July 1998, and expressed general agreement. The Defence force and Airservices were to finalise the proposed solutions. Subsequent project status reports, program control group meeting minutes and other CASA documentation indicate that the issue of provision of directed traffic information for military low jets was 'resolved'.

Despite that, and despite other actions, the mitigation strategies against the removal of directed traffic information for military low jets were not implemented up to the time that the demonstration was terminated.

1.6.3 Industry involvement

1.6.3.1 Consultation issues

During the investigation, senior CASA personnel commented that although CASA had a notice of proposed rule-making process, it did not have any established processes for determining how or when other consultation activities should take place before or after the issue of an NPRM. They also commented that decisions as to when NPRMs were issued had been inconsistent in the past.

1.6.3.2 Industry involvement plan

The CASA General Manager Airways and Airspace Standards Branch, when interviewed during the investigation, stated that a substantial amount of consultation on the design of Class G airspace had occurred since 1991. Due to that large amount of work, it was a project assumption that consultation had been completed for the Class G airspace demonstration.

During the initial briefing activities regarding the demonstration, CASA advised industry groups that further consultation would be limited to checking and confirming detailed procedures. Based on the industry response to those briefings, and on the CASA Board's decision for the *Program Definition Plan* to show more clearly how industry would be involved, CASA developed an industry involvement plan for the Class G airspace demonstration.

The CASA industry involvement plan comprised the following three elements:

- review of the safety analysis process (by an 'airline industry panel');
- development of the procedures (by a 'procedures cadre'); and
- development and delivery of the required safety education process (by an 'education cadre').

The CASA General Manager Airways and Airspace Standards Branch wrote to the AATA to outline the strategy in early June 1998. In the letter, he noted that CASA was the regulator and safety authority, and that they could not devolve those functions to the industry groups. CASA would make the final decisions based on the outcomes of each stage of the process.

1.6.3.3 Airline industry panel

The first activity of the industry involvement plan was the establishment of a representative airline industry panel to review the safety analysis process. The objective of the panel was to provide assurance to the airlines, as represented by the AATA and the RAAA, that the safety process leading to the proposed Class G airspace demonstration was sound. The composition of the airline industry panel included representatives from the major and regional airlines, and pilot associations. Representatives from Airservices and CASA also participated in the meetings. CASA's intention was for the airline industry panel to:

a. identify areas of potential concern, and

b. review the safety analysis process undertaken by Airservices Australia and CASA for the proposed Class G airspace changes to either:

   (1) report back to the organisations they represented that the safety analysis process was satisfactory, or

   (2) identify specific areas with which they were dissatisfied.

The airline industry panel met on 18 and 25 June 1998. Despite the intended aim of the panel, risk modelling and risk analysis issues were not discussed in detail at either meeting. The panel felt that their experience and knowledge of the subject was such that the safety issues could be raised and discussed from a practical point of view. The final report of the panel on 30 June stated that representatives of four regional airlines participating in the demonstration believed that the proposed Class G airspace demonstration could go ahead, if the following issues were addressed to their satisfaction prior to the commencement of the demonstration:

- pilot workload issues relating to the initiation, continuation and termination of SAR;
- the size of mandatory broadcast zones (extending the vertical limits to the base of Class E airspace), and their establishment at all common traffic advisory frequency zones associated with regular public transport operations;
- the provision of a radar 'traffic snapshot' service automatically on first contact with air traffic control, and prior to the termination of a radar service; and
- a single frequency for both the national advisory frequency and Flightwatch.

The panel also required that outstanding concerns with the safety case be resolved, although it was agreed that could take place before and during the demonstration. The safety case concerns related to a lack of confidence in the process used to develop the notice of proposed rule making, and a failure by CASA to produce an agreed acceptable level of risk.

On 3 July 1998, the RAAA endorsed the outcome of the airline industry panel. On 13 July the AATA also endorsed the outcome of the panel, and advised CASA that they believed the demonstration could proceed, provided the four issues identified by the major participants were addressed. In particular, they emphasised the need to extend the vertical limits of mandatory broadcast zones, and to change those common traffic advisory frequency zones associated with regular public transport services, to mandatory broadcast zones.

On 28 July 1998, the CASA General Manager Airways and Airspace Standards Branch replied to the AATA letter of 13 July. He stated that he was concerned to learn that the airlines wished to make support for the demonstration (element 1 of the Airspace 2000 program) conditional upon changes to mandatory broadcast zones (element 4 of the Airspace 2000 program). In addition, he noted that the extension to 8,500 ft of those zones:

- had not been subject to any safety analysis;
- was not established overseas practice;
- would require consultation with all industry sectors; and
- would require delivery of a safety education program.

The General Manager advised that a process involving those activities could not be accommodated in the timeframe for the Class G airspace demonstration.

With respect to the other issues raised by the AATA, the General Manager stated that 'solutions that go some way to meeting the concerns of the airline industry panel' in relation to SAR and radar 'traffic snapshot' issues had been incorporated in the AIP SUPP H48/98 and other safety education material. The proposal to combine the national advisory and Flightwatch frequencies was not supported for reasons similar to those outlined for mandatory broadcast zones.

In a letter to the CASA Director on 28 July 1998, the RAAA reiterated that regional airline participation in the demonstration was conditional upon:

- all current common traffic advisory frequency aerodromes in the demonstration area, which were serviced by regular public transport, being upgraded to mandatory broadcast zones, and the dimensions of those zones being altered to abut overlying Class E airspace;
- no reduction in the current 'system transparent' SAR service; and
- the serious concerns associated with the proposed national advisory frequency being placed on the agenda to be resolved.

The RAAA also expressed concern that there was no guarantee of obtaining a radar information service within radar coverage.

The CASA Director responded on 3 August, stating that CASA was satisfied with (and had approved the procedures for) the Class G airspace demonstration, and was committed to the demonstration. The Director emphasised that the Airservices position regarding a radar information service and SAR was made clear to the airline industry panel, but that he would raise the issue again with Airservices with a view to obtaining guaranteed services for the airlines. Furthermore, as a consequence of recent discussions with industry, the Director noted that CASA now had a number of concerns. They were:

- the essential need for the introduction of radar services, and the limited window of opportunity to achieve that introduction, had not been recognised by the airlines;
- the receipt of late requests from the airlines to make substantial alterations to airspace design and procedures with alternatives that had not been subject to safety analysis, consultation or inclusion in the safety education program;
- the potential for serious compromise to the safety education program; and
- the identification of the airlines' 'safety issues' on the basis of personal judgement and not objective data and analysis.

The Director added that, as he would prefer to undertake the demonstration with the support of the regional airlines, he was prepared to continue discussions with the regional airlines on any improvements that would not delay or disrupt the demonstration.

The CASA Director also wrote to the CEO of Airservices on 3 August 1998 and raised the two RAAA concerns related to the level of service provided by Airservices (RIS and SAR). The Director requested that Airservices give consideration to providing airline aircraft a radar information service at all times they were in radar coverage, and had requested that service. The CEO replied that Airservices had consistently stated a radar information service could only be supported on a workload permitting basis until after TAAATS had been commissioned, and that he was unaware of any major State which mandated the provision of radar information services in Class G airspace.

A meeting between CASA and industry was held on 10 August 1998 to discuss the industry's concerns with the Class G demonstration rules. Industry perceived the main purpose of the meeting as attracting the CASA Director's attention to the serious concerns the airline industry had with regard to the proposed changes in airspace design and procedures. While there is a record of the comments and concerns raised by individuals at the meeting, there is no record of any position or comment, including any proposed 'way ahead', by CASA. The industry concerns focused on wanting an undertaking from CASA that:

- consultation would occur;
- industry inputs would be accepted; and
- the safety case would consider pilot workload and other issues raised in their correspondence of 28 July 1998.

Representatives of both industry associations met with Airways and Airspace Standards Branch staff on 12 August 1998 to finalise a list of industry concerns and suggested solutions relating to:

- the operation of airline aircraft in a non-mandatory radio environment;
- crew workload considerations;
- the finalisation of outstanding safety case issues;
- the provision and updating of SAR protection;
- the operation of aircraft in the same airspace on different radio frequencies, and under different flight rules; and
- the loss of directed traffic information;

Two other initiatives that arose from the meeting were:

- a decision by CASA to introduce mandatory transponder areas above designated common traffic advisory frequency zones and mandatory broadcast zones, within the demonstration

area, and to extend the dimensions of a number of common traffic advisory frequency zones used by high-performance regular public transport aircraft within the demonstration area, to a radius of 15 NM and a height of 5,000 ft; and

- a decision by CASA to arrange for a team from the UK Civil Aviation Authority (CAA) to provide an opinion on whether there was a reasonable basis for CASA to decide to proceed with the Class G airspace demonstration.

On 31 August 1998, the CASA Director wrote to the AATA and advised that the UK CAA would be conducting a review of the proposed demonstration. If the UK CAA did not identify any objection to the demonstration proceeding, he expected the public support of the AATA for the demonstration.

The RAAA wrote to the CASA Director on 18 September 1998 and stated that there were still some issues that needed to be resolved prior to the commencement of the demonstration on 8 October. Those concerns included:

- a requirement for the safety case to be updated to take account of considerations believed to be necessary by the AATA safety case consultant;
- the lack of a radar information service on demand for all flight-notified IFR aircraft; and
- a lack of adequate time for training for the previously published and recently amended procedures.

On 29 September, the CASA Director responded to the RAAA letter of 18 September and advised that the safety case consultant's issues would be considered and addressed prior to the full rollout of the airspace to other areas.

A meeting was held between the CASA Director and the AATA/RAAA on 6 and 7 October. A letter from the Director to those associations on 14 October indicated that the outstanding issues had been resolved at that meeting to 'allow us to move forward together in introducing this significant change'. The outcomes of the meeting as summarised in the Director's letter included:

- the increase of common traffic advisory frequency zone dimensions and the establishment of mandatory transponder areas;
- a radar information service would be 'consistently available';
- SAR services would be seamless to regular public transport aircraft operating in the demonstration airspace;
- Airservices would explore the possibility of introducing Class E airspace immediately above the relevant common traffic advisory frequency zones and mandatory broadcast zones at some time in the future, possibly in the new year;
- the commencement of the demonstration would be deferred by 14 days to 22 October 1998 to allow time for the airlines to clarify their operational procedures and conduct the necessary training; and
- during the period of the deferment, an implementation group would meet to clarify procedures and discuss the means and objectives of monitoring the demonstration.

On 12 October 1998, the AATA wrote to the CASA Director and reiterated that further work needed to be done on the safety case prior to the commencement of the demonstration. A meeting between CASA and airline representatives to review specific safety issues was conducted on 19 and 20 October 1998.

1.6.3.4 Procedures cadre

The second stage of the industry involvement plan was for a 'cadre' comprising operational staff drawn from CASA, Airservices, the Defence force, and the regional airlines, to review and finalise the operational procedures. The objectives of the procedures cadre were to:

- identify and propose solutions to any practical operational problems related to the implementation of the revised rules and procedures for Class G airspace; and
- develop a sufficient level of understanding of the proposed rules and procedures so that the cadre could proceed with the development of industry training material.

In conducting its task, the procedures cadre was to consider the draft final rule for Class G airspace and the draft AIP SUPP H48/98.

However, the dedicated 'procedures cadre' was not established, and there was no alternative system employed to perform the intended functions of that group. Airways and Airspace Standards Branch staff later commented that the intended activities for the group may have been accepted in part by the airline industry panel, which was supposed to review the safety analysis process. That panel, however, only met twice in June 1998.

1.6.3.5 Education cadre

The third stage of the industry involvement plan was for an education 'cadre' to develop and deliver the necessary safety education programs to ensure the safe implementation of the revised rules and procedures for Class G airspace. The cadre was facilitated by a communications consultant and consisted of the same members as were intended for the procedures cadre. The education cadre is discussed later in the report.

1.6.3.6 Involvement of other sectors of the aviation industry

Other than the airlines and the Defence force, other sectors of the aviation industry had minor involvement in the development and implementation of the Class G airspace demonstration.

On 22 September 1998, the Aircraft Owners and Pilots Association (AOPA) wrote to the CASA Director and expressed support for the demonstration. It also agreed with the introduction of mandatory transponder areas for the period of the demonstration, but indicated that this should be subject to review at the end of the demonstration. AOPA also stated that operational specifications for any airspace, and consequent CASA rule-making, should be based on the premise that 'all Australians should enjoy the freedom to fly responsibly'. Any additional requirements should be introduced only after a full safety and cost-benefit analysis.

On 28 September, the General Aviation Association (representing commercial general aviation operators) wrote to the CASA Director and expressed a number of concerns, mainly regarding the uncertainty of provision of traffic information for IFR aircraft. The Association recommended that the proposed demonstration

> …should not go ahead until all safety issues have been resolved and formally advise of our opposition on the grounds of safety.

1.6.4 CASA's safety analysis activities

1.6.4.1 Relevant requirements

The only safety analysis requirements that pertained to CASA's own activities were contained in appendix C of CASA's *Project Management Manual*. The appendix was titled 'Project management and safety' and focused on a safety case approach, based on the guidelines

contained in the document *Systematic Safety Management in the Air Traffic Services* described earlier in this report. The introduction of the appendix stated, in part:

> CASA's project management procedures must ensure that the safety implications and safety hazards undertaken by CASA are properly assessed. CASA also has the responsibility for ensuring that Airservices Australia has a system for assessing safety implications and hazards in both the provision of services and undertaking changes in the way the services are delivered.
>
> The Appendix sets out the safety case approach, used in the UK, as an example of a proven method for managing the safety aspects of a project within the project management procedures.
>
> The objectives of this Appendix are:
>
> - To introduce a formal safety assessment process, based on a Safety Case approach
> - To use the Safety Case approach as a management tool for providing:
>   - Systematic identification and assessment of safety requirements and potential risks/hazards
>   - Assurance that safety requirements have been met and potential risks have been mitigated, controlled or shortcomings accepted
>   - Identification of the managerial responsibilities for particular safety requirements
>   - Independent audit of the safety assessment and risk control measures.
>
> The Safety Case is progressively developed during the life of the project. Each part of the Safety Case…builds on the earlier parts and may involve some repetition.

The appendix then described the contents and requirements for each of the four parts of a safety case, in line with the guidelines previously listed (see attachment C). In terms of general requirements, the appendix noted that each part of a safety case required a distribution list, an authority list (or list of officers responsible for the particular part of the safety case), and an amendment list.

1.6.4.2 Relevant guidelines

In addition to the relevant safety analysis guidelines previously mentioned, CASA published the advisory circular *CASA/AA MOU. Airways – 1(0) Guidelines for the preparation of safety cases covering airways systems* in February 1998. The document was advisory and had to be read in conjunction with the *Final Draft Regulatory Arrangements and Standards* document. The circular was developed by the Airways and Airspace Standards Branch within CASA and was intended for providers of air traffic services, not for CASA projects.

On page 4 of the document, the following was stated:

> CASA requires a System Safety Case, or another equivalent safety assessment process acceptable to the Authority, to be prepared by airways service providers for:
>
> - All new airways systems having operational safety implications; and
> - Any major modifications or upgrades to existing airways systems.
>
> Existing airways systems which have an accepted history of safe operation over more than two years do not need to be covered by a Safety Case unless specifically required by CASA.

The circular outlined CASA's requirements for the purpose and scope of the safety case, safety requirements, hazard identification, risk assessment and risk control. A variety of hazard identification and risk assessment techniques were listed as being acceptable, including the four methods listed in the *Final Draft Regulatory Arrangements and Standards* document, as well as the use of Australian Standard 3931.

Page 10 of the document stated:

> As previously discussed, Safety Cases should be developed in separate parts to define the safety situation of the system over the discrete stages of its lifecycle. A four part Safety Case has been adopted by some airways service providers to define the safety situation at the Operational Requirements stage, at the completion of the Design and Procurement phase, at Installation and Pre-Commissioning, and for the Operational phase.
>
> The contents of the Safety Case will differ for each part. For some systems, it may be appropriate to have more or fewer parts of the Safety Case. For all parts, the level of description and detail included should be sufficient to provide a reasonably informed reader with an understanding of the safety situation, without the need to refer extensively to supporting references.

More detailed guidance as to the contents of each of the four parts of a safety case was also provided, based on the guidelines in the document, *Systematic Safety Management in the Air Traffic Services*.

1.6.4.3 CASA's initial safety analysis activities

The *Program Definition Plan* contained a section titled 'Safety Risks', which was not modified after 7 April 1998. The following discussion of safety analysis was included in the section:

> A good deal of this work has been done already–it is not intended to 're-invent the wheel' where information is already available.
>
> The intention is to proceed, without further analysis, with those elements which:
>
> - have already been fully investigated through the safety case process and accepted by CASA; or
> - are clearly an increase over present safety levels; or
> - are a straightforward adoption of proven, safe overseas practices; or
> - in the judgement of CASA, do not require further work to be undertaken; or
> - may require further work, but are judged sufficiently safe that a trial can proceed while more data is gathered.

On 19 March 1998, a meeting was held between CASA and Airservices staff who were working on the Airspace 2000 program. At that meeting, safety analysis issues were discussed. One action item was to review the 'risk model' and determine timelines for risk analysis.

On 25 March 1998, two CASA staff provided the CASA Airspace 2000 program manager with a document proposing various risk analysis tasks that they believed were required for the program. The document indicated that the airspace risk model should be applied to several proposed airspace options to calculate their levels of risk. For Class G airspace, it was stated that the uncontrolled terminal area model needed to be extended to the approach (immediately above the terminal area) and en-route environments. It was proposed to complete that task by the end of May 1998. During the investigation, a review of documentation and interviews with CASA staff revealed that no such work was undertaken. There were differing opinions within the Branch as to whether staff were actually tasked to conduct that work.

A project Gantt chart for the demonstration project, dated 8 April 1998, noted that the safety case work was complete. Subsequent Gantt charts indicated that a decision had not yet been made on whether further safety analysis activities were required. On 17 April, a briefing package was finalised for the participants of the first program control group meeting, which was held on 24 April. The package contained a section titled 'Safety Analysis', which listed five priorities for safety analysis. The first priority was the development of a safety case for the trial

of Class E airspace, without mandatory transponders. The second priority was associated with the Class G airspace demonstration, and the following sub-tasks were listed:

- assess the effects of partial implementation of NAF (for example, flight across boundaries of demonstration area into G airspace with full flight service and DTI); and
- confirm no additional safety analysis work required that would cause delay in the implementation date.

At some point during April/May 1998, CASA asked an Airservices risk engineering expert for advice on the need for further safety analysis. That expert had not been involved in the Airspace 2000 safety case. He advised that no further work appeared to be required in terms of collecting traffic data, and modelling the level of risk involved. When interviewed during the investigation, the expert noted that although the design phase of the Airspace 2000 safety case had been completed at that stage, there were still safety issues which needed to be resolved in the implementation phase.

In briefings provided by CASA to industry groups in late May 1998, CASA stated that consultation and safety analysis work for the Class G airspace demonstration had been essentially completed. Due to concerns expressed by industry, safety analysis issues were discussed further during meetings of an airline industry panel in June 1998.

1.6.4.4 The UK Civil Aviation Authority review

In August 1998 the CASA Director arranged for a review team from the UK CAA to conduct a review of the proposed Class G airspace demonstration. The review, conducted from 7–11 September 1998 involved reading relevant documentation, a series of meetings with involved parties, and flights with regional airlines within Class G airspace. The final report was produced later in September.

The purpose of the review was stated at the beginning of the final report as follows:

> The UK CAA was contracted by the Civil Aviation Safety Authority of Australia (CASA) to provide an opinion on whether there is a reasonable basis to proceed with the demonstration Class G airspace having regard for the concerns and issues raised by the AATA, relating these back to the Safety Case Issue 5 (June 1997), and following discussions with Australian Aviation Industry.

Section 3.1 of the report stated the following:

> The demonstration Class G airspace is an evolution of the Australian Class G design towards the ICAO Class G, enhanced by the application of radar. The issues raised by Industry in our meetings regarding the demonstration can be traced back through the available documentation to Issue 5 [5 June] of the [Airservices Australia] Safety Case. The issues have been debated in a series of joint CASA/Industry ASA [Airservices] working groups and Industry working groups for a considerable time, without resolution. In effect these are safety concerns, and have led the Industry to unite their opposition to the introduction to the demonstration.

In terms of the Airspace 2000 safety case, the review team noted that it had not been kept up to date with the changes and safety analysis activities that had occurred since the final version of the Airservices' safety case. On page 7, the report stated:

> Given the outstanding issues it cannot be concluded that the Safety Case is complete. We believe, therefore, that the safety case activity has been over-represented in the Draft Final NPRM [*sic*] [Rule] where it is implied that 'due process' for safety has been completed.
>
> We also considered that some of these issues related to residual risks that would have to be controlled/constrained in order for the demonstration to go ahead as they could be potential contributory factors in loss of control incidents. In our opinion the planned system performance monitoring during the demonstration would not provide an adequate strategy for risk containment.

Notwithstanding the above we are reasonably assured that the main hazards have been identified by the process followed because:

- The change being planned is an evolution of the existing Class G airspace design as understood by CASA and the Industry. It is not a new global concept or a novel way of operating.
- Those consulted had first hand knowledge and experience of the operational aspects of the existing system upon which they were able to draw in assessing the proposed changes – as was clearly illustrated during the presentations and associated discussions.
- The set of issues causing concern have been consistent throughout.

However, in our opinion the concerns of Industry were never going to be fully resolved for want of information that could be best obtained by evaluation in a representative operational environment. Industry were not thinking in terms of giving up current methods of operation, but rather building the new Class G operation on top.

The use of system modelling as recommended by [the AATA safety case consultant] might have improved the effectiveness and understanding of the design and assessment but, in our opinion, the final outcome with regard to Industry concerns would not have been much different for the reasons given. However, the Safety Case would benefit from scenario descriptions to illustrate the feasibility of operations in Class G with regard [to] the use of frequencies, workload aspects etc.

The UK CAA report made a number of other observations, including the following:

- CASA effectively assumed responsibility for the safety case during the period after the CASA Board decided to suspend the implementation of Airspace 2000 in September 1997.
- If the current use of radio procedures were to be extended to the demonstration airspace, crew workload would become a significant problem on some occasions.
- Regular public transport operators were unwilling to gain situational awareness by only listening on the national advisory frequency. Their insistence on also arranging self-separation regardless of flight conditions or flight rules would result in frequency congestion and workload.
- The procedures included in AIP SUPP H48/98 did not encourage the use of a radar information service, an important element of the risk containment strategy associated with the demonstration. In addition, the procedures made listening on the national advisory frequency for VFR pilots optional.
- There was a clear lack of mutual trust between CASA and industry, which manifested itself in many ways and affected the ability to resolve issues.

As a conclusion, section 4.2 of the report stated the following:

With the foregoing in mind, in our opinion, the demonstration of G Class airspace could go ahead given that:

- RIS is available down to the top of MBZs

For consistency, this would imply that CTAF's within the demonstration airspace be extended vertically to meet RIS availability, and horizontally to accommodate practical descent profiles.

- There is close and active monitoring of:
  - NAF loading
  - Provision of RIS vs. demand
  - Pilot workload

until sufficient experience has been accumulated to provide assurance that [the airlines' concerns] have been addressed.

- SARTIME is updated by ATC providing RIS and can be cancelled on the ground. Exception – IFR in G not receiving a RIS.

In the rationale for this opinion, the following was stated:

> This approach would constitute an evaluation and validation of the main issues of concern under controlled conditions minimising the risks to aircraft operations. It would provide that part of the assurance which we believe is necessary to complete the safety case in respect to the demonstration Class G, and prior to any roll out beyond the demonstration airspace.

The UK team also noted that, if the recommended changes were made, the resulting package would provide a better service to IFR aircraft in Class G airspace than that which was generally available in the UK.

1.6.4.5 CASA safety case on the Class G airspace demonstration

As a result of the UK CAA report, the Airways and Airspace Standards Branch of CASA prepared a safety case for the Class G airspace demonstration. The safety case was finalised on 7 October 1998, the day before the demonstration was intended to commence. A revised version was issued on 21 October, the day before the demonstration actually commenced. The safety case for the demonstration was the first CASA had prepared.

During the investigation, CASA senior management noted that the safety case approach had only been developed relatively recently, and that organisations take time to acquire and develop their skills in that area. Many previous changes to the aviation system had been introduced in the past using methods such as expert opinion and professional judgement.

Section 1 of the safety case provided general background information. The objectives of the 21 October version were stated as:

a) The objectives of this safety case are to:

- detail the airspace architecture and procedures associated with the current airspace system;
- identify the changes associated with the Class G demonstration architecture and procedures, and detail the way in which the new airspace system will operate;
- describe the process through which potential safety issues and hazards were identified and the risks associated with those hazards were assessed;
- provide reference to the mitigators for identified issues and hazards; and
- describe safety monitoring arrangements which are to be established in order to monitor residual risks.

The following element, which had been included in the 7 October version, was deleted:

b) In meeting these objectives, the safety case will provide assurance that the proposed changes will not significantly increase risk, provided the identified mitigating actions and safety requirements are put in place.

Section 2 of the 21 October version of the safety case provided a description of the current airspace system, based on a similar section in the Airservices' safety case. Section 3 provided a description of the Class G demonstration, outlining the rationale for the demonstration, changes to be introduced, services to be provided, and general summaries of issues (such as transponder requirements, the operation of RIS, and the pilot education program).

Section 4 of the safety case was titled 'The Safety Analysis Process'. Subsection 1 contained the following paragraphs:

a) The purpose of this section is to describe the total process of analysis, discussion and evaluation which has taken place over the past several years which, when considered in their totality, give CASA sufficient confidence that the demonstration can proceed.

d) It is not the requirement for this or any other Safety Case to 'prove the system is safe'. Rather, it is required to identify safety concerns and in each case either eliminate the risk, mitigate the risk, determine strategies for monitoring the residual risk, or indeed make the decision to live with the risk—not an unfamiliar situation, either in aviation or any other field of human endeavour.

It was also noted that:

…the safety analysis process in this case is unique due to the length of time taken, the number of different approaches employed and the sheer volume of material produced.

Subsection 2 stated the following:

a) At the time of commencement of the demonstration, three residual risks remain. These are:

   i) The possibility of unacceptable congestion on the NAF;

   ii) The availability of RIS; and

   iii) The possibility that pilot workload will be unacceptable, due to:

      a) Frequency management difficulties, particularly for pressurised, high performance RPT aircraft on descent into CTAFs and MBZs; and

      b) SAR management requirements.

b) These residual risks were identified by the UK CAA team, which further concluded that these risks could not be analysed or eliminated prior to the commencement of the demonstration, and could only be properly evaluated by close monitoring during the demonstration. This advice was accepted by CASA.

c) CASA's position on each of these residual risks is given below, with paragraph numbers corresponding to those under which the risks are identified in paragraph a) above:

   i) Congestion on the NAF will be monitored during the demonstration;

   ii) AsA [Airservices] have given assurances, to CASA's satisfaction, that the availability of RIS will be high, particularly to RPT [regular public transport] aircraft on descent from or on climb into controlled airspace. Nevertheless, CASA also intends to monitor this closely during the demonstration.

   iii) With regard to pilot workload:

      a) CASA believes that the frequency management problem for pressurised, high performance RPT aircraft on descent into CTAFs and MBZs have been largely reduced, and possibly eliminated, by the promulgation of mandatory transponder areas above the CTAFs and MBZs into which these type of aircraft operate, and by mandating the monitoring of the NAF for all aircraft in the mandatory transponder area which are not in the receipt of a RIS.

      b) AsA has improved SAR management arrangements for regional airlines to ensure that pilot workload levels are not unduly increased.

Section 5 of the safety case was titled 'Safety Monitoring'. This issue is discussed later in the report.

The CASA safety case for the demonstration was not reviewed by any other agency, or any other section within CASA.

1.6.4.6 Scenario analysis activities

On 19 and 20 October 1998, a team of airline representatives, their safety case consultant, and CASA staff analysed a series of scenarios presented by the regional airlines. A result of those discussions was a series of slides with dot point listings of the hazard conditions, failure modes and mitigators for each scenario. The overall outcome of the meetings was not documented.

The General Manager Airways and Airspace Standards Branch stated during the investigation that the airline representatives had been satisfied with the results of the meetings, as evidenced by the fact that the airlines allowed the demonstration to proceed. He noted that the airlines had previously stated that they would not proceed if their concerns regarding the safety case were not satisfied.

Industry representatives reported that they were prepared to start the demonstration as long as all the mitigators which had been specified were implemented. However, if the workload became unacceptable, or the mitigators became ineffective or were not in place, then the demonstration should be terminated. The airlines did not consider that those conditions were met, as evidenced by various problems that arose after the demonstration commenced. Industry representatives also stated that they did not think that the CASA safety case process was properly conducted or completed.

1.6.4.7 Risk-modelling issues

In mid-July 1998, the CASA Chairman made the following comment as part of his review of the AIP SUPP H48/98 document:

> …it must be emphasised that the safety of the system, as shown in the safety analysis work which determines the extremely low risk levels (e.g. a mid air collision once every 190,000 years on really busy routes) is based on probability: the 'big sky theory.' It is not based on pilots making lots of broadcasts on the NAF, especially when receiving a RIS, which in most cases will be [sic] higher level of service, providing higher level of safety. This will only increase pilot workload and frequency congestion and will make no difference to the already low risk levels in this [Class G] airspace.

The CASA Chairman later expressed his opinion to BASI investigators that risk-analysis activities should have a quantifiable basis rather than be based on qualitative judgements. He emphasised the fact that the risk in uncontrolled terminal areas was much higher than the risk in the en-route phase of flight; however, he noted that the airlines were more concerned with the risk in the en-route phase of flight. The Chairman based his observations on the comparisons between the results of the model developed for the Airspace 2000 design team and the results produced by the airspace risk model for terminal areas.

In late July 1998, the CASA Chairman arranged for some risk modelling work to be conducted by the consultant who had developed the en-route collision risk simulation model for the original Airspace 2000 design team in 1996 (see attachment B). The consultant was asked by CASA to use that model to determine the risk of collision for a specific scenario, involving an IFR aircraft descending from Class E airspace into an uncontrolled terminal area (nominally Port Macquarie), with five VFR aircraft travelling in the same direction within a 16-hour period. The scenario also involved removing the influence of radio communications and see-and-avoid procedures. The resulting risk of collision was calculated to be approximately once every 300,000 years.

The CASA Chairman also asked CASA personnel to calculate the risk of collision at a typical uncontrolled aerodrome (nominally Port Macquarie), using a different model (the airspace risk model). The same type of scenario was used, with the assumption that the radio had failed

in the IFR aircraft and only unalerted see-and-avoid procedures were being used. The resulting risk of collision was calculated to be approximately once every 1,674 years.

The results of that work were reported in an article in the September/October 1998 issue of CASA's corporate newsletter *Aiming Higher*. It was stated that the terminal area risk for the scenario was 180 times greater than the en-route risk. Based on those results, the article concluded that as the en-route collision risks in Class G airspace were so low, it was not surprising the USA and the UK did not have a national advisory frequency in such airspace.

CASA staff subsequently indicated to BASI investigators that the two models were completely different, and that therefore no valid comparisons could be made. They also noted various other concerns with the en-route simulation model. In addition, they noted that other risk-modelling results showed a much lower difference between en-route and terminal area operations (see attachment D).

During the CASA Board meeting on 27 November 1998, a person who was involved in the development of the airspace risk model as an industry representative provided the Board with a presentation on the airspace risk model and safety analysis issues. The Board made the following resolutions:

- Airspace 2000 safety assessment will use quantifiable risk analysis based on the probability of collision, and standards will be set on that basis. For example, the minimum safety standard for airspace should be based on the presently accepted risk of collision per flight hour, derived from the work done on the Airspace Risk Model of 1.3×10^{-6} (this means 1.3 occurrences per million) for 10–38 passenger aircraft in Common Traffic Advisory Frequency (CTAF) areas and 1.3×10^{-7} (1.3 in 10 million) for greater than 38 passenger aircraft in Mandatory Broadcast Zones (MBZs).
- When an allocated ICAO airspace classification does not provide the level of collision protection required by CASA or the user, the additional protection will be provided by moving to a higher classification of ICAO airspace and not by modifying the existing airspace in a non-ICAO compliant way.

Annexure 1 to the Board minutes provided a one-page outline of the airspace risk model. The figures quoted in the resolution (and annexure) were based on recent calculations for a terminal area model using traffic data for the Dubbo terminal area. The results found that, for an IFR(M) aircraft, the risk was 1.3×10^{-6} per flight hour for a CTAF zone and 1.3×10^{-7} for an MBZ.

CASA staff who had been involved with the development of the airspace risk model were to later report that those calculations were only preliminary in nature, as model development had not been completed, and the results had not been appropriately reviewed by an industry panel. The CASA staff stated that using such a one-off model was not an appropriate means of determining acceptable risk criteria.

1.6.4.8 Views of CASA staff

CASA staff have indicated to BASI investigators that although they had not produced a safety case on the Class G airspace demonstration up until October 1998, they felt that a safety analysis process existed. That process included Airservices' safety case and other activities which occurred in 1997, as well as the industry consultation conducted in 1998. Several staff indicated that the safety analysis process was not well structured, and that CASA had little previous experience in preparing safety cases. Both CASA and Airservices staff commented that, had Airservices conducted the demonstration, CASA would have required of Airservices a more comprehensively documented assurance of the safety aspects of the demonstration than that produced by CASA.

The General Manager Airways and Airspace Standards Branch stated that a substantial amount of safety analysis work had already been conducted on the Class G airspace component of Airspace 2000 prior to 1998. CASA was simply implementing a project that had been approved by the CASA Board, and therefore no further safety analysis was required for the Class G demonstration. Other Branch employees stated their belief that further safety analysis work was required.

Airways and Airspace Standards Branch staff stated that they had difficulty communicating with industry representatives on safety analysis issues, noting that the airline representatives generally preferred to talk about specific, low-probability scenarios, rather than assessments of overall risk. Many of those scenarios dealt with pilots not being able to communicate with other pilots by radio, with little consideration of the likelihood of another aircraft being present in the same area. The airline industry panel meetings were cited as examples of those communication problems. As a result, CASA personnel said it was difficult to integrate industry input into the safety analysis process.

1.6.5 Airservices' safety cases for the Class G airspace demonstration

1.6.5.1 Requirements and guidelines

In implementing changes to airspace management, Airservices was required to adhere to CASA requirements relating to change management as outlined in the *Final Draft Regulatory Arrangements and Standards* document. Airservices developed its own requirements for safety cases, which were promulgated in its *Safety Management Manual* in December 1997. The requirements were consistent with those later produced by CASA in its advisory circular on safety cases.

1.6.5.2 Safety case methodology

Airservices conducted analyses of the risks associated with the Class G airspace demonstration that related to the provision of air traffic services. Safety cases were developed independently by each of the three Airservices operational districts affected by the new procedures—Southern, Northern, and Sydney. In each district, a team made up of senior staff familiar with operations in their region developed the safety case.

Each team developed a hazard log that identified and described all possible safety hazards to air traffic management as a result of the proposed changes. During the preparation of the hazard log, attention was given to various operational scenarios such as aircraft operating entirely within the demonstration area, aircraft entering or leaving from Class C or Class E airspace, and aircraft transiting from non-demonstration Class G airspace.

Once a hazard had been identified, it was assessed in terms of likelihood and severity using the UK NATS classification system. The hazard was then categorised according to one of four classes of system risk as a result of the combination of likelihood and severity:

- Level A: risk unacceptable, action required to treat the risk.
- Level B: risk undesirable, but may be accepted in exceptional circumstances with the approval of the General Manager Air Traffic Services. Contingency plans must be developed.
- Level C: risk may be accepted with endorsement of the local Operating Authority. Contingency plans and procedures must be developed.
- Level D: risk acceptable.

After the hazards were classified, various safety requirements and mitigations were identified to reduce the level of risk. The hazards were then reclassified.

The safety cases were reviewed and updated after significant changes to the demonstration procedures.

1.6.5.3 Safety requirements and mitigators

The main safety requirements and mitigators listed in the three safety cases were:

- workload monitoring and control;
- pilot education;
- controller education;
- frequency splitting in one sector to allow separate access by the controller and a coordinator (Southern District);
- implementation of a stand-alone console for the provision of a radar information service during busy periods (Sydney); and
- effective change management (Sydney).

Each of the safety cases emphasised the importance of monitoring controller workload during the demonstration and also noted that comprehensive and in-depth education programs for both pilots and controllers were crucial to the success of the demonstration.

1.6.5.4 Residual risks

Risks categorised as Level B after the application of mitigating factors and safety requirements must be formally approved by the General Manager Air Traffic Services. The hazards which remained at level B were:

Southern District

- increased vigilance and monitoring of additional airspace required by the controller;
- a lack of taxi or departure advice from flight service for aircraft entering Class C or E airspace from the demonstration Class G airspace;
- added complexity of the new airspace structure incorporated into current sector designs; and
- a reduced ability to plan traffic and control access to the control frequency.

Northern District

- aircraft off the control frequency without air traffic control approval;
- additional workload introduced due to continual vigilance required on aircraft after they pass beyond the Class C or E airspace boundary;
- phraseology used by either the pilot or controller may not accurately reflect the service requested or being given; and
- a reduced ability to plan traffic and control access to the control frequency.

Sydney District

- continuous change to air traffic services procedures; and
- human factors reaction to changes of airspace responsibilities and associated procedures.

The General Manager Air Traffic Services accepted the identified hazards subject to the following conditions:

1. additional supervisory staff to be rostered during initial implementation to monitor and manage controller workload;
2. intervention to be taken to reduce workload if an overload situation was imminent;
3. longer term action to limit workload to be coordinated with adjacent units and Head Office;
4. further risk evaluation of the category B hazard to be carried out post-implementation with a view to downgrading the risk if appropriate on the basis of operational experience; and
5. an action plan to be developed to address longer term workload issues.

Item 4 was not included in the conditions applicable to the Southern District, and item 5 was not stipulated for the Northern District.

1.6.6 Pilot education activities

1.6.6.1 Establishment and role of the education cadre

The safety cases for the Class G airspace demonstration placed a significant emphasis on comprehensive and in-depth pilot and controller education programs as important safety mitigators, as previously outlined. The Airspace 2000 communications strategy of 14 May 1998 also identified industry education as a necessary component for the safe and efficient introduction of airspace changes. One key element of the proposed education program was the establishment of a small working group of industry specialists to act as an 'education cadre' in support of the program. The education cadre proposal was discussed at the initial meeting of the program control group on 24 April 1998, and each agency present was asked to nominate operational personnel for the group. It was envisaged that the education cadre would develop and deliver training material for the Class G airspace demonstration.

A preliminary meeting was held in Sydney on 1 July 1998 to discuss the format of the group. An external communications consultant acted as a facilitator. The cadre included two personnel from the Defence force, one from an operational flying background and the other from an air traffic control background; three operational pilots from regional airlines affected by the Class G airspace demonstration; plus two Airservices' personnel from the Northern and Southern Districts. One aspect of the role of the Airservices representatives was to ensure that the procedures developed were acceptable from an air traffic control perspective.

According to the industry involvement plan produced by CASA, three CASA flight operations inspectors were meant to join the cadre. However, only one was available. There was a perception within CASA management that some other flight operations inspectors nominated to work with the education cadre were reluctant to become involved. As a result, CASA staff input to the work of the cadre was limited.

BASI investigators could not identify any documentation relating to the direction or guidance given to the education cadre. In broad terms, both CASA management and the cadre members agreed that the cadre's task was to develop a pilot training guide based on the procedures outlined in AIP SUPP H48/98. In its day-to-day work, the education cadre reported to CASA management, in particular to the General Manager Airways and Airspace Standards Branch and the Airspace 2000 program manager. In addition, it was reported that the CASA Chairman took a keen interest in the work of the cadre and had strong views as to the format and content of the instructor package.

1.6.6.2 Functioning of the education cadre

The main work of the cadre was conducted during a 3-week period from 7 to 24 July 1998. The group worked at an intensive pace as time was short, and some members had to leave on occasions to carry out other duties. During the first week, the cadre reviewed the information in AIP SUPP H48/98 to ensure that they had a full understanding of the proposed procedures. The cadre then outlined which areas would be covered in each section of the training package. In subsequent weeks they worked on specific sections in small groups. Although the cadre was not given detailed instructions as to the type of material that they should prepare, they decided to develop a very practical step-by-step package, with a strong emphasis on operational procedures.

Cadre members were later to report that a close inspection of the proposed Class G procedures gave them some concerns. In their opinion, there were areas in which the procedures did not 'fit together'. They also identified a number of aspects that they felt could cause confusion. The members commented that in their view, the CASA management personnel who were working on the project had a limited understanding of the operational problems associated with the new procedures. At some meetings, it appeared that those officers were unsure of certain details of the proposed changes.

It also appeared that the proposed changes had not been subjected to a detailed operational examination by flight crew or air traffic control staff. The cadre felt that their work represented the first time that anyone had looked at the new procedures from a practical point of view. For example, the workload implications of the procedures had not been studied, and a task analysis had not been carried out.

The cadre members felt strongly at the time that there were ambiguities in AIP SUPP H48/98 that needed to be resolved, and in some cases the proposed changes were impractical. For example, the lateral dimensions of the demonstration area needed to be altered so that they coincided with air traffic control sector boundaries. In addition, the cadre felt that there were still unresolved issues in relation to:

- the adequacy of radar coverage;
- pilot and controller workload issues;
- notification of military low-jet traffic;
- IFR traffic without flight plans; and
- possible congestion on the national advisory frequency.

During the investigation, CASA personnel emphasised that the task of the education cadre was to develop a training package based on AIP SUPP H48/98, and not to alter the proposed procedures in any way. They claimed that the cadre appeared to want to change the airspace design, in addition to preparing educational material.

The cadre argued that while it was not their job to make major changes to the AIP SUPP, they were required to interpret the document so that pilots could operate safely in the demonstration area. In order to enhance pilot situational awareness and minimise frequency management problems, they argued that:

- The radar information service should be provided on a one-off 'snapshot' basis rather than as an ongoing service, and pilots should remain on the national advisory frequency as much as possible, only changing to the control (RIS) frequency for specific traffic information as required. It was also felt that a one-off service would reduce the workload on the controller and therefore make it more likely that a radar information service could be provided on request.

- Regardless of whether a pilot received a radar information service or not, all position reports should be made on the national advisory frequency, which was the primary frequency. The cadre argued that pilots receiving a radar information service should still broadcast on the national advisory service to enhance the situational awareness of other pilots.

CASA management believed that if pilots were receiving a radar information service they did not need to be making broadcasts on the national advisory frequency. Frequency congestion was an issue that had already been identified. They also characterised the education cadre's approach as tending to modify old procedures for use in the new environment, rather than taking an entirely fresh approach. For example, when the cadre recommended that the pilots of VFR aircraft consider talking on the national advisory frequency, CASA viewed that as simply a return to pre-1991 procedures.

Some but not all of the recommendations made by the education cadre were incorporated into the new Class G procedures. It was made clear to the cadre members by CASA management and the facilitator that CASA would undertake a final review of their work before it was released as a training aid. CASA management commented that the education cadre did a good job in testing the model.

The cadre felt that the training package should contain specific scenarios, or 'flight threads', to more clearly explain how pilots should operate in the demonstration area. They developed flight threads for a number of scenarios, including staying in Class G airspace, entering Class G airspace from the side, descent into a MBZ/CTAF zone, and climb from a MBZ/CTAF zone. The cadre were subsequently instructed to stop work on the flight threads because the scenarios made operating in the demonstration area 'appear complex'. CASA management emphasised the need for the education materials to portray the 'simplicity' of the demonstration procedures.

The cadre also believed that the training material, including the flight threads, was well suited for presentation by computer-based training. Work in that area proceeded to the extent of designing a computer-based training package on paper, including all the text. In addition, some sound recordings were made by specialist Airservices staff. Eventually there was insufficient time remaining to produce and release the computer-based training package prior to the demonstration, and no further work was proceeded with.

It was reported by some cadre members that personal conflicts developed between the cadre and the facilitator towards the end of their work. However, the consultant reported that in any facilitated workshop (particularly one as controversial as airspace change), the facilitator must from time to time keep the group on track and working within the agreed frame of reference, and that this intervention may not always meet with full approval. Some members were of the opinion that the facilitator had tried to overly influence the cadre and resented that pressure. The facilitator strongly rejected that assertion. The facilitator reported that during the last week of the workshop, he removed himself from direct work with the cadre to allow them to prepare a final submission to CASA that they were prepared to sign off as their own work. However, that was taken negatively by some members to mean that the facilitator was removing himself from the process.

Towards the end of their activities, it became evident to the education cadre that CASA would not accept the training package that they had developed, without extensive revision. The cadre reported that the scenarios they had developed indicated that operating in the demonstration airspace could become quite complicated. The cadre believed that CASA was determined that the training package should not depict the new airspace procedures as being too complex, and it was for this reason that their work was not accepted in its entirety. At the end of the project,

the cadre members were so concerned that their work would be altered in an unacceptable way that they attached a rider to the final document stating that they could not be held responsible for any further changes made to the training package.

1.6.6.3 Revision of the education cadre training package

The training package developed by the education cadre was reviewed and modified by CASA personnel, including the CASA Chairman. The package was then distributed to 1,500 holders of Air Operator Certificates under the title *Flight Instructor Package — Demonstration of Modified Class G Airspace Procedures*. The package was distributed on 3 September 1998, 5 weeks prior to the expected start of the demonstration (8 October). The structure and content of the CASA package generally followed that of the package produced by the education cadre, containing 11 lesson plans on various aspects of the demonstration, with background information and overhead transparency masters for each unit.

There were a number of changes and different points of emphasis in the revised document. In particular there were marked differences in relation to the suggested use of the national advisory frequency and the radar information service, as evidenced by:

- The material prepared by the education cadre stated that, although VFR broadcasts on the national advisory frequency were not required, except when there was a possible conflict between aircraft, VFR pilots should consider broadcasting their position on that frequency to enhance the situational awareness of other users of the airspace. In contrast, the CASA package stated that VFR pilots should keep broadcasts on the national advisory frequency to a minimum, emphasising that the frequency should be used primarily by IFR pilots to facilitate radio-arranged separation in instrument meteorological conditions. VFR pilots were instructed to maintain a listening watch only.
- The material produced by the education cadre highlighted that in some circumstances it would be necessary to simultaneously monitor two VHF frequencies to maintain situational awareness in two environments. Emphasis was given to keeping a listening watch on the national advisory frequency. Pilots with only one VHF transceiver were advised to return to that frequency as soon as possible in order to maintain a continuous traffic picture. In addition, it was recommended that pilots broadcast their position, level, and intentions whenever selecting or re-selecting the national advisory frequency in order to enhance situational awareness both for themselves and other airspace users. In contrast, the CASA package did not discuss those issues in detail, nor did it give the same degree of emphasis to remaining on the national advisory frequency as much as possible.
- The material produced by the education cadre described three types of radar information service available to pilots—radar traffic information, radar position information, and radar navigation information. The cadre material stated that pilots should specifically request the type of service required, thus minimising the time required for air traffic control to provide the requested information. Pilots were advised that, in order to maximise the availability of a radar information service for other users, they should terminate that service as soon as they felt it was no longer required. In contrast, the CASA package stated that it was not intended that the different types of information available from the radar information service be viewed as individual services in any way. The CASA material stated that an ongoing radar information service would be provided, including traffic information and navigation assistance, until the service was specifically terminated, either by the pilot or by air traffic control.

CASA invited cadre members to a meeting on 17 August at which the final draft of the Flight Instructor Package was presented. One purpose of the meeting was to explain and justify the

changes that had been made to the cadre's work. Further, it gave the cadre another opportunity to influence the final draft before it was sent for publication. However, only half of the cadre members attended the meeting. The cadre subsequently expressed their disappointment that the training guide they had developed was significantly modified before being distributed by CASA. The cadre felt that the CASA-modified material was targeted towards commercial operators, while their original package was aimed at a wider range of pilots.

The Defence force representatives had strong reservations about the process by which the final style and content of the Flight Instructor Package was determined, and made their misgivings known within their organisation. As a result, on 28 August 1998 the Deputy Chief of Air Force wrote to the CASA Director to voice the Defence force's concerns. The letter rejected the argument that the final endorsement of the training package rested with CASA alone. AIP SUPP H48/98 specifically stated that representatives from CASA, Airservices, the Defence force, and the aviation industry would be conducting a pilot education program prior to the commencement of the Class G airspace demonstration.

The Deputy Chief noted that, by implication, the Defence force was acknowledged as an 'author' of the training material produced.

On 6 August 1998 the Airservices Manager Airspace and Air Routes wrote to the CASA General Manager Airways and Airspace Standards Branch expressing concern that CASA may have been planning to abandon the pilot education package in favour of simply using the AIP SUPP. During interviews, CASA personnel confirmed that this option had been considered after the cadre's material had initially been reviewed.

In their review of the demonstration in September 1998, the UK CAA's report noted that the Flight Instructor Package was 'comprehensive and well-presented'.

1.6.6.4 The CASA *Flight Safety Guide*

Another component of the pilot education program was the development of a 22-page *Flight Safety Guide*. The stated intention of the guide was to help familiarise pilots with the new services and procedures. It was a magazine-style publication written in plain language. Approximately three-quarters of the material in the *Flight Safety Guide* related to operational aspects of the Class G airspace demonstration. The remainder of the guide consisted of background information and a strongly argued rationale for the introduction of the new procedures. For example, it was emphasised that reforms to infrastructure were necessary for Australia to maintain its competitive edge. The existing air traffic control and flight service systems were described as antiquated, with pilots and air traffic controllers being the main victims. The guide was distributed to all pilots likely to operate in the Class G airspace demonstration area.

The *Flight Safety Guide* was based on the CASA-amended Flight Instructor Package and was written by the Airspace 2000 communications consultant under direction from CASA. The Chairman was also reported by senior CASA staff to have had a significant influence on the style and content of the document. CASA personnel indicated that the *Flight Safety Guide* was intended to convince the aviation community of the need for change, but given the history of past attempts at airspace reform, the approach taken may have been counterproductive.

During the investigation, a number of CASA, Airservices and industry representatives expressed concerns about the effectiveness of the *Flight Safety Guide* as an educational document. They stated that there were insufficient examples to help explain how a pilot should operate in the new airspace. In a number of areas, the *Flight Safety Guide* also appeared to minimise the impact of the proposed changes on operations in Class G airspace. For example,

while discouraging VFR pilots from self-announcing on the national advisory frequency, the guide characterised the removal of directed traffic information as resulting in 'little significant change', except that no third party would monitor pilot-to-pilot communications.

1.6.6.5 Other CASA pilot education activities

A number of other initiatives were undertaken by CASA to promote pilot awareness of the Class G airspace demonstration procedures. An educational video was produced, outlining the proposed changes and highlighting key aspects of the demonstration. The video was approximately 10 minutes long and briefly covered procedures relating to operations in the demonstration area. Several articles about the demonstration also appeared in the CASA publication *Aiming Higher*.

A 'Class G Demonstration Hotline' was set up so that pilots could contact CASA staff for further information or clarification about aspects of the new procedures. Access to the hotline was also available by facsimile or electronic mail.

1.6.6.6 Delivery of pilot education

During September 1998, a series of seminars or 'information centres' for pilots were held by CASA at a number of regional airports within and near to the demonstration area. CASA staff indicated that the role of the seminars was to answer questions and obtain pilot feedback about the demonstration. The seminars were not intended to be a primary component of the education program. As expected by CASA, only a small proportion of the pilots likely to be affected by the changes attended the seminars.

On 7 October, the CASA Director postponed the commencement of the demonstration from 8 October to 22 October, primarily due to the fact that many airlines did not appear to have conducted adequate training of their pilots for the new procedures. During the investigation, Airways and Airspace Standards Branch staff reported that many people in the industry appeared to think that the demonstration would never proceed, and therefore there was no need for the training. Similarly, pilots interviewed by BASI also reported that perception had existed within the industry.

It was reported by many professional pilots that minimal training was conducted by their respective organisations prior to the commencement of the demonstration on 22 October. In many cases, there had been no training material developed or provided by the operators to elaborate on the AIP SUPP H48/98 or the *Flight Safety Guide*, nor had active measures been taken to ensure that their pilots were familiar with the new procedures. However, the investigation also found that some operators had conducted a thorough education program to supplement the Flight Instructor Package and the AIP SUPP. A small number also had well developed guidance material in their operations manuals.

Industry representatives commented during the investigation that the changes, which occurred at short notice throughout the demonstration period, had complicated the education program. CASA personnel stated that the general nature of the procedures did not change, and that operators should have been able to conduct their basic training, supplementing that with appropriate pre-flight reference to NOTAMs.

1.6.6.7 CASA assessment of pilot training prior to the demonstration

From the outset, key stakeholders in the process recognised that pilot training was fundamental to the success of the trial. On 6 August 1998, Airservices wrote to CASA expressing concerns that weak pilot education material would threaten the planned implemen-

tation of the Class G demonstration, and that this would in turn compromise the transition to TAAATS within Airservices. In his letter to CASA on 28 August 1998, the Deputy Chief of Air Force commented that a lack of proper training would be particularly unfortunate, given that CASA itself had identified inadequate pilot education as a major shortcoming of earlier attempts to introduce changes to the management of airspace in Australia.

However, there was no formal assessment by CASA of the effectiveness of the pilot education program prior to the commencement of the Class G airspace demonstration. An informal estimate of the adequacy of the pilot education program was gained from feedback received during the education seminars, and from calls made to the Class G airspace demonstration telephone hotline.

The communications consultant involved in CASA's Airspace 2000 program expressed concern to the CASA Airspace 2000 program manager at the lack of any formal process to gather and analyse data related to the effectiveness of the pilot education program, prior to the commencement of the demonstration. The advice stressed the importance of that phase of the communication plan, and recommended that a paper summarising the findings from the field visits by CASA staff be prepared as soon as possible. In that way, the study could make recommendations about the best method of addressing any perceived or actual shortcomings of the education strategy to date. It was argued by the communications consultant that it was important this quality assurance process be completed and recorded, as it was a key element of the exercise, and an important element of the audit trail.

1.6.7 Air traffic controller education activities

1.6.7.1 Airservices *ATS Personnel Training Package*

An *ATS Personnel Training Package* for the Class G airspace demonstration was developed by the Operational Policy Branch of Airservices, with the final version completed on 26 August 1998 and disseminated to the three ATS districts. The package provided a detailed outline of the proposed changes to Class G airspace, and documented the resulting changes to both air traffic control procedures and pilot procedures. It was intended to provide group and team leaders with the information that they needed to prepare training material for their operational personnel, including controllers, flight service officers and airways data systems officers.

Operational managers and team leaders were responsible for ensuring that their operational personnel completed the sections of the training package applicable to their areas of responsibility. The actual content and method of training was left to the discretion of group leaders and team leaders. Suggested methods of instruction included self-paced learning, classroom instruction, workshops, team briefings and lectures, simulation exercises, and on-the-job training. The training package stipulated that assessment of operational personnel was to be by rating or endorsement examination, and could be supplemented by simulator or on-the-job assessment. The training package included 41 multiple-choice review questions relating to the material covered in the training package.

The investigation found no evidence to indicate that the adequacy of training provided to Airservices operational personnel prior to the commencement of the demonstration was other than satisfactory.

1.7 Operation Of The Class G Airspace Demonstration

1.7.1 Sequence of significant events during the demonstration period

22–28 October 1998

From the commencement of the G airspace demonstration the majority of the regional airlines operating in that airspace began to express similar concerns to those held prior to the demonstration. In general terms those concerns related to:

- pilot workload;
- radio frequency management problems;
- pilot education;
- congestion of the national advisory frequency;
- the lack of directed traffic information;
- SAR alerting procedures; and
- the availability of radar information services, and radar coverage limitations.

A particular concern to the airlines was that radar coverage was not available to the top of mandatory broadcast zones, as they believed had been assured during meetings on 19–20 October. Some airline representatives were later to report that they had attempted to obtain information on the extent of radar coverage in the demonstration area, but without much success. They had been provided with a map showing radar coverage, but that was not published by Airservices or CASA, as the information may not have been reliable. Consequently, a number of pilots stated that they were not aware of the lower limits of radar coverage.

29 October 1998

The AATA wrote to the CASA Director, recommending termination of the demonstration. The RAAA echoed those concerns in a facsimile to the CASA Director on 30 October 1998, stating that if their concerns could not be resolved over the next week, their members would have to reconsider their willingness to operate in the demonstration area. On the same day, a major regional airline ceased operations into aerodromes within the demonstration area.

30 October 1998

The Chief of Air Force wrote to the CASA Director and commented that issues such as workload, frequency congestion, and technical limitations including radar and radio coverage, had a significant impact on the viability of the demonstration. In addition, the mitigation of those concerns appeared impractical without major procedural changes. Due to the safety issues and concerns that had arisen during the demonstration, the Chief of Air Force stated that the Defence force believed it was prudent to suspend the demonstration and reconsider its progression.

2 November 1998

The CASA Director convened a high-level meeting with industry, the Defence force, CASA, and BASI in an attempt to resolve the safety concerns, with a particular emphasis on facilitating a resumption of services by the major regional airline mentioned earlier. The meeting resulted in a stalemate, with a communique from the airline industry and the Defence

force demanding that the demonstration be terminated, and directed traffic information be restored by midnight on 3 November. Should that not occur, three other large regional airlines would cease operations in the demonstration area. A major domestic operator, which only serviced one location in the demonstration area, had elected to divert around the demonstration airspace in order to enter the mandatory broadcast zone associated with that location from controlled airspace.

Following the meeting the Defence force undertook to investigate the provision of extended radar services at RAAF Williamtown (Newcastle) to overcome radar coverage problems in the Hunter Valley region. The RAAF subsequently agreed to increase the operating hours of its approach and tower services at Williamtown to cover the operating times of civilian airlines for a 48-hour period. A meeting between CASA and Airservices staff was also held on 2 November to resolve safety issues raised by the cessation of flights in the demonstration area by a major regional airline. Several general aviation operators subsequently contacted CASA and expressed concern that their sector of the industry had not been represented in the discussions.

3 November 1998

A proposal was developed by Airservices and CASA for addressing frequency management issues at Newcastle, Taree, Port Macquarie, and Grafton. Before departing from Canberra to Sydney that day to discuss the proposal with the regional airlines, the General Manager Airways and Airspace Standards Branch had asked his staff to conduct a risk analysis of the proposal. The analysis identified four problems:

1. Complexity of design.
2. Aircraft at or near, but just outside boundary which are monitoring the NAF.
3. No third party available to redirect traffic calling on the wrong frequency (NAF) to correct frequency (MBZ/CTAF).
4. 'Change on change on change', i.e. new docs. Which refer to existing change docs, etc. etc.

The associated consequences of the first problem were described as confusion about procedures, frequencies and transponder requirements. The identified mitigators for that problem, considered essential by the members of the risk analysis team, were pilot education with sufficient notice (at least 28 days) and charting of the changes (6 months required). The mitigators listed for the second and third problems already existed. For the fourth problem, the identified mitigator was to:

> …slow down, take stock, consolidate required changes, then proceed in a considered, cautious manner, allowing sufficient time for required pilot education.

The General Manager Airways and Airspace Standards Branch was informed of the results of the analysis late that afternoon by telephone. He indicated to the branch staff that the decision had already been made by senior management to proceed with the proposed changes the next day. He then directed the team to start work on the associated notice to airmen (NOTAM). The results of the risk analysis were not passed on to any other CASA manager. The General Manager Airways and Airspace Standards Branch was to later indicate that he thought the hazards associated with the rapid implementation of the changes were obvious, and that senior management were aware of them.

The result of the above was the introduction of a requirement for aircraft in the mandatory transponder areas to be on the associated mandatory broadcast zone or common traffic advisory frequency. In addition, the RAAF and Airservices undertook to investigate options for improving radar coverage in the Hunter Valley area. As a result of those actions, the major regional airline resumed operations in the demonstration airspace.

4 November 1998

At a program control group meeting, it was decided to form a joint Airservices/Defence force team to determine a more practical, long-term solution to the radar coverage issue. A number of options were investigated to overcome the deficiency in radar coverage, including the installation of a transportable Airservices radar at Williamtown, and employment of Airservices controllers at Williamtown. However, the issue was considered to be resolved as a result of adjustments made to the configuration of the Airservices radar displays at Brisbane.

5 November 1998

After receiving more than 70 air safety incident reports, and anecdotal evidence of operational problems associated with the demonstration, BASI commenced an investigation into the circumstances surrounding the introduction of the demonstration.

16 November 1998

Following a serious (category 3) air safety incident near Williamtown between a military Beech Super King Air and a regional airlines Jetstream (see occurrence report 9805078, section 1.7.3.5) a meeting was held involving BASI investigators, CASA staff and an airline representative. A number of options to avoid a similar incident were discussed by the participants. One of the options discussed was for the provision of a 'snapshot' of radar-identified traffic to aircraft on the ground, prior to departure from aerodromes within the demonstration area. CASA undertook to liaise with Airservices Australia to establish whether such a 'snapshot' service could be provided.

19 November 1998

Some general aviation operators had expressed their safety concerns to CASA, and some elected not to fly in the demonstration airspace. For example, on 19 November 1998, the chief pilot of a large commercial operator wrote to the CASA Director and raised safety concerns as a result of two incidents involving company aircraft. The chief pilot stated that unless major changes could be accommodated, CASA should cease the demonstration as soon as possible. The air ambulance service also placed restrictions on their operations in the demonstration area due to safety concerns.

25 November 1998

CASA wrote to one operator of VFR charter and regular public transport aircraft about the operation of the national advisory frequency. The letter asked the operator to limit his pilots' use of that service in order to minimise the loading on the frequency, which could interfere with IFR to IFR communications. The chief pilot responded by stating his opposition to CASA's request, and that he would not be encouraging his pilots to limit their use of the national advisory frequency, as they believed their calls were the minimum required for safety.

26 November 1998

The Chief of Air Force issued a directive to Air Force units to limit operations in the demonstration airspace to those missions which were essential. A similar approach was recommended to the Army and the Navy. The basis for the directive were concerns about frequency management procedures, particularly during the climb and descent phases of flights, as highlighted in the incident near Williamtown on 16 November 1998 (9805078).

1 December 1998

During discussions with Airservices staff, BASI were advised that the 'snapshot' service was being provided whenever possible, at the discretion of individual controllers.

2 December 1998

BASI wrote to Airservices and CASA to establish if the 'snapshot' service could be provided along similar lines to the radar information service i.e. mandatory on a workload-permitting basis. CASA replied on the same day that such a service was not associated with CASA's minimum safety standards, and therefore CASA did not intend to mandate the provision of the service.

8 December 1998

BASI released a number of interim recommendations to CASA, Airservices and the Department, listing 10 main areas where the Bureau, based on initial analysis of information obtained, had major safety concerns. Those concerns included:

- the lack of a clear transfer of roles and responsibilities from Airservices to CASA for the management of Airspace 2000;
- the removal of independent review processes;
- deficiencies in CASA's safety case processes;
- deficiencies in the pilot education programs of both CASA and the aviation industry;
- congestion of the national advisory frequency; and
- safety deficiencies associated with frequency management procedures and pilot workload.

BASI stated that it believed the demonstration had served its purpose and recommended, in light of the safety concerns identified, that CASA should terminate the demonstration. BASI also recommended to CASA, Airservices and the Department that they review and clarify the roles and responsibilities of their respective organisations.

The Minister tabled the BASI interim recommendations in parliament on 9 December 1998 and announced that the CASA Director had advised him the demonstration would be terminated on 13 December 1998. The Minister also announced that he had asked the Secretary of the Department to conduct a review of the roles and responsibility for the regulation, design and management of Australian airspace.

13 December 1998

The G airspace demonstration was terminated.

1.7.2 CASA monitoring and evaluation activities

1.7.2.1 Development of the monitoring plan

CASA developed an initial monitoring plan for the Class G airspace demonstration in August 1998. The UK CAA team which conducted a review of the proposed demonstration in September 1998 commented that:

> …the planned system performance monitoring during the demonstration would not provide an adequate strategy for risk containment.

In particular, they were concerned that there was not going to be any active collection of data on existing residual hazards. CASA, as a result, further developed their monitoring plan,

setting up the 'Class G safety monitoring group' consisting of representatives from CASA, Airservices, airlines, military, and the Aircraft Owners and Pilots Association. The monitoring group had no executive power and was only to make recommendations to the Airspace 2000 program control group. The CASA Director was to make all key decisions about the demonstration.

The first meeting of the monitoring group was held on 29 September. CASA understood that the purpose of the meeting was to finalise the methodology of the monitoring plan (including parameters to be monitored, lines of communication and responsibility, and decision-making points). However, industry was more concerned about whether there had been sufficient 'monitoring' of activities leading up to the demonstration. The meeting did not finalise a monitoring plan; however, CASA decided to further develop their monitoring plan.

1.7.2.2 The CASA monitoring plan

The CASA monitoring plan was outlined in the 21 October version of the CASA safety case for the demonstration. The stated objectives of the monitoring plan were:

a) When the demonstration begins, to quickly identify any operational problems associated with the implementation of the new procedures that may require urgent attention.

b) As the demonstration proceeds, to monitor aviation activity in the area to identify and where necessary quantify more general issues which emerge as a result of the [*sic*] being implemented.

c) To gather data which will enable actual risk levels in the demonstration area to be calculated.

d) To identify any gaps between theoretical risk calculations and those derived from operational experience—particularly those which result from hitherto unappreciated operational factors.

e) To propose appropriate mitigators to address identified issues where required to ensure that risk remains within acceptable levels.

The plan listed the following key items for safety monitoring:

- pilot workload;
- radar information service availability;
- radar information service effectiveness;
- national advisory frequency congestion and effectiveness versus directed traffic information;
- common traffic advisory frequency congestion and effectiveness versus directed traffic information;
- SAR management;
- Class G 'hot spots'; and
- transponder effectiveness.

The monitoring plan stated that the following methods were to be used to obtain data during the demonstration:

- During the initial days of the demonstration, CASA flight operations inspectors were to fly in the demonstration airspace and ride in the jumpseat of regional airline aircraft.
- The national advisory and common traffic advisory frequencies were to be monitored at ground stations by CASA personnel.

- The chief pilots of regional airlines represented on the monitoring group were to submit situational reports on issues arising from operations during the first two days of the demonstration.
- For the first week of the demonstration, airline and general aviation pilots were to complete a 'pilot reporting sheet' on each flight in the demonstration airspace. (Pilot reporting sheets were used throughout the demonstration period.)
- Airservices were to report to CASA the details of any problems raised in the debriefings of controllers at the end of their shifts.
- Airservices were to collect data on the number of requests for a radar information service, and the number of requests denied.
- A 'hotline' was to be set up at CASA head office to receive calls from pilots or operators who had experienced problems with the demonstration.

Data obtained by the monitoring process was to be considered by the Class G safety monitoring group.

It was planned that at the end of days 1 and 2 of the demonstration, and at the end of week 1, an initial, quick, qualitative assessment would be made of operational factors to confirm that the demonstration could proceed. Further reviews to estimate the overall effects of the changes would be made 3 months and 6 months after the commencement of the demonstration.

Another part of the monitoring plan was to collect data on incidents occurring during the demonstration period, and to compare those with incidents which had occurred prior to the demonstration. CASA Airways and Airspace Standards branch personnel would later report that they had no time during the demonstration to conduct any such analyses. The monitoring plan also outlined a methodology for comparing traffic levels and incident rates before and during the demonstration. Risk modelling was also planned to occur at some stage in 1999.

1.7.2.3 Class G safety monitoring group meetings

After the initial planning meeting on 29 September 1998, the Class G safety monitoring group held meetings on 22 October, 26 October, 28 October, 30 October, 6 November, 17 November and 1 December. During each meeting, data was presented on:

- pilot reports;
- incident reports;
- issues associated with the radar information service, national advisory frequency and pilot workload; and
- comments by Airservices, operators, Defence force and AOPA.

1.7.2.4 Pilot reports to CASA

CASA received 581 reports from pilots operating in the demonstration area. They were essentially feedback reports, most of them outlining operational concerns. The reports were received in the form of a 'pilot reporting sheet' or a telephone call over the Hotline. Approximately 79% of the reports came from airline pilots. Many of the airline reports were submitted as a matter of routine, and some reports indicated no problems. The majority of the pilot reports were based on a specific flight, though a number only dealt with general concerns. The number of reports received during each week is outlined in table 1.

As part of their monitoring activities, CASA personnel participated in flights in the demonstration airspace. Thirty-nine of the pilot report forms were submitted by CASA personnel following such flights. Most of those reports (34) were submitted in the first week.

Table 1
NUMBER OF PILOT REPORTS DURING THE DEMONSTRATION

Period	*Number of pilot reports*
Week 1: 22–28 October	228
Week 2: 29 October–4 November	71
Week 3: 5–11 November	115
Week 4: 12–18 November	50
Week 5: 19–25 November	50
Week 6: 26 November–2 December	30
Week 7: 3–9 December	35
Week 8: 10–13 December (part-week)	2
Total	581

CASA analysed the pilot reports in terms of the concerns raised by the pilots. Some reports detailed multiple concerns. The distribution of the 581 reports relative to concerns raised is as follows:

- radar information services—153 reports (26% of reports);
- national advisory frequency—117 (20%);
- pilot workload—107 (18%);
- radar and radio coverage—84 (14%);
- SAR—74 (13%);
- airspace design—66 (11%);
- terminal area frequencies—63 (11%);
- air traffic services procedures—56 (10%);
- pilot education—42 (7%);
- pilot position reporting techniques—30 (5%); and
- conflicts with other aircraft—15 (3%).

As the demonstration progressed, the percentage of reports on the national advisory frequency, pilot workload, SAR and pilot education decreased.

1.7.2.5 Monitoring of the national advisory frequency

A team at a ground station near Katoomba monitored the national advisory frequency for the following local times:

- 22 October, 0600–1800;
- 23 October, 0600–1200;
- 25 November, 0600–1800; and
- 26 November, 0600–1200.

The team was able to monitor transmissions originating within the Sydney basin to ground level, and down to approximately 5,000 ft north to Williamtown, south to Nowra, and west to Goulburn, Cootamundra and Bathurst.

The frequency monitoring team found that:

- Usage of the national advisory frequency peaked during the periods 0630–0645 and 1730–1745 each day. During those peaks, the frequency was very busy but not congested to the point of being 'unusable'. The peaks were associated with 'bank runner' traffic to or from Bankstown.
- About 85% of the calls on the national advisory frequency were from pilots of IFR aircraft.
- Over-transmissions, which could completely obliterate a broadcast without the pilot being aware, occurred randomly at a rate of approximately 10 per day.
- A similar distribution of calls was evident on each of the four days monitored.

No monitoring of the relevant flight service frequencies for the Canberra–Ballina area was conducted in the period prior to the demonstration to establish a baseline.

1.7.2.6 CASA monitoring report on the first month of the demonstration

Airways and Airspace Standards Branch staff decided to conduct an analysis of the first month of the demonstration. They were concerned that the weekly monitoring meetings were of limited effectiveness, and that a broader view was required. The report was completed by 26 November, and reviewed a wide range of issues including pilot reports, radar information services, pilot workload, the national advisory frequency, pilot education, removal of directed traffic information, airspace design, and 'critical' incidents. Observations of the monitoring report included the following:

- Limitations of the radar coverage in the Ballina, Williamtown and Wollongong areas had resulted in some problems with the provision of radar information services.
- The lack of published data on radar coverage had caused some concerns among both pilots and air traffic services staff, as they were not aware of the position at which radar contact would be lost.
- Limitations of radar coverage reduced the confidence of pilots in the advice from controllers that there was 'no observed traffic'.
- In terms of radio coverage, problems were experienced with the receipt of air traffic control frequencies in the Wollongong, Williamtown and Armidale areas.
- Airservices advised that 95% of requests for radar information services had been satisfied.
- Circumstances that induced high pilot workload included:
  - the number of frequency changes required when a radar information service was not available, or when air traffic control could not be contacted on the ground;
  - the need to obtain traffic information from more than one source (radar information service and the national advisory frequency) simultaneously;
  - over-transmissions on the national advisory frequency; and
  - the need to evaluate all radio traffic for confliction when a radar information service was not available.

- Congestion of the national advisory frequency remained a serious concern:
  - the majority of transmissions on the national advisory frequency were by pilots of IFR aircraft, indicating that the frequency was being used as intended; and
  - about 86% of pilot reports which mentioned national advisory frequency issues reported unacceptable levels of congestion on the frequency.
- The number of pilot reports which mentioned national advisory frequency problems decreased as the demonstration progressed, but reports by CASA ground observers suggested that the congestion problem had not decreased significantly.
- On the basis of telephone calls made to the Class G Hotline, occurrence reports and pilot reports, the CASA education program was considered to be not very successful.
- Removal of directed traffic information remained the single largest area of concern for pilots across all industry sectors, particularly the airlines. A consequence of the removal of directed traffic information was the loss of the single area frequency used for both flight service and pilot-to-pilot communication. A single frequency better enabled pilots to hear important broadcasts such as hazard alerts, weather information and changes to airspace status. Another consequence of the removal of directed traffic information was the loss of 'flight following' by flight service, which gave prompts for pilots to call air traffic control for clearance at the appropriate time.
- Changed procedures for SAR caused uncertainty for pilots from all sectors of the industry. The frequency of queries and pilot reports concerning SAR issues decreased considerably as the demonstration progressed.
- The creation of mandatory transponder areas made the airspace more complex, which was likely to result in more pilots being on the wrong frequency.
- No procedure had been developed for the pilot of an IFR aircraft to use in the event of radio failure in instrument meteorological conditions.

The conclusions of the monitoring report were as follows:

1. The demonstration has established that a single NAF is not a solution which is suitable for national roll-out for the following reasons:
   (a) due to the extent of its geographical coverage, it does not have the capacity to handle the volume of radio traffic; and
   (b) the volume of radio traffic being presented to pilots is too great for them to be able to effectively process effectively [sic].
2. Analysis of incident reports has shown that RIS, when available, is very effective at assisting aircraft to avoid collisions where conflict exists, but is less effective than DTI at preventing conflict developing in the first place (e.g. through provision of traffic information to aircraft on the ground).
3. The significant number of late changes made to airspace design and procedures have been implemented with lower levels of safety education than were achievable, resulting in substantial confusion among many pilots.
4. The RIS is an effective service when available, but variability of radar and radio coverage on which it relies, and the inconsistency of service provided, is making it difficult for pilots to utilise it as a reliable tool for traffic information.
5. The cessation of DTI has resulted in other associated services being no longer available, e.g. the broadcasting on the area frequency that a restricted area has become active, and prompting to call ATC for clearance. This may have been a factor in the observed increase in VCAs [violations of controlled airspace] in the demonstration area.

6. Airlines continue to press for the retention of DTI in airspace where RIS is not consistently available.

1.7.2.7 Draft Board paper on the monitoring report

After commencing the review, the Airways and Airspace Standards Branch decided that a Board Paper based on the report should also be produced. A draft Board paper, titled '*Post Implementation Review of the First Month of the Class G Airspace Demonstration*', was prepared by the General Manager Airways and Airspace Standards Branch and finalised on 27 November 1998. The first month report formed an attachment to the draft Board paper. The General Manager said he passed the report and draft Board paper up to the Assistant Director Aviation Safety Standards. The Assistant Director said he did not have a clear recollection of whether or not he had received those documents. Nevertheless, neither document reached the Director or the Board, nor could the investigation determine what happened to the documents. The Airways and Airspace Standards Branch received no feedback on the documents from upper management.

The draft Board paper made the following recommendations to the CASA Board:

1. To note the report 'Post Implementation Review of the First Month of the Class G Demonstration' attached to this Board paper.
2. To note the formal Post Implementation Review of the Class G Demonstration and development of the final Class G rules for national implementation is scheduled to commence in January 1999 for June/July 1999 implementation.
3. To note that it is likely on present monitoring trends that the current design will require modification prior to national implementation (June/July 1999) and that the current implementation may need to be amended prior to that date.
4. To consider, given the above and the fact that the further safety education is necessary, whether the trial should continue.
5. To consider that a substantial change to the relationship between the airline industry/ADF and CASA will need to be effected if a similar situation is to be avoided in 1999.

1.7.2.8 BASI monitoring of the demonstration

BASI executives attended a briefing on CASA's Airspace 2000 program provided to the Department on 12 May 1998. The BASI Director subsequently wrote to the Secretary of the Department with comments on the Airspace 2000 Program Definition Plan. The Director noted, among other things, concern regarding the CASA stated fall back position of going ahead if there was no industry support, and the message such a statement gave concerning CASA's consultation process. Moreover, the Director commented on the need for CASA to ensure that each increment contained adequate and appropriate safety measures, and that allowance be made for realistic timeframes for analysis and responses from industry. He also raised issues with regard to 'see-and-avoid' and carriage of transponders.

On 17 July 1998, after receiving information from an industry representative, BASI raised a safety deficiency notice on human performance aspects of pilot tasking and workload relating to the proposed Class G airspace demonstration procedures. As a result, an investigator monitored the development of the demonstration, and requested that CASA notify him of any opportunities to attend or observe a briefing or consultative meeting on the demonstration. However, BASI was not provided with any briefings or involved in any of the consultative forums held prior to the demonstration.

Subsequently, after receiving 28 incident reports on the first day of the demonstration, BASI set up a team to monitor the progress of the demonstration. Following receipt of over 70 air safety incident reports, the Bureau concluded that a safety deficiency did exist and commenced an investigation on 5 November 1998 into the systemic issues associated with the development and operation of the Class G airspace demonstration.

BASI was invited to join the Class G airspace demonstration monitoring group as an observer for the 30 October meeting, and then attended all subsequent meetings.

During the investigation, senior CASA personnel stated they 'drew comfort' in the safety of the demonstration due to the lack of any action on BASI's part. The first opportunity for BASI to provide an opinion to CASA on the Class G demonstration, was on 25 November 1998, when the Authority was provided with a draft version of the BASI interim safety recommendations (see section 4.1).

1.7.3 Air safety occurrence notifications received by BASI

BASI received 154 occurrence notifications that related to airspace procedures in the demonstration area or were otherwise associated with the Class G airspace demonstration. Of those, 133 referred to specific incidents. The distribution of the 133 incidents in accordance with the various BASI occurrence classifications is shown in table 2.

The classification of occurrences by BASI takes into account the perceived safety value and consequent expected level of investigation. Air safety occurrences related to the demonstration were classified independently of the team conducting the investigation. The range of classifications used by BASI were:

- Category 3 occurrences (the circumstances indicate actual or potentially serious safety deficiencies). The category is used when there is some concern for public safety, and a need for an in-depth investigation to determine the facts. A report is released to the public in the form of an Air Safety Occurrence Report (ASOR). Categories 1 and 2 refer to more serious occurrences.
- Category 4OB occurrences (the facts do not indicate a serious safety deficiency). The category is used for occurrences where the circumstances are sufficiently complex to require detailed information from the pilot, operator and/or other involved parties. A report is released to the public in the form of an Occurrence Brief (OB).
- Category 4PB occurrences (some investigation actions are needed to expand upon and/or substantiate the initially reported facts). Investigations associated with this category specifically aim to identify if safety enhancement action is appropriate for occurrences involving air transport and other commercial operations. A report is released to the public, on request, in the form of a Public Brief (PB).
- Category 5 occurrences (primarily of statistical interest and are not normally investigated). As with higher category occurrences, brief factual details are published in the *BASI Weekly Summary of Notifications*. CASA and Airservices are included on the distribution list.
- Confidential Aviation Incident Reports (can relate to specific incidents or general concerns). These vary in terms of the extent to which they indicate safety deficiencies.

1.7.3.1 Comparisons with other time periods

In order to assist the evaluation of occurrence reports related to the demonstration, a comparison was made with the 52-day periods before and after the demonstration, for the same area. The number of incidents relating to airspace procedures in the demonstration airspace (including uncontrolled terminal areas) for each category is presented in table 2. During the demonstration period there was an increase in the number of reported occurrences in all categories.

Other time periods were not analysed in detail in terms of occurrences related to airspace procedures. However, the BASI accident and incident database was searched to identify all accidents and incidents which occurred within the same area as the demonstration, from January 1995 to March 1999. With the exception of the demonstration period, the overall occurrence rate was relatively stable. It was therefore concluded that the 52-day periods before and after the demonstration provided a reasonable baseline for comparisons with the demonstration period. Nevertheless, the reporting of air safety occurrences is necessarily voluntary, and the quality of reports will vary.

Table 2
REPORTED INCIDENTS RELATING TO THE CLASS G AIRSPACE DEMONSTRATION AREA FOR EACH OCCURRENCE CATEGORY

	Time period (each 52 days)		
BASI occurrence category	***Before demonstration***	***During demonstration***	***After demonstration***
Category 3	0	1	0
Category 4 OB	0	2	1
Category 4 PB	5	12	2
Category 5	2	114	5
CAIR	2	4	1
Total	9	133	9

1.7.3.2 Types of incidents

To obtain a better appreciation of the relevance of the occurrence reports to the demonstration procedures, the reports were classified according to the following four types:

1. Conflict. This was defined as an incident where two aircraft were close or potentially close to each other and:
   - evasive action was taken by one or both crews; or
   - both crews were unaware of the existence of the other aircraft (and at least one aircraft was IFR); or
   - one or both crews were aware of the existence of the other aircraft, but the aircraft passed each other without the crews effectively arranging separation (and at least one aircraft was IFR).
2. Potential conflict. This was defined as an incident where there was no actual conflict but the traffic information system was weakened because:
   - appropriate information was not transmitted or received about an aircraft (due to a crew being on the wrong frequency, the presence of IFR aircraft unknown to the system, or incorrect/no information being passed on potentially relevant traffic); or

– if a crew had followed the minimum required and/or recommended procedures, they would have been unaware of the existence of another potentially conflicting aircraft.

3. SAR related incident.

4. Miscellaneous incident.

The number of occurrence reports for each of those types before, during and after the demonstration is presented in table 3.

Table 3
REPORTED OCCURRENCES RELATING TO THE CLASS G DEMONSTRATION AREA FOR EACH OCCURRENCE TYPE

	Time period (each 52 days)		
BASI occurrence category	***Before demonstration***	***During demonstration***	***After demonstration***
Conflict	3	15	3
Potential conflict	3	28	3
SAR-related incident	0	45	2
Miscellaneous incident	3	45	1
Total	9	133	9

For the five category 4 incidents that occurred prior to the demonstration (see table 2), two were conflicts and three were miscellaneous incidents. The three category 4 incidents occurring after the demonstration were all potential conflicts. Of the 15 category 3/4 incidents during the demonstration, there were nine conflicts, three potential conflicts, one SAR-related incident and two miscellaneous incidents. The category 3 incident and both category 4OB incidents were classified as conflicts.

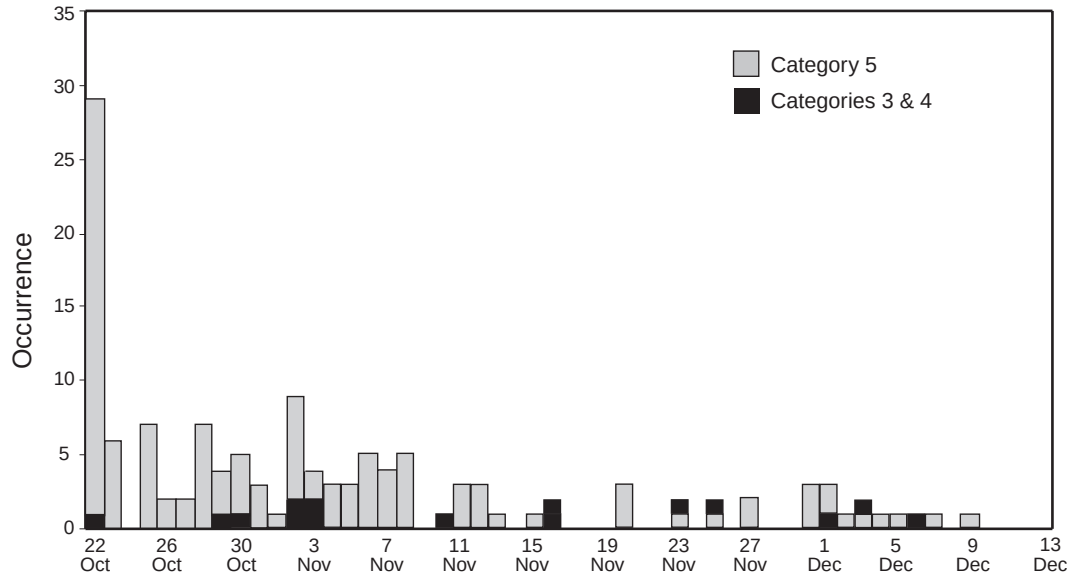
1.7.3.3 Other incidents

In addition to the 133 incidents notified to BASI, a review of the 581 pilot report forms submitted to CASA identified 17 other events which could be classified as either a conflict or potential conflict, using the criteria discussed earlier. Three of those events were classified as conflicts, and 14 were classified as potential conflicts.

1.7.3.4 Frequency of occurrence reports

The distribution of the 133 specific incidents relating to airspace procedures over the 52-day period of the demonstration is shown in fig. 2. There were 27 reports relating to incidents on the first day of the demonstration (22 October 1998). Overall, 80 incidents occurred during the first 2 weeks (22 October to 4 November). That equated to a rate of 40.0 incidents per week, or 30.6 incidents per week excluding the first day. The rate dropped to 14.0 incidents per week in the following fortnight (5 November to 18 November), and to 7.3 incidents per week thereafter (19 November to 13 December). The overall decline in the reporting rate over the demonstration period was largely the result of a reduction in the number of category 5 incidents.

FIGURE 2.
Distribution of incident reports over the Class G airspace demonstration period



The rate of category 3/4 incidents was 3.5 per week in the first fortnight, falling to 1.5 incidents per week in the second fortnight. That rate remained at 1.5 incidents for the remainder of the 52-day period. The rate of category 3/4 incidents during the periods before and after the demonstration was 0.7 per week and 0.4 per week respectively. The difference between the demonstration period (excluding the first 2 weeks) and the baseline periods before and after the demonstration was statistically significant ($\chi^2_1 = 4.4$, $p < .05$).

Of the incidents occurring in the first 2 weeks of the demonstration, 28 were classified as a conflict (8) or potential conflict (20), equating to a rate of 13.0 per week. There were 6 such incidents in the second fortnight (3.0 per week), and 9 during the remainder of the demonstration period (2.6 per week). The rate of those incidents during the periods before and after the demonstration was 0.8 per week. The difference between the demonstration period (excluding the first 2 weeks) and the baseline periods before and after the demonstration was statistically significant ($\chi^2_1 = 11.5$, $p < .001$).

The three category 3/4 incidents during the demonstration which were not conflicts or potential conflicts were evenly distributed throughout the demonstration period (22 October, 3 November and 16 November).

In terms of the other conflict or potential conflict events identified in the pilot report forms submitted to CASA (see section 1.7.2.4), nine occurred in the first 2 weeks, five in the next two weeks, and three during the remaining period. That pattern appeared to be consistent with the overall response rate of the pilot report forms.

1.7.3.5 Factors involved in the incidents

Forty-five of the 133 incidents notified to BASI during the demonstration dealt primarily with SAR related issues. Other issues involved in the 133 incidents were:

- education and training (87 incidents);
- frequency management issues, including workload (57 incidents);
- congestion on the national advisory frequency (6 incidents);
- radar information service limitations (5 incidents).

Inadequate pilot education was found to be linked to confusion experienced by pilots operating in the demonstration area, particularly during the first few weeks. For example, a number of pilots were unsure of the radio frequency they should have been using (see occurrence 9805511 below). SAR related incidents were also largely related to education problems.

Education-related incidents reduced significantly over the demonstration period, from 32.2 per week during the first 2 weeks, 9.8 incidents per week in the following 2 weeks and 1.4 incidents per week for the remainder of the demonstration period. SAR related incidents reduced by similar amounts during the demonstration.

The number of incidents associated with radar information services and the national advisory frequency remained relatively constant during the demonstration; however, the numbers involved were too small to allow any conclusions to be made.

Summary of BASI investigation report on occurrence 9805511 (category 4PB).

On 23 November 1998, the pilot of a regular public transport Twin Otter aircraft reported that he was conducting an instrument approach at Aeropelican. No response was received to the inbound report he made on the CTAF at 15 NM south of the aerodrome. On base leg of the approach, at about 600 ft above ground level, a helicopter was observed to pass to the right of the Twin Otter. The helicopter reportedly passed about 100 ft lower and with approximately 200 m horizontal separation. The Twin Otter pilot made an immediate transmission on the CTAF, but there was no response. The pilot of the helicopter was eventually contacted on the NAF. When questioned as to his intentions, the pilot replied that he was tracking southbound coastal at 500 ft. He said he had not heard the inbound call from the pilot of the Twin Otter and advised that he was confused as to the correct frequencies to operate on.

In terms of frequency management, IFR operations in the Class G airspace demonstration area involved the potential use of a number of different radio frequencies (including the NAF, Flightwatch, RIS, MBZ/CTAF/MTA, Area Control and company operations). The rate of incidents related to frequency management was 12.6 per week in the first 2 weeks, 4.0 per week for the next 2 weeks, and 3.2 per week for the remainder of the demonstration. Occurrences 9804984, 9805078, and 9805530 described below all involved frequency management issues. Prior to the introduction of the Class G airspace demonstration, the crews of each aircraft would most likely have been alerted to the presence of each other through the provision of directed traffic information.

Summary of BASI investigation report on occurrence 9804984 (category 4OB)

On 10 November 1998, prior to departing Lismore, the pilot of a Beechcraft King Air transmitted taxi and departure reports on the Lismore/Casino/Ballina mandatory broadcast zone frequency (MBZ) but received no replies. He then contacted Brisbane Centre for a radar information service (RIS) and was advised that there was no radar observed traffic. The pilot of a Saab SF-340B, which had just departed Casino, was monitoring the Brisbane Centre frequency and heard this report. He then contacted the pilot of the King Air to arrange separation. Shortly after, the pilot of the King Air saw the SF-340B pass underneath his aircraft. Subsequently, the pilots established that they had both transmitted the required MBZ reports but neither had heard the other's transmissions. The SF-340B pilot was not required to monitor the Brisbane Centre frequency, but by doing so he enhanced the crew's situational awareness.

Summary of BASI investigation report on occurrence 9805078 (category 3)

On 16 November 1998, the crew of a BAe Jetstream was maintaining the aircraft at 5,000 ft for separation from a descending Beechcraft King Air. The sector controller transmitted radar information on the Jetstream to the pilot of the King Air. This transmission was not acknowledged by

the King Air pilot and was subsequently reported to have been over-transmitted by another pilot. The King Air was observed on radar to descend through the level of the Jetstream. The two aircraft passed each other with approximately 600 ft vertical separation and 0.5 NM horizontal displacement. The crew of the King Air sighted the Jetstream skimming through the cloud tops in their 11-o'clock position. The crew of the Jetstream were in instrument meteorological instrument conditions and did not sight the King Air.

Summary of BASI investigation report on occurrence 9805530 (category 4PB)

On 1 December 1998, the pilot of a Beechcraft King Air was on descent to Williamtown and was given traffic information on an aircraft at 8,000 ft with transponder code 2000. Although the crew of the King Air and the crew of a Beechcraft 1900 in the area attempted to contact the crew of the unidentified aircraft, two-way communication could not be established on any of the designated frequencies in use for that area. The investigation was not able to determine the identity of the other aircraft or pilot.

1.7.3.6 Geographical distribution of incident reports during the demonstration

The 133 incidents that occurred during the Class G airspace demonstration period were widely distributed across the geographical extent of the demonstration area.

FIGURE 3.
Geographical distribution of incident reports during the demonstration

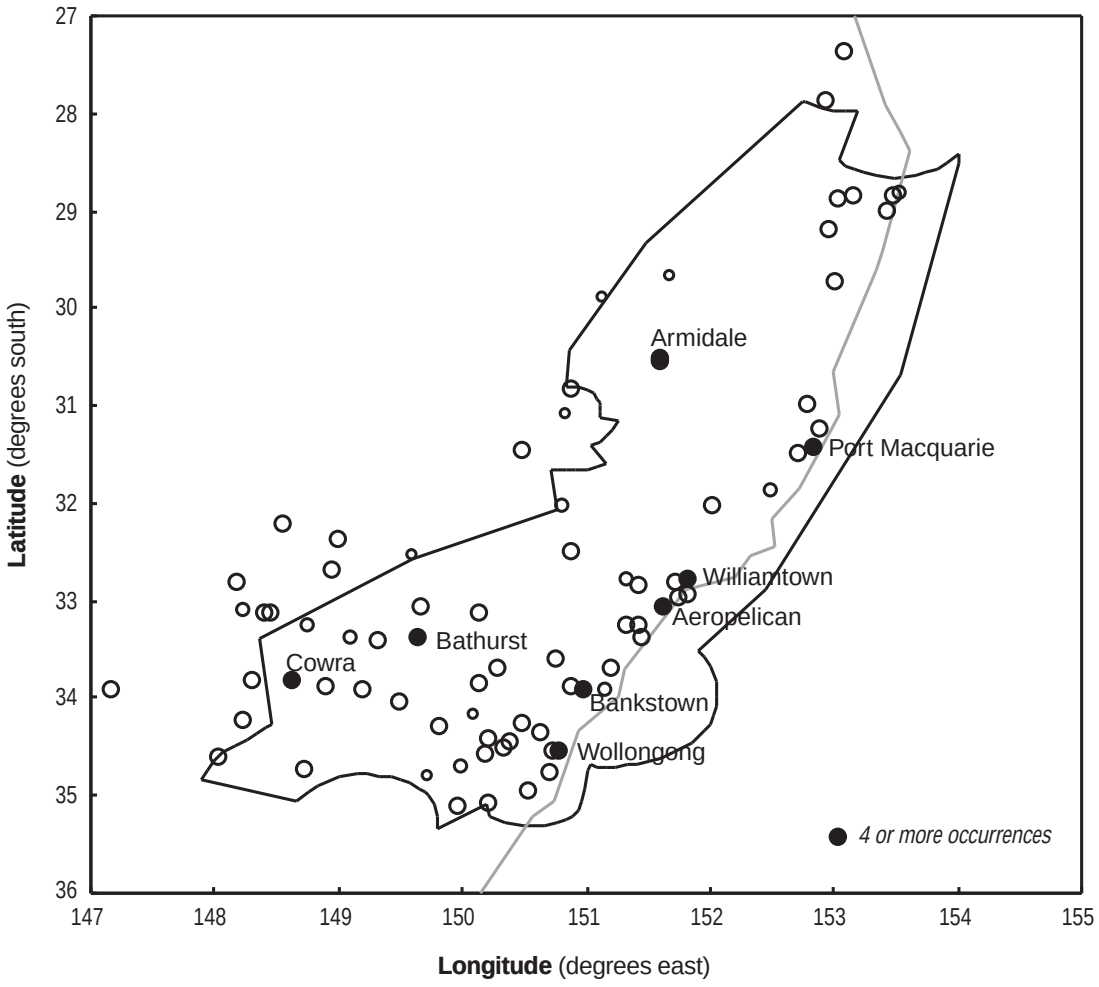


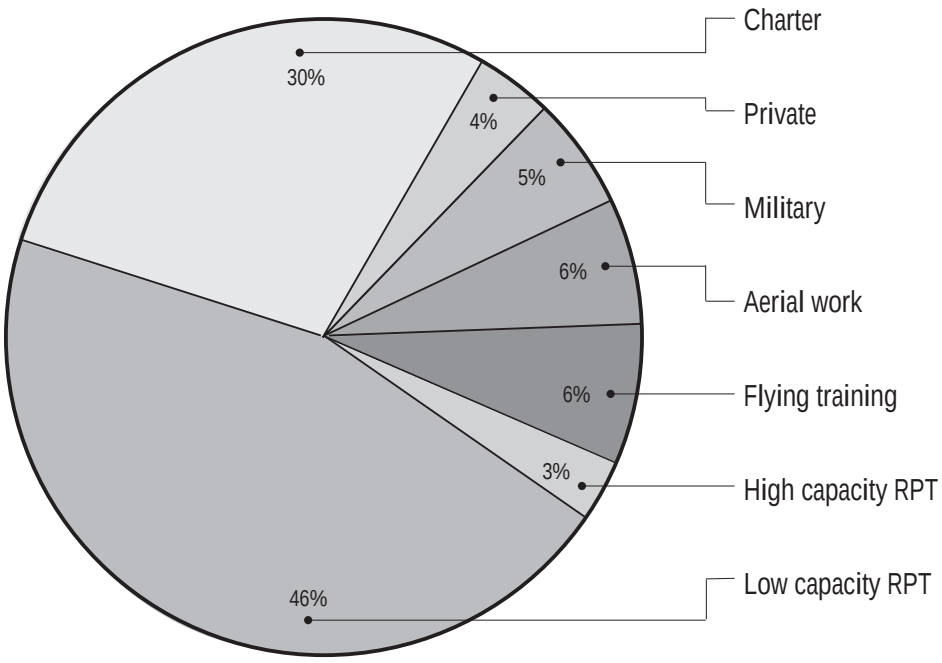
Figure 3 plots the position, as recorded in the BASI database, of each specific incident related to the Class G airspace demonstration. Some incidents had a reported position near to, but outside, the demonstration area. In those cases, the incident concerned airspace procedures related to operations in the demonstration area.

1.7.3.7 Background information obtained from incident reports

Fifteen of the 133 incidents during the demonstration involved two aircraft, hence 148 aircraft were involved in total. Of those 148 aircraft:

- About 94% of flights were being conducted in accordance with the instrument flight rules;
- Information about the type of flight operation being conducted was available for 72% of the aircraft. A breakdown of that data is shown in fig. 4.
- Where the information was available:
  - half of the reported incidents originated from regular public transport services, most of which were low-capacity operations (aircraft certified as having a maximum seating capacity of no more than 38 seats);
  - charter flights accounted for a further 30% of the reports;
  - operations involving fare-paying passengers were the source of 79% of the incident reports;
  - private flying accounted for 4% of reports for which the 'type of operation' information was available.

FIGURE 4
Types of flying operations resulting in incident reports



1.7.4 Changes to procedures during the demonstration

The key document advising details and procedures for the Class G airspace demonstration was AIP SUPP H48/98 (see attachment H), which was issued on 13 August 1998. Changes to common traffic advisory frequency zones, and the introduction of mandatory transponder

areas which occurred in September 1998, were notified to airspace users in a *Flight Safety Guide* supplement, mailed out to all pilots on 18 September 1998. In addition, an amendment to the instructor pack was developed and disseminated.

AIP SUPP H66/98 was issued on 5 November. The purpose of that document was to consolidate all of the changes which had been made to the demonstration procedures since the issue of AIP SUPP H48/98. It also replaced 28 head office and regional NOTAMs, and was to be read in conjunction with AIP SUPP H48/98.

Over 30 notices to airmen (NOTAMs) regarding the Class G airspace demonstration procedures were issued before and during the demonstration period, including 13 that promulgated significant changes. The remainder detailed changes at specific locations, while also referring pilots to the 13 general NOTAMs. Many pilots interviewed by the investigation team stated that they found the proliferation of NOTAMs difficult to comprehend, and were concerned that in searching through significant amounts of material, they may have missed relevant information. That was confirmed when the investigation revealed deficiencies in the knowledge of some pilots who believed that they had accessed all relevant information. Some pilots indicated that cross-referencing of NOTAMs related to the demonstration would have been very useful.

Other problems experienced by flight crew with regard to NOTAMs included:

- NOTAMs that specified changes to occur at short notice. For example, NOTAM CO138/98 (issued 21 October) detailed significant changes to the demonstration procedures which had occurred up to that time. The NOTAM was issued approximately 18 hours before the demonstration commenced, giving pilots very little time to prepare for flight in the demonstration airspace.
- NOTAMs that were issued to update previous NOTAMs. Pilots reported that the changes were often not obvious. For example, NOTAM CO139/98 (issued 21 October) consisted of one and a half pages of airspace and procedural changes that related to the demonstration area. That was replaced on 3 November by NOTAM C148/98 containing large amounts of text similar to the previous NOTAM. However, Coffs Harbour had been deleted from a list of seven mandatory broadcast zone aerodromes above which the NOTAM established a mandatory transponder area. In addition, the requirement for pilots of aircraft transiting a mandatory transponder area to monitor the national advisory frequency was changed to include an additional requirement for pilots in five specific mandatory transponder areas to monitor the CTAF/MBZ frequency relevant to the aerodrome. Pilots in other mandatory transponder areas were still required to monitor the national advisory frequency.
- Many NOTAMs were multi-page documents that pilots said required considerable time to read and absorb. Pilots also reported that some of the NOTAMs were poorly worded or ambiguous. For example, NOTAM CO160/98, which was planned to take effect from 24 November 1999, included the cancellation of three mandatory transponder areas, and changes to several common traffic advisory frequencies. The NOTAM also advised that the changes would be confirmed by the issue of a replacement to AIP SUPP H66/98. The implementation date was amended by later NOTAMs to 26 November, 30 November and finally, 1 December. When the replacement AIP SUPP was not issued by 1 December, the industry was unsure whether the changes were to go ahead. NOTAM CO172/98, issued on 1 December, stated: 'AIP SUPP H69/98 cancelled before issue and that H66/98 remains current until further notice'. That was insufficient to clarify the situation, and for approximately 24 hours some pilots operated as though the changes had taken place, while others used the old procedures.

On 2 December 1998, BASI provided written advice to CASA demonstration staff that uncertainty about the changes was resulting in the use of two different frequencies in the Bathurst CTAF. NOTAM CO050/98 was issued later the same day, stating that the CTAF for Bathurst was to remain as 126.7 MHz.

CASA Airways and Airspace Standards Branch employees responsible for preparing the NOTAMs and AIP SUPPs stated that there was a lot of time-pressure involved in producing some of the documents.

1.7.4.1 Educational implications of the late changes to procedures

On 15 November 1998, the communications consultant involved in the CASA Airspace 2000 program provided a detailed report to the General Manager Airways and Airspace Standards Branch concerning the educational implications of the late changes to the new Class G demonstration procedures. The consultant strongly argued that those changes had resulted in education material being out of date and inaccurate by the time the demonstration had commenced. He stated that the situation had the potential to seriously impact on safety, and was not addressed by CASA. His report also stated that:

> ...the Instructor Pack and the Flight Safety Guide, the two primary supports to AIP SUP H48/98, [were] deficient in accurate content prior to the introduction of the Demonstration of Modified Class G Airspace Procedures. This situation, from both an educational and communications perspective, is as much irresponsible as it is illogical.

The report also noted that, as late as 15 November 1998, the CASA website still listed the outdated Instructor Pack and encouraged its downloading.

The consultant's report stated that CASA did not have a process to assess the ability of pilots to understand and adapt to proposed amendments to procedures, before they were introduced. It recommended that CASA appoint a senior manager to oversee a program to ascertain the knowledge and understanding within the aviation industry of the new procedures. In addition, it recommended that CASA convene a representative group of flight instructors from both airline and general aviation to evaluate the impact of the amended changes. It was suggested that the group include a representative from BASI with expertise in human factors, and an Airservices representative with a background in quality assurance. Those recommendations were not acted upon.

The report also recommended that CASA formally advise the aviation industry that the *Flight Safety Guide* was obsolete and should be 'destroyed'. Unlike the Instructor Pack, it was not designed for amendment. The *Flight Safety Guide* posed a potential safety threat as it contained inaccurate operational information. It was noted that a glossy, well produced publication such as the guide was likely to be retained by both pilots and organisations and therefore had the potential to provide misinformation in the future.

The consultant recommended a high-level evaluation be undertaken of change management processes to ensure objective consideration of the impact of 'last minute' policy decisions on system integrity. That was seen as especially important for national education and communication campaigns concerning major change programs.

1.7.5 Views of the demonstration project team

Interviews were held with the eight CASA Airways and Airspace Standards Branch staff who had worked on the demonstration, including the branch manager. The two Airservices members of the project team were also interviewed. Two members of the project team felt they could not comment on the viability of the demonstration due to their limited involvement. Six

of the other eight team members stated that the demonstration should have ended when, or before, it was actually terminated.

Four of the CASA staff cited safety concerns reflecting those stated in the monitoring report as their reasons for supporting termination. They had made their opinions known to the General Manager Airways and Airspace Standards Branch, but he stated that he did not pass that information on to higher management. Another member of the project team observed that the weather conditions had been generally favourable for the first 6 weeks of the demonstration. Had the weather conditions not been so favourable, the risk levels would have been higher.

Several members of the project team stated that the demonstration should have been terminated because the purpose of the demonstration had become unclear, and the airspace model had become unnecessarily complex. As a result, they believed the model was not suitable to be rolled out in other areas of Class G airspace, citing changes made on 3 November as the 'final straw' in reaching their conclusions. The CASA Chairman also stated to the investigation team, prior to termination of the demonstration, that the model was too complex and not suitable for a national rollout.

One Airways and Airspace Standards Branch staff member sent an internal memorandum on the demonstration to other branch members and to the Assistant Director Aviation Safety Promotion on 13 November 1998. The document contained the following statement:

> How comfortable can CASA be that the now very complex system and the information dissemination are sufficiently robust for the demonstration to continue?

However, members of the demonstration project team also reported that, despite the problems encountered, the demonstration had provided a lot of useful information which could be used for planning further changes to Class G airspace procedures.

1.7.6 Views of pilots during the demonstration

BASI interviewed 41 pilots from all levels of the aviation industry, and from locations throughout the Class G airspace demonstration area. Seventeen of those interviewed were from the general aviation sector, with the remainder from the airline sector. Each interview contained a standard set of questions designed to enable BASI investigators to form an overall assessment of pilot's experiences, and to facilitate further questioning when considered necessary.

The main observations obtained from the interviews were:

- The education program was generally poor, and the education materials lacked specific guidance in many important areas.
- There was insufficient rigour/operational experience applied in the CASA assessment of operational implications of the demonstration.
- The timing of training by operators varied; approximately half the organisations had conducted training prior to 8 October 1998, but the others waited until 21 October.
- To achieve 'proper education' required a freeze of operational changes, which did not occur.
- There was a general industry perception that the demonstration was not going to commence, as was the case with the 11 November 1993 cancellation.
- The radar information service, which was available approximately 90% of the time, was generally regarded as a good service.

- Frequency management was a significant pilot workload issue for multi-crewed aircraft, and was generally regarded as unacceptable for single-pilot IFR charter and airwork operations.
- National advisory frequency congestion was an issue that was largely associated with 'bank runner' departures from and arrivals to Bankstown (0630–0730 and 1800–1900, Monday to Friday).
- National advisory frequency congestion could be very frustrating and distracting, and had the potential to prevent the transfer of vital information.
- No information was generally available regarding reliable air traffic control radar coverage to enable pilots to plan their trip to best utilise radar information services for traffic conflict avoidance.
- There was some misunderstanding regarding what a radar information service actually provided. Some pilots inadvertently entered control areas/restricted airspace while receiving a radar information service because they were expecting the controller to give advice when they were approaching airspace boundaries.
- There was a large degree of confusion about SAR procedures, resulting in many operators arranging their own SAR alerting in an ad hoc manner, or in some cases 'not bothering'.
- Some operators were avoiding the demonstration airspace altogether, or during adverse weather.
- There was a general perception that most pilots operating from aerodromes within the demonstration area became more familiar with applicable procedures as the demonstration progressed; however, problems inherent in the design of the Class G airspace demonstration procedures persisted.

In an Airways and Airspace Standards Branch report on the first 4 weeks of the demonstration, the following was stated regarding AOPA and the demonstration:

> AOPA expressed concerns about the late changes made to the airspace model, the effectiveness of the pilot education program, the amount/consistency of radar coverage, the distribution of radar coverage, the distribution of information about late changes through AVFAX had been unsatisfactory and the amount of unnecessary chatter on the NAF.

Although AOPA had interviewed 102 of its members, none had significant problems with the demonstration. The Association indicated strong support for the Class G demonstration.

1.7.7 Views of controllers during the demonstration

A representative sample of air traffic services personnel from each of the three Airservices districts were interviewed after the commencement of the demonstration. Air traffic controllers cited a range of safety concerns with the new procedures. A number of controllers indicated that they had witnessed incidents related to the demonstration, including occurrences involving violations of controlled airspace. They reported that some pilots believed that the provision of a radar information service meant that the controller was monitoring the position of their aircraft in relation to controlled airspace boundaries. Aircraft had also re-entered controlled airspace after a radar information service had been terminated, or they had infringed other control areas. Aircraft were entering the base of controlled airspace without a clearance. At times, providing a radar information service could be an added distraction to the controller when vectoring aircraft. In some cases, pilot requests for a radar information service were made at inappropriate times, over-transmitting the controller.

Another concern raised by controllers was that pilots were not always aware of other traffic in mandatory transponder areas. For example, one aircraft might be on the national advisory frequency while another was on the control frequency. Management of radio frequencies was a recurring problem. That was particularly evident in the case of single-pilot operations.

Overall, controllers indicated that the effect of the new procedures on controller workload was variable but in most cases not significant. Provision of a radar information service had increased workload for some controllers, particularly at certain busy times, but most requests from pilots for that service could be accommodated. Controllers commented that over the duration of the demonstration there was an increase in the number of pilots asking for radar information services. One controller stated that traffic levels had been less than anticipated. Another reported that traffic could build up very quickly, and that at times it could be difficult to manage. Pilots also tended to request a radar information service for as long as possible.

Other reported concerns related to radio phraseology and SAR procedures. Controllers also reported that because taxi calls were no longer relayed to controllers by flight service, there was less warning of departing aircraft. One controller was of the opinion that without monitoring by flight service there would be more undisciplined use of radio frequencies. There were additional concerns about changes being made to the procedures 'on the run'.

Controllers highlighted a poor understanding of the new procedures by many pilots due to a lack of effective training. For example, pilots would contact ATC on the wrong frequency, or not answer calls from the controller. Other pilots would leave a frequency without advising air traffic control. That created an extra workload as the controller attempted to 'find' the aircraft on another frequency and advise the pilot of his/her mistake. There was also ignorance about correct phraseology and reporting requirements, including pilots of IFR aircraft. A number of controllers mentioned an increase in workload due to the necessity for them to carry out pilot briefings over the radio. The need for those briefings decreased over time.

Some controllers commented that while the proposed procedures had merit in principle, the implementation left much to be desired. There was support for the greater utilisation of radar, but it was felt that it needed to be adequately resourced. Initially the demonstration had been very confusing. Such confusion had reduced with time, but had not ceased completely. It appeared that there had been insufficient planning of the changes, and issues that had not been properly addressed were still arising.

1.8 Management Issues

1.8.1 CASA management structures

When the new CASA Director commenced duty on 1 July 1998, he had 15 regional or branch managers reporting directly to him, including the General Manager Airways and Airspace Standards Branch. However, during the latter half of 1998, a new CASA organisational structure was progressively introduced. Under the new structure, branch and area managers were to report to one of four assistant directors. The General Manager Airways and Airspace Standards Branch was to report to the Assistant Director Aviation Safety Standards who, although appointed in July, did not take up that position until 19 October 1998. As a result, an Acting Assistant Director Aviation Safety Standards was appointed on a consultancy basis for the period from July to October 1998.

CASA was to have overall responsibility for the carrage of the Airspace 2000 Program. The intended program management structure was outlined in the *Program Definition Plan*. Airways and Airspace Standards Branch staff, in project teams, were to report to the General Manager

of that branch, who was then to report to the program control group (see attachment G). In actual practice, for most of the demonstration project the General Manager reported to the Chairman (see section 1.8.4).

The Director was a member of the program control group. On 1 December 1998, the Assistant Director Aviation Safety Promotion assumed responsibility to oversee the Airspace 2000 program. Although Airspace 2000 activities would have expected to have been the responsibility of the newly appointed Assistant Director Aviation Safety Standards, he was less aware of Airspace 2000 issues. A new Airspace 2000 Branch was formed with staff drawn from the Airways and Airspace Standards Branch. Airspace 2000 Branch staff reported to the Assistant Director Aviation Safety Promotion. The remainder of the Airways and Airspace Standards Branch continued to report to the Assistant Director Aviation Safety Standards.

1.8.2 Roles and functions of the CASA Board

Section 32B (1) of the *Civil Aviation Act 1988* stated:

> The purposes of the Board are:
>
> (a) to decide the objectives, strategies and policies to be followed by CASA; and
>
> (b) to ensure that CASA performs its functions in a proper, efficient and effective manner.

Section 84A (1) of the Act stated:

> The Director is, under the Board, to manage CASA.

As a normal part of the investigation, four current CASA Board members, other than the Chairman, were interviewed about the role and function of the Board. One would not comment on those issues. The others stated that the Board should act in a strategic role and not be involved in implementing strategies. One of these stated that the Board was not unanimous on the issue.

The Director stated during an interview that he was currently working on developing a Board charter to clearly define the roles of the Director and the Board, and the processes by which the Board should interact with the rest of the organisation.

1.8.3 Guidelines for the relationship between Board members and staff

During its first meeting on 18 August 1995, the CASA Board considered issues associated with how it should deal with correspondence, contact with CASA staff, speeches, and media relations. The Board agreed to nine proposals, including that all correspondence received by the Chairman on operational issues be referred to the Director for reply direct, and that all Board members' visits and contact with CASA staff, or staff from other organisations, be coordinated with the Corporate Relations Branch. Those arrangements were discussed in the Board meeting on 26 June 1996, and it was agreed that they were working well.

For the Board meeting on 23 May 1997, a paper was submitted by the then Chairman to inform new Board members of the existing Board policy on certain matters. Paragraph 2.2 of the paper stated:

> In relation to members' contact with CASA staff, it is Board policy for all written and oral contact to be made through the Office of the Director or the General Manager, Corporate Relations. This is designed to ensure that Members receive timely and coordinated advice on the issues they have raised. It also provides CASA staff with a clear policy position if approached by Board Members.

After discussing various issues concerning the Board's operation, the Board agreed that all operational correspondence addressed to Members of the Board would be referred to the

Director for response. They also confirmed the arrangements agreed to during the 18 August 1995 meeting regarding correspondence, contact with CASA staff, speeches, and media relations. Those arrangements were again noted by the Board during their meeting on 18 July 1997.

1.8.4 The role of the Chairman of the CASA Board in Airspace 2000

The Chairman was originally appointed to the CASA Board in May 1997 as Deputy Chaiman. He was appointed as Chairman in December 1997. Prior to joining the Board, the Chairman had a long history of involvement in airspace reform activities. As a previous Chairman of the Civil Aviation Authority (1990–1992), he oversaw the introduction of airspace changes in 1991. Later, as the President of the Aircraft Owners and Pilots Association (AOPA), he was involved in developing the Australian Aviation Industry Association policy on airspace reform in 1995. He was a member of the Airspace Steering Group in 1996, and became leader of the design team for Airspace 2000 during that year.

During the investigation, senior CASA personnel reported that the CASA Chairman had a significant interest and experience in airspace issues, together with a strong desire to ensure that those issues were developed along particular lines.

Evidence obtained during the course of the investigation showed that the Chairman had assumed direct executive control over Airspace 2000 issues. Interviews were conducted with the members of staff within the Airways and Airspace Standards Branch involved in the Class G airspace demonstration, including the General Manager and the program manager. They reported that for most of the demonstration project, the program manager and other staff reported to the General Manager, who reported directly to the Chairman. Except for the involvement of the Director towards the latter stages of the program, the Chairman made or approved most of the decisions regarding the demonstration.

Staff members stated that all documents and agreements were sent to the Chairman for checking and clearance, and that the Chairman was heavily involved in the writing of many documents, including AIP SUPP H48/98, the draft final rule, and training material. Moreover, the Chairman had almost daily telephone contact with the General Manager and individual team members, providing suggestions, directions or requirements for aspects of the demonstration. Airways and Airspace Standards Branch staff stated that, in effect, the Chairman acted as the Airspace 2000 program manager.

A review of CASA documentation associated with the demonstration found that minutes from the Chairman were sent to team members on a frequent basis, providing suggestions or instructions regarding the demonstration and other Airspace 2000 program issues. The Chairman was not involved in project meetings with the industry, Airservices personnel, Defence force personnel, or the program control group.

On 11 June 1998, the General Manager Airways and Airspace Standards Branch sent a minute to the Acting Director about the chain of command on airspace issues. The minute stated:

> Given that you will soon be handing over control of the organisation to the incoming Director, I suggest that he be made aware of the Chairman's 'ownership' of the Airspace 2000 program and the fact that he is heavily and directly involved in management of the program and development of the procedures on a day-to-day basis.
>
> This very direct working relationship between a general manager and a Board Chairman could be viewed as unusual and open to misinterpretation. I would also appreciate advice if the new Director wishes to vary the current arrangements.

No response to that minute was found on files made available to BASI. Airways and Airspace Standards Branch staff stated that the Chairman maintained his close involvement with the demonstration after the arrival of the new Director on 1 July 1998.

With regard to the direct and frequent contact that the Chairman had with Airways and Airspace Branch personnel, the branch staff commented that they found this disruptive, indicating that such contact distracted them at times from their branch priorities, and could be intimidating. A number of staff noted that receiving instructions or suggestions from such a senior person in the organisation, and the manner in which those communications were sometimes delivered, also made them uncertain of their position.

A number of Airways and Airspace Standards Branch and other CASA staff believed that such close involvement by the Chairman was a safety issue because of the potential weight which would be given to a directive or comment made by the Chairman to an individual. If staff did disagree with his instructions or suggestions, then the means for recourse were not clear. Branch staff commented that the Chairman discouraged any decisions that he did not agree with, and also discouraged activities which may have delayed the implementation process. Moreover, staff commented that the Chairman was also reluctant to change his mind on many issues.

Due to concerns about the direct contact between the Chairman and Branch staff, the Assistant Director Aviation Safety Standards raised the issue with the Chairman during a general discussion on 27 October 1998. He advised the Chairman that he would prefer that all contact with Branch staff came through his position. The Assistant Director made that same request a few days later, requesting a response in writing. Subsequently, the Chairman generally notified the Assistant Director prior to contacting any Branch staff.

On 26 November 1998, the Chairman wrote to the Director concerning his (the Chairman's) involvement with airspace matters. The memorandum stated in part:

> Following discussions with [Assistant Director Aviation Safety Standards], I thought I should confirm my involvement with airspace and other issues.
>
> Firstly, I do not wish to be involved in any detail at all in relation to airspace or other issues. As Chairman I should be involved with the Board in setting policy and strategic direction.
>
> Having said this, until we have a person who has the knowledge and time to understand the full airspace package and be able to prepare material promptly without errors, and to communicate the need for change to stakeholders, it is absolutely imperative that I, and other Board members, and anyone else with any added skills, are involved with the detail of the issues – especially before they are sent out for public comment or for action.

In correspondence from the Chairman to the Director on 25 and 26 November, the Chairman noted that he did not support the changes that had been made to the airspace model on 3 November. The Chairman was concerned that the changes did not conform to proven international procedures and ICAO recommendations. He also stated a concern that AIP SUPP H66/98 contained errors which could have been identified if he had seen the document beforehand.

1.8.5 Involvement of senior management

Airways and Airspace Standards Branch staff commented that senior management in CASA appeared to be reluctant to be involved in the program until the later phases. Although the Acting Director was present at key meetings with external agencies, and was involved in administrative and financial approvals, he was not closely involved in making any decisions regarding the direction or scope of the Airspace 2000 program or the Class G airspace demonstration.

A review of CASA documentation associated with the demonstration noted that the new Director first attended the program control group meeting on 23 July 1998. After that, he began to be involved in activities to address the concerns of the regional airlines. He then made certain key decisions before and during the demonstration. The Director later stated that he would probably have postponed the demonstration in July, had he been more aware at that time of all the associated problems. He questioned the suitability of conducting the demonstration prior to the implementation of TAAATS, but also commented that, had he made a recommendation to defer the demonstration, it would not in his opinion have been viewed favourably by the Board.

CASA has advised that there were significant problems in CASA's leadership and management structures during the period in which the Class G airspace demonstration was being planned and developed. CASA suggested that the problems were so endemic that they had an adverse impact on its capacity to deal with a substantial project such as the demonstration.

1.8.6 Decision-making processes

Airways and Airspace Standards Branch staff were asked about how decisions were made during the planning and implementation of the Class G airspace demonstration. The majority of the staff believed that many decisions were made in an ad hoc, reactive manner, stating that the project appeared to be rushed, and that issues were not always fully addressed.

Particular decisions or actions which staff commented upon included:

- the limited industry consultation before the procedures were scheduled to be finalised on 1 July 1998;
- the level of safety analysis and preparatory work, such as risk modelling, pro-active testing of the national advisory frequency, testing of operational procedures, and full analysis of pilot workload; and
- the late changes which occurred after procedures should have been finalised.

In terms of factors contributing to those decisions or actions, Airways and Airspace Standards Branch staff reported the following issues:

- an apparent unwillingness by some parts of the airline industry to approach the demonstration in an objective, constructive manner, and to modify their operational procedures for the demonstration;
- the firm deadlines for the demonstration, which occurred due to TAAATS implementation issues;
- the unwillingness of the CASA Chairman to deviate from a pre-determined position on many issues; and
- a lack of appropriate review mechanisms.

With regard to review mechanisms, many staff members from CASA and Airservices who were interviewed commented that had Airservices been the lead agency in the demonstration, CASA would have required a safety case and a more documented process than CASA appeared to require of itself. They stated that because CASA was so closely involved in implementation, it had lost the impartiality it would have applied, had Airservices been the lead agency. In addition, they noted that CASA's direct involvement also removed the ability of affected parties to appeal to an agency to resolve safety issues and disputes.

On the other hand, some CASA personnel commented that CASA had to make decisions, and that things could not be reviewed endlessly. They stated that the Airspace 2000 program had previously been reviewed by CASA, and that it was now being implemented.

Airways and Airspace Standards Branch staff stated that there was a problem with CASA's internal review mechanisms due to the Chairman's close and direct involvement in the demonstration. They noted that the Chairman's involvement effectively removed the intermediate management levels, and the normal checks and balances which helped ensure that issues were fully considered. The normal evolutionary process for the development and implementation of projects was circumvented all the way up to the Board of the organisation.

Airservices personnel involved in the planning and implementation of the demonstration expressed concerns regarding the failure of CASA to meet its agreed obligation to undertake effective industry consultation and finalise procedures by 1 July 1998. They also expressed concerns about the difficulty in obtaining agreements from CASA on certain issues, stating that although details may have been agreed upon with CASA staff, the CASA Chairman would often amend them soon after.

Both CASA and Airservices personnel reported that their organisations were committed to the demonstration to the extent that there appeared to be no intention of reverting to the previous system once the demonstration started. As a result, some suggested that both organisations had lost the ability to be objective.

1.8.7 Involvement of the CASA Board

As a normal part of the investigation, Board minutes and associated documents were reviewed to examine the degree of Board involvement in the Airspace 2000 program, and the Class G demonstration in particular. Board members indicated to the investigation team that the minutes were a comprehensive record of all Board discussions, including any debate on an issue as important to CASA as Airspace 2000. However, the investigation team noted that the Board minutes generally contained less detailed discussions after September 1997, and that reasons for certain key Board decisions were generally not documented.

As discussed in section 1.5.5, the Board was asked to note the 7 April version of the Airspace 2000 Program Definition Plan during the Board meeting on 17 April 1998. The Board subsequently decided that a new program management structure should be prepared to more clearly illustrate how industry was to be involved. In addition, the Board decided that the CASA Chairman, and Chairman of the Safety Committee, while acting as advisors, should not be members of the control group, nor should the Board Chairman be the program sponsor.

No reasons were provided in the minutes for the Board's decisions. Interviews were conducted with several of the Board members who were at that meeting. One Board member stated that he had made it clear during the meeting that it was inappropriate for Board members to be involved in implementing an airspace change or any other project. He stated that this was the role of the Director, who should set up the appropriate team to conduct the task. Another Board member could not recall the actual discussion, but noted that the decision was appropriate in terms of 'corporate governance'. The member also stated that the Board should set strategies and policies to be followed, and that the Director should ensure they were carried out. He also stated that the Board should not get involved in the implementation of those strategies and policies. Another Board member who was at the meeting shared that view.

Despite those views, CASA management reported that the Board was aware of the Chairman's ongoing, direct involvement in airspace projects. In addition, CASA management stated its view that the Board was entitled to rely on the Chairman to draw to its attention any issues requiring more detailed consideration on its part.

There was no discussion regarding Airspace 2000 or the Class G demonstration recorded in the minutes of the June and July 1998 Board meetings. During the August meeting of the Board, the Director reported that a meeting had been arranged to discuss airline concerns. The Director also noted that he had arranged for a team from the UK Civil Aviation Authority to provide an independent assessment of the safety case. During the meeting, one Board member asked the Chairman why CASA was proceeding with the demonstration. The Chairman's explanation related to the issue of radar coverage being available but unused in the demonstration area. Board members provided various suggestions for promoting the demonstration. There were only brief comments recorded in the minutes of the September and October meetings of the Board regarding the Class G demonstration.

The 27 November 1998 Board meeting lasted approximately 8 hours and exclusively discussed the Class G demonstration and Airspace 2000 issues. The minutes of that meeting contained a number of resolutions, but little discussion of the reasons why such resolutions were made. The minutes recorded a discussion about data which suggested that higher risk existed around a terminal area than in the Class G demonstration. The Board also discussed issues associated with the relationship between Airservices and CASA regarding the designation of airspace, and that there were issues to be resolved on that matter.

When interviewed, Board members stated they had been satisfied that the demonstration should proceed. They reported that they were under the impression that consultation, education and safety analysis activities had been appropriately conducted. The Board had no concerns collectively about the demonstration. One Board member commented that, while the Board was aware that not all industry supported the changes, they believed that most of the industry generally supported the demonstration.

Airways and Airspace Standards Branch staff expressed concern that they had wanted the Board to 'approve' the *Program Definition Pla*n, but it was only passed to the Board to 'note'. The General Manager Airways and Airspace Standards Branch was never asked to attend a Board meeting. Except for the draft concept plan and draft *Program Definition Plan*, no other documents were submitted to the Board by Airways and Airspace Standards Branch personnel regarding the demonstration.

2 ANALYSIS

2.1 Introduction

The events and circumstances associated with the development of the Airspace 2000 program and the G airspace demonstration are complex. The purpose of this analysis is not to review all of the previous detail, provided in section 1.1 to 1.8, but to identify and examine key issues. That process is necessary in order to gain an insight into the factors that contributed to this failure of an attempt to bring about a significant change to the operation of Australian airspace. Those key issues are discussed in terms of:

- *operational safety factors* which existed during the demonstration;
- *project management factors* which contributed to the occurrence of the safety factors; and
- higher-level *organisational factors* which contributed to the project management factors.

It should be re-emphasised that it is not the purpose of the investigation to determine blame or liability, but to explain how and why events unfolded as they did. A series of apparently unrelated safety events may be regarded as tokens of an underlying systemic failure of the safety system. The investigation, while not an audit, having determined the facts as best it can, needs to look beyond actions at the operational level, in order to understand the organisational processes and management decisions that influenced those actions. The investigation can also provide an insight into the safety health of the organisations involved, and any consequent effect on the wider safety system. Such a process facilitates the development of effective recommendations aimed at improving aviation safety.

Each of the following sections of the analysis is associated with one or more significant findings in section 3.

2.2 Operational Safety Factors

2.2.1 Specific safety issues

During the demonstration, a number of safety issues were identified from air safety incident reports submitted by pilots and air traffic controllers, pilot feedback reports, and other monitoring activities. The CASA demonstration project team outlined many of those issues in their report on the first month of the demonstration (see section 1.7.2.6), which were consistent with those identified by BASI. Although the extent of some of the problems was difficult to quantify, the primary safety issues included the following:

- The operation of the national advisory frequency was associated with regular occurrences of frequency congestion and over-transmission. The extent of those problems fluctuated from day to day, but on average did not decrease significantly over the period of the demonstration.
- Due to the physical limitations and variability of radar coverage and controller workload, the availability of the radar information service proved unreliable as a tool for traffic information, and consequently did not meet industry expectations.
- Pilot workload generally increased during the demonstration, particularly for single-pilot instrument flight rules operations. The main factor contributing to the higher workload was the need for pilots to use multiple radio frequencies. The introduction of the mandatory transponder areas was intended to reduce the need for regular public transport pilots to use the national advisory frequency. However, due to a lack of confidence in the

reliability of the radar information service, pilots continued to make use of the national advisory frequency.

- A significant proportion of pilots had a low level of knowledge of the demonstration procedures. For example, 87 of the 133 incidents notified to BASI involved education and training issues, while 45 incidents involved SAR related issues mainly resulting from confusion and a lack of awareness.

2.2.2 Changes in safety levels during the demonstration

CASA received a total of 581 written or telephone pilot feedback reports during the demonstration period. Many of those reports outlined operational concerns. The frequency of those reports generally decreased as the demonstration progressed, although there appeared to be an increase for a short period after the changes introduced on 4 November. It could be argued that the overall reduction in pilot reports was a measure of their greater familiarity with the new system, with a consequent improvement of safety. However, the frequency of pilot reports is not considered to be a very reliable indicator of safety levels. The reports were essentially feedback reports rather than air safety incident reports. It could also be argued that the decrease in the rate of reports was due, at least in part, to 'reporting fatigue', and it is likely that many pilots did not see a need to report the same issues or concerns on multiple occasions.

Of the 154 occurrence reports notified to BASI relating to the Class G demonstration, 133 related to specific incidents. The issues described in the incident reports were consistent with the shortcomings identified through other information sources (see section 1.7) during the course of the investigation. The frequency of air safety incidents reported to BASI decreased as the demonstration progressed, largely due to a reduction in the frequency of category 5 incidents. Much of the decrease was associated with a reduction in the frequency of incidents related to education and SAR issues.

The frequency of category 3 and 4 incidents was higher during the first 2 weeks of the demonstration than the remainder of the demonstration period. However, the rate remained stable over the rest of the demonstration period. There was also a decrease in the reporting rate of conflicts and potential conflicts after the first 2 weeks of the demonstration. Again, the rate stabilised after that initial period. However, the rate of incidents associated with frequency management/workload problems appeared to remain relatively constant throughout the demonstration.

The air safety incident data should be treated with caution. While the decrease could be attributed in part to pilots becoming more familiar with the new procedures, many factors could have affected the reporting of incidents during the demonstration period. The Class G airspace demonstration was a contentious issue in the aviation community, and was also the subject of significant media coverage. This acted to heighten pilots' and controllers' awareness of the issues, and probably influenced their respective views. Many factors could have influenced the reporting of incidents during the demonstration, including the following:

- Some pilots and controllers may have been more inclined to report incidents during the demonstration because they were opposed to the new system.
- Some pilots and controllers may have been less inclined to report incidents during the demonstration because they were in favour of the new system.
- Some pilots and controllers may have been more inclined to report incidents during the demonstration due to a heightened awareness of safety issues and incident reporting responsibilities.

- Traffic levels during the demonstration may not have been a true representation. For example, some operators did not use the demonstration airspace or placed restrictions on operations within the area.

Measurement of usage of the national advisory frequency was another means by which data were collected to monitor safety levels during the demonstration. A major concern associated with the demonstration was congestion on the national advisory frequency. However, measurement of the level of communications on that frequency was limited, as the sampling only took place from one location for relatively short periods during the first and fifth weeks of the demonstration. Although the data showed no appreciable difference in the amount of national advisory usage during those periods, the limited amount of data collected did not allow for reliable analysis. The data that was collected suggested that at times the frequency was very busy, but not congested to the point of being unusable. However, one of the main observations gained from BASI interviews with pilots was that national advisory frequency congestion could be very frustrating and distracting, and that it had the potential to prevent the transfer of vital information.

2.2.3 Differences in safety levels between systems

Although there were clearly some operational safety problems during the demonstration, there were also operational safety problems in the current Class G airspace (see section 1.2.3). It is not BASI's specific role to evaluate the overall safety of one system versus another, albeit general comparisons can be made in terms of two variables—incident rates and risk analysis results.

In terms of incident rates, there were clearly many more reported incidents concerning Class G airspace issues during the demonstration period (133 incidents) than during equivalent periods immediately before (9 incidents) or immediately after (9 incidents) the 52-day demonstration period.

As indicated in section 2.2.2, non-operational factors associated with the lead-up to the Class G demonstration may have influenced the incident reporting rate. Nevertheless, it is reasonable to assume that such reporting biases would be considerably moderated for more serious incidents. During the demonstration period, the rate of category 3/4 incidents was approximately four times higher than it was during equivalent periods before or after the demonstration. Most of those incidents involved fare-paying passenger flights. Although the rate of category 3 and 4 incidents decreased after the first two weeks of the demonstration (3.5 incidents per week), it remained constant after that period (1.5 incidents per week). Both rates were higher than the baseline periods before and after the demonstration (average of 0.5 incidents per week). A similar pattern of results was found for those incidents classified as conflicts or potential conflicts. Although only small numbers were being used in those analyses, the differences were statistically significant ($\chi^2_1=11.5$ $p< .001$). Overall, it could be concluded that the incident rate at the end of the demonstration period was higher than the baseline periods (before and after the demonstration).

In terms of risk analysis comparisons, there were no requirements for Airservices or CASA to conduct a comparison of the level of risk associated with the current Class G airspace versus the proposed system under Airspace 2000. The only comparison conducted was the risk modelling presented in the Airservices' *Airspace 2000 Safety Case*, where the current system (with directed traffic information), was contrasted with the Airspace 2000 model (with the national advisory frequency, but not considering a radar information service). That risk modelling was never subjected to the extensive review process applied to previous versions of the airspace risk model (see attachment D).

The subsequent UK NATS audit focused on the general process of the safety case rather than on specific detail. CASA identified some concerns regarding the risk modelling, but did not complete a full review before convening the Airspace Technical Expert Panel. The AATA/RAAA review focused on general rather than specific issues associated with the risk modelling.

During the investigation, BASI made a number of observations about the results of the risk modelling undertaken (see attachment E). Based on an analysis of those observations, and with the benefit of hindsight not available to CASA planners, the following conclusions were reached:

- There were a number of inappropriate assumptions and interpretations made during the development of the risk modelling data for the Airspace 2000 safety case, that seriously affected the validity of the conclusions reached.
- The increase in risk in the en-route phase, when replacing directed traffic information with the national advisory frequency, was higher than that reported in the safety case.
- The risk in the en-route phase formed a larger component of the overall risk per movement than was reported in the safety case.
- It is likely that the change in the overall risk per movement, when replacing directed traffic information with the national advisory frequency, was different from that reported in the safety case, but that difference could not be quantified without further risk modelling. Such a task was beyond the scope of this investigation.

Based on the experience of the Class G airspace demonstration, a number of additional issues were identified which had the potential to increase the safety risk of operations using a national advisory frequency, when compared with a directed traffic information service. For example, national advisory frequency congestion and pilot education problems were more significant during the demonstration than were anticipated by the Airservices' safety case panel. Moreover, the safety case panel assumed that the probability of pilots operating on the wrong frequency would be less with the national advisory frequency, as opposed to directed traffic information, due to there being less vertical frequency boundaries in the new system. However, frequency management problems were found to be at least as significant, if not more so, in the Class G demonstration than in the current Class G airspace.

No risk modelling has been conducted to predict the effectiveness of a radar information service in reducing collision risk. A range of issues need to be considered when assessing the effectiveness of this type of service, relative to a directed traffic information service. Factors which can be used to indicate the advantages of a radar information service over directed traffic information include the following:

- A radar information service is based on real time. As a result, the timeliness, quality and reliability of information is potentially superior to that provided by directed traffic information, which mainly consists of less reliable data derived from pilots and flight data strips. That information has to then be assessed and acted upon by a flight service officer. In areas of high traffic movements, the provision of directed traffic can overload a flight service officer to the extent that information is either not provided, as evidenced by occurrence 9701187 (see 1.2.3.2), or is provided incorrectly.
- A radar information service will generally provide information on VFR aircraft, a service which is not provided by directed traffic information.

In addition to those factors, a number of other issues need to be considered when comparing a radar information service with directed traffic information. Those issues include:

- Air traffic services already provide information about radar-observed traffic to IFR aircraft departing controlled airspace. That information includes all radar-observed traffic within 2,000 ft below the lowest level of controlled airspace, and is provided on a mandatory basis.
- Radar coverage was variable throughout the demonstration airspace. As a result, a reliable radar information service was not always available.
- A radar information service was only provided on a workload-permitting basis during the demonstration. In practice, that equated to satisfying pilot requests for that service approximately 95% of the time.
- The implementation of the radar information service introduced another radio frequency, and indirectly increased frequency management problems for both IFR and VFR aircraft.
- The combination of the radar information service and the national advisory frequency did not provide certain services which had been provided with directed traffic information, including:
  - traffic information for aircraft on the ground;
  - flight following services, which prompted pilots to call air traffic control for clearance at an appropriate time;
  - traffic information on military low-jet operations; and
  - broadcasts about the activation of restricted areas.

Based on the foregoing analysis of risk modelling, incident rates, feedback reports and interviews, the following conclusions can be made regarding the relative effectiveness of the demonstration, and of the current Class G airspace procedures:

- Where a radar information service was not available during the demonstration, the national advisory frequency provided a significantly higher risk environment than would have been provided by directed traffic information.
- Where a radar information service was available during the demonstration, it was very effective in providing accurate traffic information and conflict resolution.
- Overall, the relative effectiveness of a radar information service versus directed traffic information could not be determined without further risk modelling.

The Airservices *Airspace 2000 Safety Case* reported that the overall annual risk level for crew members was approximately 40 to 50 chances per million person years of a mid-air collision in Class G airspace (with and without directed traffic information). That rate was reported to be within the 'as low as reasonably practicable' (ALARP) range used in other industries.

Later calculations conducted for Airservices found those risks to be almost double (see attachment D). No formal position regarding risk acceptability criteria has been promulgated for aviation in Australia. Draft risk acceptability criteria have been developed by CASA. According to those criteria, the risk levels reported in the Airservices safety case for some of the flight service sectors in the Class G demonstration area were within the 'scrutiny range', a higher risk level than the ALARP range (see attachment D).

As outlined in the 1996 report on the airspace risk model (see attachment D), risks in the ALARP range should generally be reduced if it is cost-effective to do so. Further detailed risk modelling is therefore warranted in order to evaluate the practicality of options for reducing the risk per movement in Class G airspace, or to upgrade some areas of Class G airspace to a higher classification.

2.3 Project Management Factors

2.3.1 Purpose of the Class G airspace demonstration

The purpose of the Class G airspace demonstration was not clearly stated. A September 1998 review of the demonstration by the UK Civil Aviation Authority commented that the reason for the demonstration was not understood by industry, but that CASA appeared to regard the demonstration as a means of winning industry confidence in the proposed airspace changes.

In effect, the purpose of the demonstration was to test a model of Class G airspace prior to a national rollout. Following a variety of changes made to the airspace model during the demonstration period, and after consultations between CASA and the airlines, it became widely recognised by staff within CASA and Airservices that the resulting model was unsuitable to be rolled out nationally due to its complexity. The value of continuing the demonstration beyond that point is questionable. That the demonstration did continue with a deficient airspace model made the purpose of the demonstration even less clear.

In the Airservices *Airspace 2000 Safety Case*, the national advisory frequency was the primary mitigator for the removal of directed traffic information, while the provision of a radar information service was to be simply an added safety feature. However, in much of the promotional material and correspondence concerning the Class G demonstration, the primary purpose appeared to shift to the increased use of radar. It is somewhat surprising that, if radar was to be the primary mitigator, then other options for achieving this were apparently not fully considered.

Furthermore, it was the intention to roll out the model nationally. Once the primary means of selling the demonstration shifted to 'upgrading DTI to a RIS' rather than replacing directed traffic information with a national advisory frequency, the rationale and justification for a national rollout of the model, to areas outside radar coverage, would seem to have been lost.

2.3.2 Airspace selection and timing of the demonstration

The location of the demonstration was directed by the CASA Chairman. The rationale for conducting the demonstration in the Canberra–Ballina region appeared to be that it was an area where radar was not being utilised as much as it was in other areas, where a Radar Advisory Service existed. The area also generally lay beneath Class E airspace, another element of *Airspace 2000*. It was clearly the most densely trafficked area of Class G airspace in Australia, yet radar was not being utilised. The basis for the selection of that area is thus understandable. However, conducting a demonstration or 'trial' in that area, of such a significantly new system, placed a considerable onus on CASA to ensure that all appropriate safety analysis, consultation and education activities had been comprehensively addressed.

The timing of the demonstration in the narrow window of opportunity prior to the implementation of TAAATS was questionable. As a result, deadlines were always going to be relatively fixed. Safety analysis, consultation and education activities were conducted within tight schedules, providing little flexibility when problems were experienced with the implementation.

2.3.3 Safety analysis

There is no doubt that the Airspace 2000 proposals for Class G airspace were subjected to many different safety analysis activities. The UK NATS, in commenting on Airspace 2000, recommended that there should be at least four parts to a safety case process—the requirements determination phase, the design and procurement phase, the installation and transition phase, and the initial operation phase. The recommendation was incorporated into CASA's own *Project Management Manual* as a requirement for CASA projects.

However, the overseas comparisons and risk analysis activities conducted during the design phase of the CASA demonstration were quite limited in nature, and provided little safety assurance for the changes. In contrast, the Airservices safety case was a substantial project involving both qualitative and quantitative analysis, which was audited and endorsed by the UK NATS. The Airservices safety case was also reviewed by CASA, which identified residual concerns as the regulator.

An Airspace Technical Expert Panel process was established by CASA to conduct specific qualitative analyses to resolve such concerns. However, those analyses were to some extent inconclusive, as the panel did not agree on certain risk levels, and on some of the mitigators. The results of the panel's work were never integrated with the Airservices safety case, and the overall meaning of the analyses was consequently unclear.

The Airservices' safety case and the Airspace Technical Expert Panel were activities conducted as part of the design phase. A further part of the safety case was required for any 'installation and transition' activities, such as the development of specific procedures and requirements for the Class G demonstration. However, CASA did not formally prepare a safety case for the demonstration until the UK CAA had conducted their review in September 1998, which concluded that the safety case for the demonstration had not been completed.

CASA safety analysis activities for the demonstration were deficient in the following areas:

- A comprehensive and systematic analysis of pilot tasks for the Class G demonstration model was not conducted. The education cadre did conduct a preliminary review, although that was not the intended role of the cadre. It was intended that a procedures cadre be formed to review procedural issues; however, that activity never eventuated. CASA and the airlines also conducted an analysis of a number of scenarios on 19–20 October 1998, but the meeting focused on quite specific issues presented by the regional airlines. Overall, none of those activities provided a thorough examination of the potential effects that could arise from a combination of procedural changes on pilot workload, situational awareness and crew coordination. Such an analysis should have identified deficiencies in frequency management and other operational procedures.
- A proper analysis of the functionality of the national advisory frequency was not carried out prior to the demonstration. CASA, Airservices, the UK CAA, and the Airspace Technical Expert Panel were all of the opinion that monitoring of that facility during its initial operation would provide sufficient risk containment. However, the national advisory frequency was a critically important safety element of the demonstration. With the exception of Canada, there was no equivalent system in other leading countries to which the proposed Australian system could be compared. Moreover, it was always likely that Australian operators would place a high degree of emphasis on the national advisory frequency in their operational procedures. It was therefore reasonable to have expected that a pro-active analysis would have been carried out. Had such an evaluation been undertaken, it is considered likely that deficiencies, subsequently exposed during the demonstration, would have been identified prior to the demonstration.
- A thorough analysis of the limitations of radar and radio coverage in the demonstration airspace, and the implications of those limitations, was not undertaken. Further definition and distribution of those limitations, prior to the demonstration, would have assisted planning activities. Flight crews were later to voice concerns that they had not been provided with guidance material on the extent of predicted radar coverage.
- The results of Airspace 2000 safety analysis activities were not consolidated into one document or hazard log. Although there was no specific requirement for such integration,

it would have provided a more effective basis for decision-making regarding the demonstration.

- The CASA safety case for the demonstration was not updated after significant procedural changes were formulated on 3 November 1998.
- A formal external review of the CASA safety case for the demonstration was not undertaken, nor was there any requirement for such a review.

In addition to the deficiencies described above, the safety analysis activities for the demonstration did not appear to fully consider the results of CASA's previous analysis work in preparing the draft final rule in September 1997. In particular, the 1997 draft final rule specified, after the notice of proposed rule-making consultation process, a requirement for Class E airspace to link with mandatory broadcast zones, so that high capacity regular public transport aircraft could operate in a mandatory radio environment.

The safety analysis activities for the demonstration showed no evidence of fully considering the following recommendations of the UK CAA:

- A radar information service should be available to the top of mandatory broadcast and common traffic advisory frequency zones. That was not achieved. The changes introduced on 4 November 1998 almost fulfilled the intended benefits of that recommendation, through the use of mandatory transponder areas on the terminal area frequency.
- There should be 'close and active monitoring' of national advisory frequency loading. However, the formal monitoring activities amounted to two samples of 18 hours from one location. CASA personnel also participated in 39 flights in the demonstration airspace, primarily during the first week of the demonstration, and submitted pilot reporting forms on those flights, which were included in CASA's overall analysis of 581 pilot report forms. It would be reasonable to expect that 'close and active' monitoring would have involved a more frequent, structured and comprehensive sampling process, particularly after the first week of the demonstration. Furthermore, the quality of monitoring would have been enhanced by the collection of baseline measurements of relevant flight service frequency loadings prior to the demonstration.
- There should be 'close and active monitoring' of pilot workload. However, the monitoring was passive, as it was restricted to the receipt of pilot report forms. Those forms did not request a rating of pilot workload, and ratings or judgments were not provided in most cases. There was also no measurement of pilot workload prior to the demonstration to provide a baseline for assessment.

2.3.4 Consultation

CASA believed that a substantial amount of consultation had already taken place on Class G airspace issues during airspace reforms since 1991. As a result, it was assumed that no further consultation was required for the Class G demonstration. However, that assumption is difficult to reconcile with the following issues:

- The importance of industry support to ensure the successful implementation of Airspace 2000, and specifically the Class G demonstration, had been widely recognised and noted by CASA, Airservices, and the external consultants from the UK. Although 'consultation' does not necessarily mean that 'consensus' will be achieved, it is clear that obtaining industry support was recognised as being critically important to the success of the demonstration. For example, industry opposition was noted in the CASA *Program Definition Plan* as a potentially high risk to the successful implementation of the project.

- Although a substantial number of consultation activities had occurred prior to 1998, it did not appear that such consultation had been finalised. A notice of proposed rule-making process had occurred, but there was no feedback to industry on CASA's responses to industry concerns. More significantly, CASA made a number of changes to the proposed Class G airspace design and procedures after the notice of proposed rule making process. Although CASA ultimately had to make decisions about issues under its responsibility, its failure to complete the rule making process, and to adequately undertake effective consultation with stakeholders prior to the demonstration, contributed to the industry view that the demonstration would not go ahead.
- During planning for the demonstration, the need for further consultation was recognised. As a result, CASA developed an 'industry involvement plan' in June 1998. However, by the time the plan was put into place to include industry in the development of the Class G demonstration procedures and training material, the AIP SUPP H48/98 was already close to finalisation. In addition, an important element of the plan, the procedures cadre, was never implemented.
- In late July 1998, the new Director recognised that the airlines had legitimate operational concerns which needed to be addressed. However, there was then limited time to resolve those issues. Terminating the demonstration at that stage appears not to have been viewed as an option, yet continuing without further consultation would have also presented serious problems. Due to the importance of the project to CASA, the Director decided to continue with the demonstration in the belief that the operational concerns of the airlines could be resolved.

Consultation activities for the demonstration were undertaken at the wrong end of the project. The results of inadequate consultation in the early stages of the project led to far-reaching problems with safety analysis and education activities, which ultimately resulted in a flawed Class G airspace model, and the demise of the demonstration.

2.3.5 Education

From the outset it was recognised by CASA that effective education and training would be a crucial element of the Class G demonstration. It was essential that airspace users be adequately prepared for operating in the new system. CASA's Airspace 2000 communications strategy highlighted that premise and set the framework for producing and distributing a range of education materials. However, in practice, the pilot education program was deficient for a number of reasons:

- The development of the training material was commenced before the demonstration airspace procedures had been thoroughly vetted by operational pilots and controllers.
- The level of detail in the training material was inadequate to ensure that pilots could gain a thorough and practical understanding of how to conduct operations in the demonstration airspace. The education cadre advocated that a greater level of detail was required, but the Chairman had a strong desire to portray the simplicity of the demonstration procedures. However, the effects of inadequate or unrealistic detail in the education materials were subsequently revealed by the level of confusion which existed in the pilot community, even among pilots who had read the materials. The lack of operational scenarios in the published education materials was one particular omission that contributed to the misunderstanding and confusion. CASA finally planned to introduce such scenarios in their third AIP supplement on the demonstration, along similar lines to those originally proposed by the education cadre. However, the demonstration was terminated before that plan could be implemented.

- CASA management viewed the education program as a means of both 'selling' the demonstration and providing education material. By not clearly differentiating between the two purposes, each was inadequately addressed.
- The impact of late changes to the Class G demonstration procedures on pilot education activities was given insufficient consideration by CASA. Some training material was not updated to reflect those changes.
- There was no process established to evaluate the effectiveness of the pilot education materials and overall education program, prior to the start of the demonstration. The small amount of work that was done was deficient in both scope and method.
- There was a minimal involvement of CASA operational staff in the development and promotion of the pilot education program. Such a low level of involvement is considered likely to have indicated to industry, and CASA personnel, that the organisation did not give a high priority to education and training for the Class G airspace demonstration.

Another significant problem with the pilot education program was the lack of active support from some regional airlines and other operators who, based on their previous experiences, appeared to believe that the demonstration would not go ahead. As a result, when the demonstration did go ahead, their efforts to ensure that their flight crews were properly trained were largely ineffectual (see 2.3.8 for further analysis).

In contrast, the development and implementation of training for air traffic control staff was carried out in an effective and timely manner by Airservices.

2.3.6 Late changes

In the Program Definition Plan, CASA recognised the problems associated with not conducting careful and comprehensive planning, and of acting in an 'ad hoc, reactive and ultimately self-defeating manner'. However, during the last 3 months of the project, CASA reverted to acting in that way as a direct result of inappropriate consultation and safety analysis activities in the early planning phases of the proposed demonstration.

The late changes to demonstration procedures were introduced by the CASA Director, after consultation with the regional airlines, and in response to their criticisms of plans prior to that. Such consultation was critical to ensure that the demonstration would proceed with industry support. However, the effect of late changes also reduced the capacity of CASA to ensure that education and safety analysis activities were appropriately conducted.

2.3.7 Guiding principles

During the planning and implementation of the demonstration, CASA management and/or project staff appeared to possess a series of underlying beliefs which guided their decision-making processes. The Chairman played a significant role in promoting such beliefs within CASA. However, some of those beliefs, which were quite influential, were based on flawed assumptions:

1. *Traffic levels in en-route Class G airspace were essentially so low that a collision risk was negligible. In effect, the 'big sky' theory dictated that mitigators for reducing risk provided little (if any) improvement in safety levels.*

   No attempt was made by CASA to ensure that the actual collision risks of the current and proposed Class G airspace systems were accurately modelled. Although Airservices had conducted limited risk modelling, subsequent analysis by BASI indicated that the risk levels associated with the new system were higher than those published (see attachment E). Moreover, no criteria for evaluating risk acceptability had been established by CASA.

2. *Industry acceptance of the changes would best be achieved by a 'selling' process, emphasising the 'simplicity' of the new system.*

   CASA staff accepted that the 'selling' approach was ultimately ineffective. The proposed arguments for the changes were only stated in general terms, and it was naïve to expect that industry would accept the changes without a more soundly based series of arguments.

3. *Pilots' acceptance of the new airspace procedures would increase after they had been using them for a period of time.*

   That belief appeared to be based on the fact that industry, despite some initial resistance, had accepted the introduction of Class E airspace in the Canberra–Ballina region in February 1998. However, the introduction of Class E airspace, which had a minimal impact on operational procedures, provided an enhanced level of service, and no reduction of services. The changes to the Class G procedures had a far greater impact on operational procedures, and radically changed or removed services which had been previously available. A belief that a positive shift in attitude would occur through use of the Class G demonstration procedures was not based on sound evidence.

4. *Directed traffic information was 'unsafe' and expensive, and the resources would be better distributed in other parts of the aviation system.*

   There is no doubt that directed traffic information has limitations, and is provided at a cost. However, it is also clear that directed traffic information does provide important services to the aviation industry. No cost-benefit analysis of the removal of directed traffic information was conducted for the demonstration or Airspace 2000. In addition, Airservices informed CASA during the initial planning phase of the demonstration that, if directed traffic information was replaced, the cost savings would not be redistributed to other parts of the safety system.

5. *The Class G demonstration was safer than the previous system because it was increasing the use of radar-based services.*

   Most of the written documentation describing the demonstration emphasised that a major reason for the airspace changes was to increase the use of radar-based services. However, a large part of the demonstration airspace was not within radar coverage. The majority of Class G airspace in Australia is also not within radar coverage. Furthermore, a number of factors need to be considered when comparing the risk levels associated with the directed traffic information system versus the demonstration procedures (see section 2.2.3). The manner in which radar-based services are introduced can clearly have a large influence on their ability to reduce risk levels.

6. *The Class G demonstration was safer than the previous system because it was based on proven overseas practice.*

   The airspace systems of other leading overseas countries are all different, and the demonstration procedures were not based on the airspace system of any one of those countries. In addition, there was no formal comparison of the demonstration model (including consideration of the Australian aviation system and environment) with appropriate overseas airspace systems.

7. *Australian airspace was not compliant with ICAO requirements and not aligned with the practices of other leading aviation countries, and there was a need to ensure compliance and greater harmonisation.*

   The use of 'ICAO compliance' and 'harmonisation with world best practice' concepts as justifications for change appear to be arguments of convenience. For example:

- Within a broad interpretation of the ICAO International Standards and Recommended Practices – Air Traffic Services, Annex 11, Australia's current Class G airspace is ICAO 'compliant'.
- The airspace systems of other ICAO states such as the USA and Canada are not fully ICAO compliant.
- In the USA and Canada, IFR flight in Class G airspace would be the exception rather than the norm. The lowest classification of airspace such aircraft would normally operate in would be Class E airspace.
- In the USA and Canada, radar coverage in areas of even moderate traffic density is generally far more extensive than in Australia.
- The Class G / Class E environments of the UK, the USA, Canada and New Zealand significantly differ. Consequently, international harmonisation is not really possible.
- Neither CASA nor Airservices conducted a comparison of Australian Class G / Class E airspace with overseas environments.

The extension of radar services where possible is generally accepted as an enhancement over current levels of service and safety. However, it does not automatically follow that the removal of directed traffic information in areas outside radar coverage is necessarily appropriate or desirable. In other leading aviation countries the provision of directed traffic information is of less importance, as IFR aircraft generally operate either in at least Class E airspace, or radar-based traffic information services are more consistently available due to greater radar coverage. In that regard, the concept of removing a directed traffic information service, without reference to Australia's aviation environment, would seem to ignore many of the wider issues.

The existence of such flawed assumptions casts strong doubt on the justification for the conduct or timing of the Class G airspace demonstration. That issue is discussed further in section 2.5.

2.3.8 Industry support

Industry support was regarded as being critically important for the success of the demonstration. However, support from the regional airline sector of the industry was only ever provided on a conditional basis.

During the investigation, several CASA personnel commented that the planning and implementation of the demonstration was hampered by the approach of the regional airlines. In particular:

- There was a resistance to airspace change within the airline industry.
- The number of airline concerns appeared to increase and change during the consultation process.
- The airline industry approach to risk analysis emphasised problems with specific, low-probability scenarios, rather than looking at the overall level of risk.
- Many operators, including regional airlines, conducted an inadequate level of training and education for their pilots.

In relation to those perceptions, a review of relevant documentation obtained during the course of the investigation indicated that the specific issues of concern to the airline industry were described differently in various documents. Nevertheless, the airline industry's overall position regarding Class G airspace issues had remained consistent since the origin of Airspace 2000. The airline industry position was that regular public transport services should only

operate in an environment where the minimum services were a third-party traffic information service on IFR aircraft for en-route, and a mandatory broadcast zone for terminal areas.

With regard to the risk analysis issue, none of the Airspace 2000 risk-analysis activities included a comprehensive examination of all relevant factors to provide a clear statement of the relative risks of the current Class G airspace system versus the Airspace 2000 system.

However, while there were some deficiencies in the safety analysis processes, the airlines did not take full advantage of a number of opportunities to address their specific concerns. For example, CASA provided an opportunity for the airlines to address their concerns with the safety analysis process during airline industry panel meetings on 18 and 25 June 1998. It would appear that the value of that opportunity was limited, due to the airline representatives' preference to discuss specific concerns relating to practical scenarios, rather than addressing the formal safety analysis issues, as was the intended purpose of the meetings.

In terms of education activities, some operators did develop effective pilot training programs for the Class G airspace demonstration. Those programs enabled operators to better cope with the changes which were made to procedures just before and during the demonstration.

However, the training conducted by other operators seemed belated and inadequate. That appeared to be partly due to a lack of commitment on their part to the proposed changes, and to a feeling that the operational details and timing of the demonstration were still open to change. Regardless of those reasons, a higher level of preparation by some operators was clearly warranted. Indeed, it is likely that many of the incidents reported in the early stages of the demonstration would not have occurred had all operators made full and timely use of the information available.

2.3.9 Role of BASI in the G airspace demonstration

It is not BASI's role to audit CASA's activities. BASI first provided CASA with a draft version of its interim recommendations (see section 4.1) on 25 November 1998. At no stage prior to that time were BASI personnel able to, nor did they, provide any considered opinion on the Class G demonstration to CASA.

2.4 Higher-Level Organisational Factors

A range of project management issues concerning the Class G demonstration were identified in section 2.3. The environment which encouraged the development of those issues can be analysed and described in different ways. The BASI analysis has chosen to focus on the existence of organisational factors that increased the likelihood of project management problems occurring.

2.4.1 Corporate experience

CASA had little previous experience in, or established processes for, preparing safety cases and directing consultation for a major change management project, of which it was the proponent. Although there were general procedures laid down in an appendix to their *Project Management Manual*, the organisation did not use them. CASA assumed responsibility for preparing a safety case when the role of the organisation changed from solely being the safety regulator to also taking responsibility for proposing and managing airspace reform. That role change is discussed further in section 2.4.4.

In terms of consultation activities, CASA had a notice of proposed rule-making (NPRM) process. However, there were no established processes for how or when consultation activities should take place before or after the issue of a NPRM.

2.4.2 Organisational structure

The Acting Director/Director's lack of senior management support, and large span of control, led to high personal workloads, and contributed adversely to monitoring and control within the management structure of CASA. In the latter part of 1998 Assistant Director positions were created and staffed to address this.

2.4.3 Review mechanisms

CASA had no adequate internal review mechanisms for the planning and development of the demonstration. Project work was not reviewed by a separate section or branch within the organisation. The demonstration project team and their management essentially reviewed their own work, but this was compromised by other factors (see sections 2.4.5 and 2.4.6).

The CASA Board did not closely monitor the demonstration, nor was it their role to do so. However, as stated in their *Program Definition Plan*, CASA clearly recognised the strategic importance of the Airspace 2000 program to the organisation. As a project of strategic significance, it met one of the tests for Board review; and it would seem that the CASA Board could have fulfilled a useful, high-level review function. The Chairman had a dominant involvement in the demonstration and consequently, perhaps, the Board as a whole neither received nor asked for regular detailed briefings on the progress of the demonstration, particularly during the early development phases.

It may have been expected that the program control group and the issues control team would have played an important review role. However, they appeared to have little influence on decision-making processes. CASA, Airservices and the Defence force viewed CASA as the lead agency for the project. Consequently, Airservices and the military restricted their activities to support roles. Although both organisations expressed their concerns to CASA about various aspects of the demonstration, the responses received appeared unsatisfactory to them.

Neither CASA and Airservices had any intention of reverting to the previous system once the demonstration had started. There was clearly a potential for both organisations to lose objectivity when making decisions about the demonstration. Although personnel from each organisation commented that some loss of objectivity had occurred, the extent was of a dimension that was difficult to determine.

There were no planned substitutes for the external review mechanisms that would have applied if, for example, Airservices had been the lead agency in the demonstration (in which case it is reasonable to assume that CASA would have closely monitored the activities of Airservices). Such monitoring would have included a review of operational procedures, education materials, and the safety case for the implementation phase of the demonstration.

When CASA became the lead agency for Airspace 2000 at the end of 1997, no systems were established to provide a similar level of review for CASA project management activities. The decision of the Director to organise a review of the proposed demonstration by the UK CAA was commendable, and directed towards that issue. However, the review should have been a continuous presence during the development process and completed prior to the finalisation of operational procedures.

2.4.4 Roles and responsibilities regarding airspace

In July 1995, the government restructured the Civil Aviation Authority into two separate agencies; Airservices Australia and CASA. From then, until the end of 1997, Airservices was the agency responsible for activities concerning airspace design, designation of airspace, and the design of airspace procedures. As the safety regulator, CASA had the responsibility to set the 'minimum' standards required for different types of airspace and associated procedures, and was responsible for the safety oversight of Airservices.

At the beginning of 1998, CASA became more heavily involved in airspace issues through its own version of the Airspace 2000 program, becoming the major proponent for the Airspace 2000 changes. It also effectively changed from an agency setting minimum standards, to an agency setting prescribed service requirements. CASA also sought legislation to establish its new role, and to provide itself with additional powers, including the designation of airspace. Its expectations on making such legislative changes proved to be overly simple, and the Department advised the Authority that more detailed analysis was clearly warranted before attempting any changes.

There were several reasons why CASA became more actively involved in airspace issues in 1998. Those reasons included the following:

- the CASA Chairman's intense interest in airspace, and progressing airspace reform;
- Airservices' focus on TAAATS issues rather than Airspace 2000 issues, once CASA had deferred the implementation of Airspace 2000 in September 1997; and
- CASA's belief that by taking over functional responsibility of airspace issues, they were operating within the 'political imperatives' of the time.

However, there was no government direction to CASA to take over functional responsibility for airspace. Although the government had been considering the issue, no formal decision had been made, and no legislative changes had occurred. Despite that, the continual exchange of advice between CASA, Airservices and the Department, may have provided a presumption of authority to proceed. CASA appeared to have assumed that the decision of the Airservices Board to agree with a proposal to transfer legislative responsibilities to CASA, together with a lack of objection from the Minister, was enough justification to proceed under apparent delegation from Airservices. No formal delegation was provided.

The transition to CASA's new level of involvement in airspace matters failed to include processes designed to minimise the prospect of adverse consequences:

- There was no clear definition of the new roles of Airservices and CASA, with respect to airspace.
- There were no arrangements in place to ensure that CASA's actions were independently monitored, either internally or externally, to the extent that CASA had previously monitored Airservices' airspace change activities.

It is clear that those omissions resulted in an inadequate level of monitoring of the activities of an agency that was proposing and implementing significant changes to airspace procedures and design.

2.4.5 Roles and responsibilities of the Board and executive management

In the legislation and Board documentation sighted by BASI, the respective roles of the CASA Board and Director appeared to be quite clearly defined and agreed. The Board set strategic direction and policy, while the Director managed the Authority and implemented the Board's decisions. The Board had also decided that contact with CASA staff would only be made through the Director's office.

The investigation found that several Board members, as well as the Chairman, believed that the Board should only set strategic direction and not become involved in day-to-day management issues. In line with those views, the Board also decided on 17 April 1998 that Board members should not be involved in the program control group for the Airspace 2000 program, and that the Board Chairman should not act in the role of program sponsor. Despite that, considerable evidence was found to indicate that the Chairman continued to be involved in the day-to-day management and development of the Class G demonstration as well as other Airspace 2000 projects.

2.4.6 Involvement and management style of the Chairman

The Chairman had continued to have a strong interest and involvement in the reform of Australian airspace since his earlier term as Chairman of the Civil Aviation Authority. That interest included being the design team leader of the Airspace 2000 program in 1996. When he was appointed Chairman of CASA at the end of 1997, he played a significant role in that organisation, taking over responsibility for the Airspace 2000 program. Having acted in a key decision-making role for the Airspace 2000 program in the previous year, there was clearly the potential for a perception to emerge that objectivity was at risk when making decisions about the program.

The reasons for the Chairman's close involvement included a perceived lack of senior executive management capacity in CASA when the organisation was developing its Airspace 2000 program, the Chairman's strong and continuing interest in airspace issues, and his firm desire to ensure that those issues were developed along particular lines. However, issues cited earlier suggest that the organisation had not equipped itself for such a shift in governance arrangements. The Chairman's close involvement in project management became associated with a number of undesirable consequences, including:

- the removal of previous internal review processes, including important review mechanisms at higher levels than the decision-maker;
- a decrease in the ability of CASA managers, and the organisation as a whole, to coordinate their decision-making processes;
- an increase in confusion among staff and external parties regarding who in CASA was making decisions, and what decisions were valid; and
- uncertainty among CASA staff regarding their ability to query the Chairman's decisions or instructions due to his senior position.

It was subsequently reported by CASA staff that the Chairman's management style was characterised by micro-management, an unwillingness to consider other views, and rigid adherence to a pre-determined path. The Chairman also appeared to show a low level of interest in activities that could lead to delays in the implementation process.

Many of the problems associated with the planning and implementation of the demonstration were related to inadequate safety analysis, consultation and education activities. Although there were many reasons for the problems encountered, there is considerable evidence to indicate that the influence of the Chairman's active involvement and management style contributed to those problems.

2.5 Final Comment

Since Class G (or uncontrolled) airspace is associated with the lowest level of air traffic services, it is not surprising that there are limitations associated with that type of airspace. There have been a number of recent improvements to the levels of service provided in Class G airspace, including the introduction of a radar advisory service in many parts of Australia, as well as the replacement of Class G airspace in the Canberra–Ballina region, between 8,500 ft and 12,500 ft, with radar-based Class E airspace. In addition, air traffic controllers now provide pilots of IFR aircraft descending from controlled airspace, with information on radar-observed traffic to at least 2,000 ft below the base of controlled airspace.

There have also been a number of recent attempts to change Class G airspace by replacing directed traffic information. The most notable proposal was the Airspace 2000 program and associated Class G demonstration.

There are valid reasons to examine options for change, such as minimising the limitations of the current system in areas of higher traffic density. However, the safety analysis activities conducted to date have not provided a complete case for the proposed changes. A cost-benefit analysis of the proposed changes has also not yet been conducted, even though the risks were rated in the 'as low as reasonably practicable' category in the Airservices' safety case. Moreover, arguments for the need for change based on compliance with ICAO requirements, harmonisation with world-best practice, and compatibility with TAAATS appear to have been overstated. In essence, adequate justifications for changing the current en-route Class G airspace system in Australia have not yet been presented.

The Airspace 2000 project only considered one type of proposal for changing Class G airspace. Alternatives, such as the introduction of further sections of Class E airspace or a radar advisory service, have not yet been systematically evaluated or compared.

This investigation identified several operational safety problems associated with the Class G airspace demonstration. It also found that the project management of the demonstration was deficient because critical safety analysis, consultation and education issues were not adequately addressed. Those problems developed in an environment influenced by a number of fundamental deficiencies in CASA's management or 'corporate governance' arrangements at the time. Subsequent changes may have addressed many individual short-term issues, but the overall point remains: major strategic change should be introduced at a time when internal structures are clearly established. In the case of the demonstration, systemic weaknesses in organisational leadership and management had a direct bearing on aviation safety. Ultimately, due to those organisational deficiencies, CASA was unable to ensure that it was appropriately equipped to conduct the demonstration.

However, the Class G airspace demonstration was useful for providing important information on operational and project management issues which can be used in future planning for airspace reform. Such activities must ensure that the lessons of the demonstration are not forgotten.

3 CONCLUSIONS

3.1 Findings

1. The Class G airspace demonstration suffered from significant operational safety problems due to:
   - frequency congestion, over-transmissions, and pilots experiencing difficulties interpreting information on the national advisory frequency;
   - inconsistent availability of the radar information service associated with limitations in radar coverage;
   - increased pilot workload associated with frequency management tasks; and
   - limited pilot knowledge of the demonstration procedures.
2. The extent of the operational safety problems decreased as the demonstration progressed, but was still significant at the end of the demonstration.
3. Where a radar information service was not available during the demonstration, the national advisory frequency provided a significantly higher risk environment than would have been provided by directed traffic information.
4. Overall, the relative effectiveness of a radar information service versus directed traffic information could not be determined without further risk modelling. Where a radar information service was available during the demonstration, it was very effective in providing accurate traffic information and conflict resolution. However, directed traffic information would have provided more timely advice of potential conflicts.
5. The safety analysis activities for the en-route Class G airspace elements of Airspace 2000, conducted prior to the Class G demonstration, contained several deficiencies.
6. CASA's overall project management of the Class G airspace demonstration was deficient because:
   - the purpose of the demonstration was not clearly defined;
   - the selection of the timing and location of the demonstration placed significant pressure on CASA to ensure that consultation, safety analysis and education issues were comprehensively addressed;
   - safety analysis activities contained several significant deficiencies;
   - there was a lack of appropriate consultation in the early phases of the project;
   - the design and management of the education program contained several significant deficiencies; and
   - late changes made to the airspace design and procedures significantly compromised the effectiveness of CASA's safety analysis and education activities.
7. A number of guiding principles associated with the project were based on flawed assumptions.
8. Adequate justification for the airspace changes associated with the Class G demonstration was not provided.
9. A significant proportion of the aviation industry did not conduct an appropriate level of education and training to prepare for the demonstration.

10. The following organisational factors adversely influenced the ability of CASA to effectively manage the Class G demonstration project:

    - There was a lack of established processes within CASA for conducting safety case and consultation activities for large change-management projects.
    - CASA's management profile and staffing prior to July 1998 reduced the ability of the organisation to effectively monitor and control its activities.
    - There was a lack of appropriate internal and external review mechanisms for ensuring the objectivity of the project.
    - The division of roles and responsibilities between CASA and Airservices Australia regarding the design and regulation of airspace was not clearly defined.
    - The division of roles and responsibilities between the CASA Chairman and the Director and other management was not clearly defined.
    - The influence of the CASA Chairman's involvement in airspace reform and management style contributed to the project management deficiencies associated with the demonstration.

4 SAFETY ACTION

4.1 Interim Recommendations

The Bureau of Air Safety Investigation issued the following interim recommendations on 8 December 1998. Where a response has been received from the action agency or agencies involved, that response has been reproduced. The Bureau's classification of each response is also included.

IR19980253

The Bureau of Air Safety Investigation believes that the Class G Airspace Demonstration has served its purpose. In the light of the safety concerns identified by this investigation, BASI recommends that the Civil Aviation Safety Authority should now terminate the demonstration.

The results of the demonstration should be subject to a comprehensive evaluation that specifically addresses the safety concerns identified by BASI.

The evaluation process should take into account the time required to:

review and analyse the demonstration;

refine the model where required and conduct a proper safety analysis; and

provide a comprehensive and effective education and training program for any subsequent changes to Class G Airspace.

If this is not achieved, the deficiencies identified in this investigation are likely to be repeated, thereby seriously compromising the successful introduction of future changes to airspace, including reintroduction of Class G Airspace incorporating RIS and NAF.

Response:

The CASA Director announced on 9 December 1998 that the demonstration would be terminated on 13 December 1998.

Response status: CLOSED - ACCEPTED

IR19980260

The Bureau of Air Safety Investigation recommends that the Civil Aviation Safety Authority review program management policies and procedures for current and proposed changes to the aviation system, in the light of experience gained from the present Class G Airspace Demonstration.

Response:

The following response was received from the Civil Aviation Safety Authority on 31 August 1999:

CASA is still awaiting formal, consolidated advice on the results of the review conducted by the Secretary DoTRS last December. However, certain aspects are becoming more lucid.

In a letter from the Assistant Secretary Aviation, DoTRS, to CASA, dated 29 June 1999, CASA was advised that the Government's decision is that 'the regulatory responsibility for the design, declaration and management of airspace are to remain with Airservices and not to be transferred to CASA'. CASA understands that Airservices, in line with this decision, has been given direction by the Government to develop, by December 1999, a program for airspace reform.

In a draft working paper attached to the above mentioned letter, it was stated that before making a decision 'Airservices would provide CASA with formal safety cases justifying any changes, including training and education of users'. CASA can review and, if necessary, veto the change. The

paper went on to say that ' This acknowledges possible conflicts of interest which may arise were CASA to be both regulator and the initiator of airspace reforms.

The paper gave CASA's role as setting minimum standards to be applied to each particular class of airspace. It did not restrict CASA from initiating an upgrading of a class of airspace, however, it stated that CASA must identify 'a clear justification' and 'accompany any such proposal with evidence supporting the safety issue'. An overriding requirement was 'When CASA seeks to change the classification of airspace, the DoTRS is to ensure an independent analyst is engaged to consider, and publish comments upon, the safety case made by CASA'.

CASA is willing to adopt the principles espoused in the above and believes that acceptance of them by the three parties would address the Interim Recommendations.

Response status: OPEN

IR19980256

The Bureau of Air Safety Investigation recommends that the Department of Transport and Regional Services, the Civil Aviation Safety Authority and Airservices Australia review and clarify the roles and responsibilities of the respective organisations in relation to the regulation, design and management of airspace to ensure the safety integrity of the aviation system.

BASI simultaneously issued this recommendation as IR980261 to CASA, and as IR980257 to Airservices Australia.

Department of Transport and Regional Services response:

On 9 December 1998, the Minister for Transport and Regional Services tasked the Secretary of the Department to conduct a 'review of roles and responsibilities for the regulation, design and management of Australian airspace' by 22 December 1998. The report was completed by the required date, and provided to the Minister, CASA, Airservices and BASI.

The Minister released the report to the public on 4 November 1999, along with a policy statement—*A Measured Approach to Aviation Safety Reform*. The Minister also issued new Charter Letters to Airservices and CASA that reflected the strategic direction set out in the statement. In essence, the statement indicated that responsibility for design, declaration and management of airspace would remain with Airservices and would not be transferred to CASA. However, CASA would retain the responsibility of setting the minimum standards for the safe operation of each class of Australian airspace, and the procedures to be used by air traffic controllers and pilots in each class of airspace.

Response status: CLOSED - ACCEPTED

Airservices Australia response:

The following response was received from Airservices Australia on 3 June 1999:

We note that the Department of Transport and Regional Services has actioned this recommendation and understand that the result of the review will be released soon.

Response status: CLOSED - ACCEPTED

CASA response:

See CASA response to IR19980260.

Response status: CLOSED - ACCEPTED

4.2 Final Recommendations

As a result of the investigation into the Class G airspace demonstration, the Australian Transport Safety Bureau makes the following recommendations:

R19990139

The Australian Transport Safety Bureau recommends that the Civil Aviation Safety Authority (CASA) review regulations, policies, practices and procedures with a view to ensuring that prior to the implementation of any change to the aviation system, including any initiatives undertaken by CASA, an appropriate safety analysis process consistent with the degree of change is undertaken.

R19990140

The Australian Transport Safety Bureau recommends that the Civil Aviation Safety Authority (CASA) and the Department of Transport and Regional Services review CASA's corporate governance framework.

ATTACHMENTS

ATTACHMENT A

Main features of the Airspace 2000 concept

The following table is an extract from the document,
Airspace 2000: A plan for the future management of Australian airspace,
Section 5.2, Version 2, pages 10-11, 1 August 1996.

Features	*Description*
Class G Services	• IFR will use self-announce/self-segregation procedures on the National Advisory Frequency (NAF). A third-party traffic information service will be provided in terminal areas by Unicom, or by ATC, on a workload permitting basis to aircraft performing an instrument procedure in IMC.
Radar Service	• All transponder equipped aircraft within radar coverage can directly contact the radar controller and receive, on a workload permitting basis, a radar service. This service will be provided at the discretion of the controller and will require the allocation of a specific transponder code as the controller will be accepting full responsibility for the provision of the service. The service may be terminated by the controller at any time. It should be noted that this is a no-charge, low-key service and aircraft which require radar based traffic separation /information service should operate IFR in Class E airspace and pay the applicable en-route charge
Flight Following for SAR Service	• IFR aircraft in Class G airspace can be provided with a full position flight following service if required. This service will normally be available in all geographic areas. A standard em-route charge will be levied for this service.
Upgrading from Class G to E	• If any route in Class G airspace has: – a peak of over 5 IFR movements in one direction within a one hour period, or – an intersection on the route has a peak of over 5 IFR movements within a one hour period; and these peaks re-occur more than twice per month, the route shall be subject to a specific safety analysis using actual and forecast traffic data. A Class E airway shall then be established if a higher level of protection is necessary.

– Notwithstanding the failure of a particular route to meet the upgrading criteria, it will be upgraded if a particular user requests the upgrade and meets the full cost of providing the service.

Upgrade from Class E to C

- If a route is required between overlying Class C en-route airspace and Class D terminal airspace, and control area protection is required, it will be Class E, unless a safety analysis using actual and forecast traffic data shows that a higher level of protection is necessary.

Unicoms

- To benefit from the major safety improvements provided by third party services at non-tower airports, private air/ground facilities (Unicom) will be encouraged by allowing the following practices when Unicom services are provided:
- straight in approaches will be permitted at airports with an operating Unicom;
- a standard Australia wide CTAF frequency of 126.7 (called Multicom) will apply to all non-Unicom aerodromes. Aerodromes with high traffic levels, either permanently or temporarily, will operate on a unique Unicom frequency.

Radio Requirements

- Radio requirements will follow ICAO recommendations. IFR aircraft will require radio in all airspace and VFR aircraft will require radio in C and D airspace.
- Recommended procedures for VFR aircraft are — monitor the relevant ATC frequency in Class E airspace, monitor the National Advisory Frequency (NAF) when en-route in Class G airspace, and monitor the CTAF frequency when in the terminal area.
- An education campaign will take place informing pilots of the limitations of radio when a third-party service is not available.

Transponder Requirements

- All aircraft in Class C airspace.
- All aircraft operating IFR in radar airspace.
- All aircraft in 'transponder mandatory' Class E approach airspace to Class D towers.
- All aircraft over 750kg, or with more than a 25 amp generating system, operating in Class E 'transponder mandatory' en-route airspace.

Military Airspace

- Controlled airspace (Class C, D and E) shall be the minimum dimensions necessary to facilitate IFR movements as per ICAO recommendations. Airspace required for other purposes such as training, firing, etc should be given a different nomenclature.

Special Use Airspace

- Military Operations Areas should be introduced where these are required for specific military operations. Alert areas should replace the existing Danger Areas where they are promulgated for flying training purposes.

Other Recommendations

- IFR pilots will be encouraged to fly up to 0. 1 NM to the right of track and VFR pilots will be encouraged to avoid flying on routes or areas likely to have IFR traffic. These IFR routes and approach areas will be featured on charts used by VFR pilots. A major education campaign will take place to increase pilot awareness of the alerted see-and-avoid environment at non-tower airports. This will include an awareness of operating schedules of RPT services to non-controlled aerodromes.

ATTACHMENT B

Initial safety analysis of Airspace 2000

B.1 ICAO guidelines

In part 4 of the document *Airspace 2000: A Plan for the Future Management of Australian Airspace* (August 1996), the Airspace 2000 design team discussed the issue of recognised safety assessment procedures. They noted that the ICAO Review of the General Concept of Separation Panel had recommended for publication the *Manual on Airspace Planning Methodology for the Determination of Separation Minima*. The manual was used as a general basis for the safety analysis presented in the Airspace 2000 design document.

ICAO ratified its manual in May 1996. The first edition was published in November 1998. Representatives from Airservices and CASA were involved in the development of the manual.

The primary objective of the manual was to assist airspace planners with the implementation of air traffic management systems. The document provided a framework by which airspace characteristics, aircraft capability and traffic demand could be assessed for the purpose of determining safe separation minima for en-route operations. As the document focused on separation minima, it was not originally intended for use in designing Class G airspace. However, the general principles could still be applied.

Subsection 5.1.1 of the manual stated:

> The safety of a system depends on a number of characteristics of the airspace. When the relevant characteristics have been identified and quantified, there are two basic methods for determining whether the system is acceptably safe:
>
> a) comparison with a reference system; and
>
> b) evaluation of system risk against a threshold.

In terms of comparisons with reference systems, subsection 5.1.2.1 stated:

> Comparison with a reference system is a 'relative' method, i.e. all the relevant characteristics of the proposed system are compared with the corresponding characteristics of a reference system which has been judged to be safe. Provided that the proposed system can be demonstrated to be similar or better than the reference system in all safety-related aspects, then it also may be assumed to be safe. Clearly, the most important aspect of this approach lies in the identification of a suitable reference airspace which, for minor changes, may include the current system and the demonstration that the proposed system is sufficiently similar to justify the approach.

In terms of the evaluation of system risk, subsection 5.1.3.1 stated:

> The evaluation of system risk against a threshold is an absolute method where, after identification and quantification of all the safety-related characteristics of the system, an explicit relation between these characteristics and collision risk is determined and used to estimate system safety. This estimate is then compared against a maximum tolerable risk – for example, a target level of safety. The estimation of risk for any airspace is a very complex procedure and may require extensive data on all aspects of the performance of the system. The choice of a suitable value for the maximum level of risk may also be a difficult exercise.

B.2 Comparisons with overseas systems

The Airspace 2000 design document noted that while Airservices had made some progress in terms of developing a quantified risk assessment approach, the approach needed a considerable amount of further work before

> …the necessary consensus could be generated in the Australian aviation community to rely on this approach as a realistic way of making these decisions.

As a result, the following was stated in the document about safety analysis methods:

> The Airspace 2000 proposal is based on the ICAO-approved method (a) – comparison with a reference system, supplemented by situation-specific risk analysis where called for and feasible at this time using actual traffic and collision data where possible…
>
> The Airspace 2000 proposals are based on comparisons with accepted practices for managing aviation risks in:
>
> - the United States of America
> - the United Kingdom
> - Canada
> - New Zealand
>
> because these nations have:
>
> - a developed and advanced airspace management regime
> - similarities with Australia in respect of cultural values
> - when taken together, a vast body of experience in operating certain airspace management regimes.

However, there was no discussion in the design document of comparisons of enroute Class G airspace between different countries.

During the Class G airspace demonstration investigation, a number of CASA and Airservices' employees from various levels in each organisation were asked about the extent to which comparisons of Class G airspace systems had and could be conducted. It was reported that a number of studies of overseas airspace systems had been carried out, but that no report of a systematic and comprehensive comparison of different systems existed.

By far the majority of those questioned about that issue stated such comparisons would be difficult, if not impossible, to conduct. Some interviewees stated that if comparisons were to be conducted, they would have to consider a range of relevant variables to comply with the intent of the ICAO *Manual on Airspace Planning Methodology for the Determination of Separation Minima*. It was stated that the factors to be considered should include the extent of Class G airspace, extent of radar coverage, types of services provided, other aspects of the airspace architecture, traffic density, type of aircraft, terrain and weather.

On 14 April 1998, the CASA Chairman, who had been the leader of the Airspace 2000 design team, sent a memorandum to the Acting Director about safety analysis issues. The memorandum stated, in part:

> I also point out that Airspace 2000 was based on following proven safe overseas practices as per ICAO recommendations, rather than preparing a safety case from raw mathematical data. The reason that Airspace 2000 followed the proven method is because it is so difficult and so subjective to gather information on airspace – especially when in Australia traffic densities are so different to the UK, Europe and America.

Due to the limitations in the overseas comparison approach, Airservices did not use this as a justification for Airspace 2000 in their safety case (see section 1.4).

B.3 Evaluation of system risk

In terms of evaluating system risk in Class G airspace, the Airspace 2000 design document contained reference to traffic data collected by Airservices Australia in 1994/95. It noted that there was relatively little traffic in the 'low-traffic density area' (see section 1.3.1). That data was presented more comprehensively in the Airservices *Airspace 2000 Safety Case* (see attachment D).

In the Airspace 2000 design document, it was noted that the provision of DTI by Airservices consumed a large amount of resources, but provided little benefit in avoiding collisions because the number of actual conflicts was so low. It therefore concluded that the provision of DTI in the low-density traffic area was not justified, and that a NAF should be provided.

The Airspace 2000 design team also engaged a consultant to develop an 'en-route collision risk simulation model'. The model, finalised in June 1996, was intended to be a planning tool or a 'filter' to allow airspace managers to concentrate on those areas of airspace requiring more attention. In particular, it was intended to be used to identify those areas of Class G airspace which could be upgraded to Class E airspace.

The model was restricted to scenarios involving aircraft travelling on the same route and in the same direction. When referring to the model, it was noted in the Airspace 2000 design document:

> Opposite direction traffic will be separated because they will be at a different ICAO hemispheric cruising level. The collision risk associated with any traffic crossing track or changing level is at least an order of magnitude smaller than that of same direction traffic and while this is not explicitly calculated, it does not significantly affect the decision.

By varying some parameters, the model estimated the average number of years between mid-air collisions. The factors which could be varied included the number of aircraft travelling on the route (in the same direction), the number of possible altitudes, the speeds of the various aircraft, the sizes of the aircraft, the degree to which the aircraft were on track and at the designated altitude (e.g. navigational 'scatter'), and the effectiveness of various hazard reduction factors (such as air traffic control, self-announce pilot-to-pilot links, see-and-avoid procedures, and airborne collision avoidance systems).

For the purposes of the Airspace 2000 design team, the model was used for a hypothetical scenario in which five aircraft were travelling on the same route, and each aircraft was randomly assigned one of eight flight levels. In terms of hazard reduction factors, pilot-to-pilot radio links were estimated to be 95% effective and visual sighting (and correction) was estimated as being 50% effective. If that scenario occurred 24 times a year, the model estimated that the average number of years between collisions would be 191,906 years. That was equivalent to an approximate risk of collision per hour of 10^{-9}.

During the investigation, personnel from Airservices and CASA who had been involved in risk analysis activities noted that the 'en-route collision risk simulation model' was very simplistic in nature. They noted that the model only referred to one type of collision scenario, and did not consider actual traffic levels. It also did not fully consider the effects of a variety of different factors. In addition, CASA personnel were concerned that, in contrast with the airspace risk model (see section attachment D), the 'en-route collision risk simulation model' had not been subjected to public scrutiny. Due to the model's limitations, they did not consider that it provided an adequate basis on which to make decisions regarding airspace changes. Furthermore, that risk model was not referenced in later Airspace 2000 safety analysis activities.

ATTACHMENT C

Overview of Airservices Australia's Safety Analysis of Airspace 2000

C1 Relevant safety analysis requirements

In April 1996, CASA published the document *Safety Regulation of Airservices Australia and Aerodrome Rescue and Fire Fighting Service Providers — Final Draft Regulatory Arrangements and Standards*. Attachment A of that document was concerned with the safety regulation of Airservices, and section 6 of that attachment was titled 'General Safety Regulatory Standards'. Section 6.3 was concerned with 'change management', and contained the following:

> Objective: To control and manage safety hazards in any change to existing systems, equipment or procedures to ensure unacceptable hazards are eliminated by the time the change is completed.
>
> Airservices shall define, document and maintain a change management process which:
>
> - describes the current baseline configuration, detailing the known functional/performance configuration of the system, equipment or procedure as approved prior to the change;
> - identifies the impact of change on the existing configuration;
> - details the hazard analysis method and hazard categorisation scheme used;
> - describes the Risk Analysis method used, which may take any of the following forms:
>   – assessment of overseas experience where relevant;
>   – quantitative modelling based on sufficient data, validated model and analysed assumptions;
>   – experienced judgement within a process designed to ensure that:
>   (a) relevant competence and experience is applied;
>   (b) relevant issues and components of the decision have been addressed;
>   (c) no component of judgement is anonymous;
>   (d) the infrastructure lends itself to continuity of services supplied, either stated or implied.
>   – trial implementation under surveillance and with sufficient backup, until sufficient data and experience has been acquired;
> - describes the Risk Control/Mitigation processes for eliminating or reducing risk factors which may have been identified within the SMS (Safety Management System). Risk controls may employ any, or a combination of:
>   – processes and/or procedures redesign;
>   – equipment redesign;
>   – staff training;
>   – administrative controls.
> - ensures that all changes are documented in such a way that all users are informed of the change; and
> - details approval authorities who are linked to the identified safety accountabilities.

C2 Relevant safety analysis guidelines

Safety analysis guidelines provided by ICAO were discussed in attachment B.

Australian Standard 4360:1995 *Risk Management* stated that the main elements of a risk management process are: (a) establish the context; (b) identify risks; (c) analyse risks; (d) assess and prioritise risks; (e) treat risks; and (f) monitor and review. The document provided general guidance on how to conduct those activities. It also provided the following definitions:

> Risk — the chance of something happening that will have an impact on objectives. It is measured in terms of consequences and likelihood.
>
> Risk management — the systematic application of management policies, procedures and practices to the task of identifying, evaluating, treating and monitoring risk.
>
> Risk assessment — the overall process of risk analysis and risk evaluation.
>
> Risk analysis — a systematic use of available information to determine how often specified events may occur and the magnitude of their likely consequences.

Australian Standard 3931:1998 *Risk Analysis of Technological Systems – Application Guide* provided more detailed guidance on how to conduct risk analysis activities, but did not prescribe specific methods. It also provided the following definition:

> Risk evaluation — process in which judgements are made on the tolerability of the risk on the basis of risk analysis and taking into account factors such as socio-economic and environmental aspects.

To provide assurance that risks are being managed appropriately, organisations in some safety critical industries are required to prepare a 'safety case' for new systems, existing systems, or when changes are being made to existing systems. In the document *Systematic Safety Management in the Air Traffic Services* (1995), Richard Profit of the UK National Air Traffic Services (NATS) stated the following regarding safety cases:

> The Director General of the UK Health and Safety Executive has defined a safety case as "a properly structured and comprehensive presentation of the hazards resident in any plant, their importance in terms of the risks of occurrence and their likely effect, and the means whereby they are to be managed". The essential features of a safety case are that it should fully describe the system or operation, identify the hazards, assess the risks, identify the measures in place to mitigate or control the risks and explain the safety management arrangements for the system or operation... The safety case is thus an important management tool… What the safety case concept does is provide a structured approach to managing safety issues and it needs to be maintained as a living document.

The document also stated that it was best to think of a system safety case in terms of a process rather than a document, with the latter merely recording the process. The document further outlined specific questions and issues to be addressed in four life-cycle phases of a system:

- requirements determination phase;
- design and procurement phase;
- installation and transition phase; and
- initial operation phase.

On page 103 of the document, the following was also stated in relation to safety cases:

> If the safety plan is drawn up and implemented right at the outset and then developed in step with the procurement programme, it produces a sound safety case. Hard-earned experience shows that it is very difficult to produce a safety case in retrospect just before a system is introduced into operation – particularly if the safety analysis is also done in retrospect… For convenience, we will refer to the four life cycle phases as parts 1–4. Although each part is likely to have a different author, the safety case is normally completed as a single document.

C.3 Description of the Airservices' Airspace 2000 Safety Case

The *Airspace 2000 Safety Case* was the first safety case developed by Airservices Australia, and it was based on the approach advocated in the document *Systematic Safety Management in the Air Traffic Services*. The first version of the safety case was completed on 7 February 1997. Controlled versions were then issued on 27 February, 25 March and 5 June. Minor amendments to the 5 June version were issued on 10 July 1997.

In subsection 2 of section 1 of the document, the following was stated:

> The objectives of this safety case are:
>
> a. to detail the airspace architecture and procedures associated with the current airspace system;
>
> b. to detail the airspace architecture and procedures associated with the Airspace 2000 system;
>
> c. to identify changes associated with the new architecture and procedures, and detail the way in which the new airspace system will operate;
>
> d. to identify potential safety issues and hazards and to assess the risks associated with those hazards;
>
> e. to identify safety requirements in place or to be established to control those risks; and
>
> f. to explain the safety management arrangements for the new airspace system.
>
> In meeting these objectives, the safety case will provide assurance that the changes proposed by Airspace 2000 will not significantly increase risk, provided that the identified mitigating actions and safety requirements are put in place.

Section 6 of the safety case was titled 'hazard identification and assessment'. The following prime question was used to determine if a hazard was relevant:

> Will this hazard result in, or increase the risk of, a mid-air collision between two aircraft?

Subsection 2.1 of section 6 stated:

> Where hazards have been identified throughout this safety case, an assessment of risk has been made, based on an objective analysis of operational facts, data gathered during an analysis of information concerning the current and proposed operating environment, analogy to previous risk assessment work, experienced judgement, or a combination of these elements.

During the investigation, the Airservices' project manager for Airspace 2000 stated that a risk analysis approach was preferred due to the difficulties inherent in an overseas comparison approach (see attachment B), and the difficulty that would arise in 'selling' the latter approach to some industry groups.

Ratings of the likelihood and the severity or consequence of each hazard were made using scales from the *Australian Standard 4360:1995 Risk management*, and are outlined in tables C.1 and C.2. The two factors were not combined into an overall level of risk. The judgements were made by a safety case panel of three air traffic services specialists. None of those specialists had qualifications in the fields of flight operations, human factors or risk analysis.

Table C.1
RATING SCALE FOR LIKELIHOOD OF EACH HAZARD

Level	*Descriptor*	*Description*
A	Almost certain	The event is expected to occur in most circumstances
B	Likely	The event will probably occur at some time
C	Moderate	The event should occur at some time
D	Unlikely	The event could occur at some time
E	Rare	The event may occur only in exceptional circumstances

Table C.2
RATING SCALE FOR SEVERITY OF EACH HAZARD

Level	*Descriptor*	*Description*
A	Insignificant	Incident or accident resulting in no injuries or fatalities
B	Minor	Accident resulting in injuries or very few fatalities
C	Moderate	Accident resulting in few fatalities
D	Major	Accident resulting in extensive injuries, or several fatalities
E	Severe	Accident resulting in multiple fatalities

The hazard log included in section 6 stated that there was only one top level hazard – a potential mid-air collision. The log listed a number of lower level hazards which, if not mitigated or resolved, could increase the risk of the top level hazard occurring. For each of those lower level hazards, the assessed likelihood and severity, mitigations, and safety requirements were listed. Details for each of the hazards relevant to Class G airspace are listed in table C.3.

As shown in table C.3, details for the removal of DTI (hazard 14) were presented in appendixes to the safety case. The analysis for that hazard involved collecting data on the traffic levels in Class G airspace, and then using the airspace risk model to calculate the level of risk associated with the current system compared to the proposed system. Details of those risk modelling activities are presented in attachment D.

C.4 Initial analysis of traffic data

Appendix 2 of the safety case presented traffic data for Class G airspace. The initial data collection efforts were conducted for the Airspace Steering Group. A variety of traffic data was collected from the period 1994 to 1996 for the low-density traffic area, and the following was concluded regarding that area:

> An analysis of the data collected supported the contention that a directed traffic service was not warranted on traffic movements, but some safety considerations may need to be addressed to mitigate the perceived reduction in safety by complete removal of directed traffic.

After Airservices was assigned carriage of Airspace 2000, the safety case panel collected further data during November 1996 for all flight service sectors. The results were presented for each

sector separately, up to flight level 200. Each sector provided data for a 7-day period on the number of flight service conflicts. Such conflicts occur when two aircraft are within the parameters required for traffic information to be passed – that is, less than 1,000 ft vertical spacing, and either 10 minutes or 15 NM horizontal spacing.

When discussing that data, the following was stated in appendix 2:

> The analysis indicates that the earlier study of low density sectors is valid, and that the information gathered during the early data collection remains valid. The analysis also shows that on a daily basis, a small number of the examined FS [flight service] sectors, particularly on the east coast, have relatively high conflict levels. Further analysis of these high traffic levels indicates that on the whole, the traffic is spread throughout the day, with conflict pairs rarely peaking above 2 to 3 per hour.

It was also noted that traffic peaked in some sectors at particular times. That occurred most notably for Melbourne Flight Service Sector 17, which showed a consistent peak of 20 to 30 flight service conflict pairs between 0600 and 0700, and 1900 and 2000 Eastern Standard Time (EST) on weekdays. Similar situations occurred for Sydney Flight Service Sectors 4 and 6. It was stated that those peaks were due to 'bank run' aircraft. Table D.4 in attachment D presents the estimated number of annual conflicts for each flight service sector.

It was noted in appendix 2 of the safety case that sectors such as Melbourne sector 17 were within extremely good radar coverage. It was also stated that there were planned mitigations to replace some Class G airspace in that area with Class E airspace (down to 8,500 ft) and to introduce a radar information service (RIS).

Table C.3
HAZARD LOG FROM THE AIRSERVICES AUSTRALIA *AIRSPACE 2000 SAFETY CASE*

9. Removal of the radar advisory service (RAS)

Safety Hazard	*Effect*	*Likelihood*	*Severity*	*Mitigation*	*Safety Requirement*
9.1 Radar traffic information and avoidance advice not provided to IFR/military low-jet (MLJ) flights.		Unlikely	Moderate	1. The RAS will be replaced by a more wide-ranging radar information service (RIS). 2. CASA have criticised the current RAS frequency arrangements.	9.1.a) Establish procedures for the RIS.
9.2 Radar information services not provided to VFR flights.		Moderate	Minor	1. Refer 9.1 above. 2. VFR flights will have access to RIS services, on-request and air traffic control (ATC) workload permitting.	Refer 9.1 above.

10. Establishment of a RIS in Class G airspace

Safety Hazard	*Effect*	*Likelihood*	*Severity*	*Mitigation*	*Safety Requirement*
10.1 Service not provided continuously.		Rare	Moderate	1. The RIS is an add-on service to Class G airspace procedures. 2. The risk associated with operations in Class G airspace are very low to start with.	10.1.a) Ensure that promulgated procedures for the RIS specify that it will be provided unless it is impracticable to do so.
10.2 Flights not routinely monitoring ATC frequency when receiving an on-going RIS.		Rare	Moderate	1. Refer 10.1 above	10.2.a) Comprehensive education program.

12. Reclassification of MBZs as CTAFs

Safety Hazard	*Effect*	*Likelihood*	*Severity*	*Mitigation*	*Safety Requirement*
12.1 VFR flights not operating on terminal frequency.		Moderate	Minor	1. There is little evidence of non-radio compliance in existing CTAFs where regular public transport (RPT) operations take place (refer CASA survey). 2. It is a primary responsibility for VFR flights to see-and-avoid (CAR 163A)	12.1.a) Comprehensive education and pilot awareness program. 12.1.b) Consider mandating the radio call back device (AIC 5/97) at all higher density non-controlled terminal locations.
12.2 VFR flights not radio equipped and operating in terminal area.		Unlikely	Moderate	1. A large percentage of aircraft are radio equipped (CASA survey). 2. Non-radio equipped aircraft generally operate away from aerodromes served by RPT operations. 3. There are currently dispensation procedures allowing non-radio operations to MBZs.	12.2.a) Promulgate with an entry in ERSA those aerodromes serviced by RPT operations. 12.2.b) Comprehensive education and pilot awareness program.

14. Replacement of air traffic services (ATS) provided third party directed traffic information (DTI) services in Class G airspace with enhanced radio-alerted see-and-avoid procedures (core element)

Safety Hazard	*Effect*	*Likelihood*	*Severity*	*Mitigation*	*Safety Requirement*
14.1 Level of alert to IFR flights is reduced.	Discussion on the levels of risk, and mitigations, is contained in Appendix 1 (of the safety case).				
14.2 Level of alert to VFR flights about IFR flights is reduced.	Discussion on the levels of risk, and mitigations, is contained in Appendix 1 (of the safety case).				

15. Introduction of revised frequency management arrangements in Class G airspace, including the introduction of a national advisory frequency (NAF)

Safety Hazard	*Effect*	*Likelihood*	*Severity*	*Mitigation*	*Safety Requirement*
15.1 Frequency congestion.	Inability to transmit or receive a position report could compromise radio-alerted see-and-avoid procedures	Unlikely	Moderate	1. There are a number of problems associated with current re-transmission facilities, leading to frequency congestion. 2. The number of calls will decrease in the new system Class G airspace (i.e. calls to and from flight service will be eliminated) 3. If the frequency is found to be congested, the continent will be divided into a number of advisory areas. 4. The implementation of the generic national CTAF will eliminate terminal area transmissions on the NAF.	15.1.a) Comprehensive education and pilot awareness program. 15.1.b) Establish arrange-ments to ensure that NAF congestion is monitored. Monitoring may be achieved through BASI CAIR reports or similar.

16. Deletion of routinely provided flight-following services to IFR flights operating in Class G airspace

Safety Hazard	*Effect*	*Likelihood*	*Severity*	*Mitigation*	*Safety Requirement*
16.1 Flights are not provided with current search and rescue (SAR) alerting service in event of missed reports.		Rare	Moderate	1. In the current system the failure to report position results only in the declaration of a SAR phase, and does not result in a search for the aircraft until fuel expiry. 2. The option of IFR flights being able to submit SARTIMEs alleviates the flight-following situation.	16.1.a) Develop and promulgate regulatory changes allowing IFR flights to use SARTIMEs instead of flight following.

17. Changes to the provision of information relating to military low-jet (MLJ) activity

Safety Hazard	*Effect*	*Likelihood*	*Severity*	*Mitigation*	*Safety Requirement*
17.1 Flights are not provided with ATS third-party radio alert regarding the operations of military jets on low level exercises.		Unlikely	Minor	1. Military low-jet activity takes place at very low levels and has little effect on normal IFR operations — the main effect is on VFR operations. 2. The operations are often below normal flight service VHF coverage — i.e. VFR flights may not hear the alert anyway. 3. Military pilot broadcast procedures would be more relevant that outdated procedural flight service information. 4. Information about MLJ activity will be available through NOTAM or NAIPS. 5. The NAMPS Low Level Operations Working Group will be reviewing MLJ activity.	17.1.a) NAMPS Low Level Operations Working Group to coordinate and develop broadcast procedures for MLJ flights. 17.1.b) Education and awareness program to advise pilots where information on MLJs can be obtained.

18. Removal of the requirement for mandatory flight notification for IFR flights operating in Class G airspace

Safety Hazard	*Effect*	*Likelihood*	*Severity*	*Mitigation*	*Safety Requirement*
18.1	This change item does not constitute an immediate threat of increased risk of a collision between two flights. It does, however, reduce the capacity to monitor the system for IFR-flight activity in Class G airspace, and to examine trends in traffic, and so monitor the safety of the system.				

19. Removal of the mandatory requirement for radio carriage above 5,000 ft for VFR flights operating in Class G airspace

Safety Hazard	*Effect*	*Likelihood*	*Severity*	*Mitigation*	*Safety Requirement*
19.1 VFR flights unaware of IFR flights.		Unlikely	Moderate	1. The current system does not require radio carriage by VFR below 5,000 ft — arguably this is the most critical area for IFR operations (i.e. arrival airspace).	19.1.a) Comprehensive education and pilot awareness program. 19.1.b) Encourage the fitment and use of radio for those flights planning operations above 5,000 ft, and not already radio equipped.

ATTACHMENT D

Discussion of the risk modelling of Class G airspace in the Airservices Australia *Airspace 2000 Safety Case*

D.1 Airspace risk model

In the early 1990s, the then Civil Aviation Authority (CAA) had difficulty in establishing quantifiable risk levels under proposed changes to airspace arrangements. In 1994, the CAA engaged risk engineering consultants to help CAA staff develop a model to calculate mid-air collision risk levels in various classes of airspace in the terminal and en-route environments. The resulting model was known as the airspace risk model (ARM).

The airspace risk model is a 'cause-consequence model' with a 'loss of control' point at its centre. If two aircraft reach that point in time, then pilot actions will be ineffective in reducing the probability of a collision. The loss of control point was taken to be 12 seconds between the two aircraft, which is approximately equivalent to a distance of 1 NM laterally and 500 ft vertically. The 'cause' side of the model details the reasons why the loss of control point may be reached. The 'consequence' side of the model details the factors which affect the probability of collision after the loss of control point is reached, and the likely consequences of a collision.

The first version of the airspace risk model was published in August 1995, and dealt with risks associated with uncontrolled terminal areas. The 'cause' side of the model was divided into three basic phases: traffic alert; considered action, ranging from 5 minutes to 1 minute from collision; and evasive action, ranging from 1 minute to 12 seconds from collision. For each of those phases a number of factors were considered for both aircraft involved in a potential collision. Those factors are outlined in table D.1.

For each of the factors, probabilities were estimated and the factors were combined, via a series of AND/OR gates, to produce an overall estimate of the probability of 'loss of control' in a given situation. Situations, and correspondingly the probabilities for certain factors, were varied in terms of the types of each of the two aircraft involved: VFR; single-pilot IFR (IFR1); and dual-pilot IFR (IFR2). Situations were also varied in terms of terminal area configurations (e.g. unalerted, CTAF or MTAF) and weather conditions (instrument meteorological conditions or visual meteorological conditions).

The probabilities used for some of the factors were directly based on empirical data (e.g. radio fitment). The probabilities for other factors were estimated by the study team based on empirical data, or on nominal human error rates for generic types of tasks.

As a part of the model development process, the CAA convened an independent Industry Safety Panel, composed of nine representatives from different parts of the aviation industry, together with a flying operations inspector and an air traffic specialist. A BASI representative acted as an observer. The tasks of the panel included verifying the model assumptions and logic, and reviewing the probabilities for the various factors proposed by the study team. Where there were variations in opinion, probabilities were finalised through a voting process. The probabilities for air traffic services failure were not reviewed by the Industry Safety Panel. Although the 1995 report discussed issues that were considered for each factor's failure probabilities, it did not specify the full range of issues that were considered.

The airspace risk model only calculates the 'relative risk' of a collision. That is, it only estimates the risk of a collision given the existence of a certain type of conflict pair in a certain type of situation. To obtain the 'absolute risk', or the actual risk of collision in a given area in a given time period, the number of conflict pairs had to be determined.

Table D.1
FACTORS CONSIDERED IN THE AIRSPACE RISK MODEL (1995)

Traffic Alert Phase

- Aircraft receiver not installed
- Aircraft receiver fails
- Aircraft transmitter not installed
- Aircraft transmitter fails
- Crew select wrong frequency
- Crew fails to listen
- Crew fails to make a call
- Air traffic services processing error (if relevant)
- Air traffic services communications error (if relevant)

Considered Action Phase

- Crew fails to see unreported traffic
- Crew fails to see reported traffic
- Crew fails to respond to threat
- Crew responds incorrectly

Evasive Action Phase

- Crew fails to see other aircraft
- Crew fails to respond to threat
- Crew responds incorrectly

D.2 Modifications to the airspace risk model in 1996

In October 1996, another report on the airspace risk model was published, by the risk engineering consultants for Airservices. That report compared the risks associated with procedural Class C and procedural Class D towers. During the development of that version of the risk model, modifications were made which had relevance to the 1995 uncontrolled terminal areas version. Those changes included the use of revised see-and-avoid probabilities. In addition, the earlier version of the model had worked on the assumption that a 'loss of control' situation would result in a collision on 0.3 % of occasions. For the 1996 version, different probabilities were used for different types of conflict pairs, based on an analysis of the size of different aircraft types and the geometry of aircraft collisions.

Risks were presented for four different aircraft types: VFR; single pilot IFR aircraft with a capacity of less than 10 passengers, IFR(L); two pilot IFR aircraft with a capacity of between 10 to 38 passengers, IFR(M); and two pilot IFR aircraft with a capacity of over 38 passengers, IFR(H). The previously used category of IFR1 related to IFR(L), and IFR2 related to IFR(M) and IFR(H).

D.3 Further development of the airspace risk model

Since 1996, both CASA and Airservices worked on the airspace risk model independently. CASA's main effort in 1998 was on an en-route model for Class E airspace (radar). Work also

continued on an updated model for uncontrolled terminal areas. Airservices are developing versions of the airspace risk model for controlled airspace in terminal areas.

Neither CASA nor Airservices have fully developed a version of the airspace risk model for en-route Class G airspace, although some preliminary work was undertaken in late 1995.

The 1995 version of the model was presented to ICAO's Review of the General Concept of Separation Panel in October 1995, and was subsequently accepted for inclusion in the ICAO *Manual on Airspace Planning Methodology for the Determination of Separation*. The airspace risk model was formally endorsed by CASA in April 1997.

D.4 Results of the airspace risk model

In general, risk levels can be discussed in terms of the level of risk per year (or years between collisions), per movement or per flight hour. Each method has its own advantages and disadvantages. Risks can also be presented for a group or number of people involved in a possible collision, or individual risk.

The main method which has been used for presenting group results is a frequency and severity graph, with the vertical axis representing the risk per a given period and the horizontal axis relating to the number of fatalities which would result from the collision. Both axes are depicted logarithmically. In the 1995 report, it was found that MBZs had a much lower relative risk than CTAF zones. That difference was up to an order of magnitude depending on the compliance with radio procedures in the CTAF zone. It was also found that risks for IFR-to-IFR conflicts increased to an order of magnitude in IMC conditions versus VMC conditions, but the presence or absence of flight service only had a minor impact.

For individual risk, airspace risk model results have been presented in terms of the chances of a fatality per million people per year for three different types of people: casual passenger (10 movements per annum), frequent flyer (100 movements per annum), and crew member (500 movements per annum). For the 1995 model, preliminary calculations were conducted for one aerodrome. Although not reproduced here, similar results are discussed in section D.6.

Incorporating the relevant changes from the 1996 airspace risk model, absolute risk levels were calculated for five different uncontrolled aerodromes. The results of those calculations were not presented in the 1996 report, but similar results were presented in appendix 6 of the Airservices' safety case, and are discussed in section D.6.

In terms of the evaluation of the acceptability of risk levels, no formal position has yet been promulgated for aviation in Australia. However, CASA personnel in the Airways and Airspace Standards Branch developed draft criteria in the early part of 1999, but these have not been reviewed by CASA. Results of the airspace risk model have generally been discussed in terms of the risk levels present and found acceptable in other industries.

The 1995 airspace risk model report noted that risks could be classified as negligible, tolerable or intolerable. The tolerable region is also known as ALARP ('as low as reasonably practicable'). Based on their preliminary calculations, the 1995 report tentatively concluded that CTAF zones were barely tolerable (depending on the participation rate) and that MBZs were tolerable.

The 1996 report on the airspace risk model noted that risks could be classified within the following ranges:

- 'intolerable' range, where the risk cannot be justified under any circumstances;
- 'scrutiny' range, where the community may accept the risks under certain circumstances;

- ALARP range, where risks are acceptable providing that they are reduced to a level of low as practicable; and
- 'acceptable' range.

The 1996 report stated that the ALARP range could be subdivided into two areas. For the higher risk area of the ALARP range, it is:

> …usually necessary to demonstrate that further risk reduction is impractical or the costs of risk reduction are grossly disproportionate to the benefits.

For the lower risk area of the ALARP range:

> …risk is regarded as tolerable and decisions as to whether further risk reduction is warranted are usually made on the basis of cost benefit ranking.

When discussing risk acceptability, appendix E of the 1996 airspace risk model report stated:

> With references to the results for crew members, higher risk exposures are arguable because they make their living from being exposed to the risk. [Company name withheld] argue that if something is more dangerous than driving a car (about 100 chances per million person-years) then the risk is unacceptable unless in exceptional circumstances. Conversely, risks of being struck by lightning (about 0.1 chances) are regarded as trivial. One chance [per million] would be regarded as acceptable, ten as tolerable (within ALARP) and the obligation to demonstrate that risk reduction is impracticable or the cost of risk reduction is grossly disproportionate to the benefits becoming increasingly onerous as individual risk increases beyond say, 30 to 50 chances per million person-years.

Since 1996, CASA personnel have conducted further revisions of the uncontrolled terminal area version of the model. That work has indicated that risk at a CTAF infringes the scrutiny range, according to draft risk acceptability criteria developed within CASA, for cases where there are approximately 20,000 movements per year and at least 20% of those movements are IFR. Upgrading to an MBZ appears to reduce the risk towards the middle of the ALARP range.

D.5 Modification of the airspace risk model for the en-route environment

To establish an estimate of the risk associated with the proposed Class G airspace under Airspace 2000, the safety case panel adapted the previous work on the airspace risk model in uncontrolled terminal areas. The panel considered the removal of DTI and its replacement with the NAF in its analysis. It did not consider the introduction of a RIS.

During the investigation, Airservices Airspace 2000 project manager stated that the main purpose of the risk modelling part of the safety case was to provide a broad indication of the extent to which risk would change under the new system in en-route Class G airspace. It was not intended to provide an accurate estimate of the absolute risk associated with the new system in Class G airspace.

The Airservices' safety case panel decided that only three of the factors in the 1996 airspace risk model for uncontrolled terminal areas needed to be changed to provide an estimate of the risk level in the en-route environment: 'wrong frequency'; 'failure to listen'; and 'failure to make a call'.

In terms of 'wrong frequency', the original failure probabilities of the 1995 model were estimated to be 8.7×10^{-3} (VFR), 2.8×10^{-3} (IFR1), and 9.0×10^{-4} (IFR2). The panel thought that the value for IFR1, essentially an interpolation of the values for the other two aircraft, was too high and was reduced to 1.8×10^{-3}. For the en-route situation, the panel then decided to reduce the IFR probabilities by 50%, to 1.0×10^{-3} (IFR1) and 4.5×10^{-4} (IFR2). The reasons for that reduction were clearly outlined in the safety case. The main reasons were the reduced number of frequency changes and an increased level of pilot vigilance under the new system.

In terms of vigilance and alertness, the panel assumed that where third-party DTI was removed, the level of alertness of pilots would increase. Below that assumption was a 'note' which stated that the assumption 'was later tested by the safety case panel, and it was determined that this may not necessarily be the case'.

In terms of 'failure to listen', the panel noted that there may be difficulties in assimilating the traffic information provided under the new system, and that this would not be fully catered for by increased alertness of pilots. As a result, the values for IFR1 and IFR2 were increased by 50% to 6.0×10^{-3} and 1.85×10^{-3} respectively.

A CASA employee who was interviewed during the investigation, and who had worked on the airspace risk model, noted that difficulties in assimilating information were actually considered in a different part of the 1995 model, in terms of 'fails to see' traffic factors in the considered action phase.

In terms of 'failure to make a call', the safety case panel noted that the original values for IFR1 and IFR2 were 9.2×10^{-3} and 1.4×10^{-3} respectively. They decided that the figure for IFR1 had been set too high for the 1995 model, as the probability set for the VFR pilots had been too high. Consequently, a value of 4.2×10^{-3} was considered more appropriate for IFR1. That view was supported by the risk engineering consultants who worked on the original model. The panel then considered that the removal of the third party traffic information service, and increased peer pressure on pilots to make appropriate radio broadcasts, as well as a lower workload in en-route environments relative to terminal environments, would reduce the probabilities for that factor. However, the lack of a 'compulsion' to make radio calls, and the absence of flight service to chase calls, would increase the error rates. The panel finally resolved that the probabilities for IFR1 and IFR2 should be increased by 25%.

D.6 Risk engineering consultants' work for the Airspace 2000 safety case

The risk consultant who was involved in developing the original airspace risk model recalculated risk levels based on the revised failure probabilities. The consultant conducted relative risk calculations for the original terminal area model (model A), with the model adapted to reflect the change in the 'fail to listen' probability (model B), and then with all the new probabilities developed by the safety case panel (model C). The relative risk results for the IFR comparisons for models B and C are presented in table D.2.

Table D.2
RELATIVE RISKS OF A COLLISION FOR MODEL B AND MODEL C (EXTRACTED FROM APPENDIX 6 OF THE *AIRSPACE 2000 SAFETY CASE*)

Situation			*Conflict Pairs*			
	IFR(L)	*IFR(L)*	*IFR(L)*	*IFR(M)*	*IFR(M)*	*IFR(H)*
Model B	*IFR(L)*	*IFR(M)*	*IFR(H)*	*IFR(M)*	*IFR(H)*	*IFR(H)*
IMC no flight service	3.07×10^{-3}	9.32×10^{-4}	9.32×10^{-4}	1.96×10^{-4}	1.96×10^{-4}	1.96×10^{-4}
IMC flight service	2.14×10^{-3}	5.40×10^{-4}	5.40×10^{-4}	1.36×10^{-4}	1.36×10^{-4}	1.36×10^{-4}
VMC no flight service	5.79×10^{-4}	1.31×10^{-4}	9.22×10^{-5}	1.56×10^{-5}	1.09×10^{-5}	3.16×10^{-6}
VMC flight service	4.03×10^{-4}	7.65×10^{-5}	5.35×10^{-5}	1.08 x 10-5	7.59×10^{-6}	2.20×10^{-6}
Model C						
IMC no flight service	2.73×10^{-3}	8.76×10^{-4}	8.76×10^{-4}	1.98×10^{-4}	1.98×10^{-4}	1.98×10^{-4}
IMC flight service	2.15×10^{-3}	5.51×10^{-4}	5.51×10^{-4}	1.40×10^{-4}	1.40×10^{-4}	1.40×10^{-4}
VMC no flight service	5.15×10^{-4}	1.24×10^{-4}	8.67×10^{-5}	1.58×10^{-5}	1.10×10^{-5}	3.20×10^{-6}
VMC flight service	4.06×10^{-4}	7.79×10^{-5}	5.45×10^{-5}	1.12×10^{-5}	7.83×10^{-6}	2.27×10^{-6}

Relative risks involving VFR aircraft were conducted assuming a 95% VFR compliance rate with CTAF procedures. The results for model B were reported as 1.46×10^{-2} (VFR to VFR), 5.97×10^{-3} (VFR to IFR(L)), 4.64×10^{-3} (VFR to IFR(M)), and 3.26×10^{-3} (VFR to IFR(H)). The results for model C were the same, except that the relative risk between VFR and IFR(L) increased slightly to 6.04×10^{-3}.

Using those relative-risk probabilities, absolute risks were calculated for five different uncontrolled aerodromes — Dubbo, Ayers Rock, Kununurra, Devonport and Wynyard. Absolute risk per aircraft movement was then calculated for each of the four types of aircraft, for whether flight service was present or not, for models A, B and C. The risk engineering consultants then analysed traffic data from 1995 which was collected from the low density traffic areas of Australia. An analysis of those data indicated that there were only 14% as many traffic conflicts in en-route Class G airspace compared with uncontrolled terminal area airspace. As a risk model for CTAF zones was being used, the results were therefore multiplied by 0.14 to produce figures for the en-route Class G phase.

The results were presented in terms of a flight between an aerodrome with a Class D tower and an aerodrome with a CTAF zone. Data were presented on the risks for each of the flight phases, for each of four types of aircraft — VFR, IFR(L), IFR(M), and IFR(H). Data were also provided on the cumulative risk for a casual passenger (10 flights per year), a frequent flyer (100 flights per year) and a crew member (500 flights per year). The full comparisons for model B and model C are presented in table D.3. The percentage change values for model C were the basis for the conclusions in the safety case that there was an insignificant change in risk associated with the removal of flight service (DTI).

It should be noted that although the relative risks of various IFR to IFR conflicts in table D.2 increased from the flight service to the no-flight service model, the changes in absolute risk for the three types of IFR aircraft in table D.3 do not change anywhere near the same amount. The reason for that is the major component to the absolute risk figures for IFR aircraft is the influence of VFR aircraft.

In terms of the individual risk results, the following was stated in appendix 6 when discussing the data for model A:

> Taking IFR(M) for example, the individual risk for a casual passenger varies form [*sic*] 0.79 to 0.82 chances per million per year of a fatality depending on whether Flight Service is provided or not. In either case this is less than 1 in a million and in other industries would be considered an acceptable risk. For a frequent flyer travelling 10 times as often, the individual risk range rises from 7.93 to 8.16 chances per million per year of fatality — which is at the lower end of the tolerable risk range. For crew members, the individual risk levels vary from 39.64 to 40.78 chances per million per year of a fatality.
>
> We are not aware that specific individual risk target levels have been set for the aviation industry, other industries would not consider these levels of occupational risk to be intolerable, albeit the ALARP principle of demonstrating that risk is "as low as reasonably practicable" will apply.

Table D.3
ABSOLUTE RISK RESULTS FOR MODEL B AND MODEL C (EXTRACTED FROM APPENDIX 6 OF THE *AIRSPACE 2000 SAFETY CASE*)

Situation	*Type of Aircraft*			
	VFR	*IFR(L)*	*IFR(M)*	*IFR(H)*
Model B, with flight service				
Class D tower	1.20×10^{-7}	1.80×10^{-7}	2.00×10^{-8}	2.50×10^{-8}
En-route	8.12×10^{-8}	1.02×10^{-8}	7.28×10^{-9}	9.52×10^{-9}
CTAF	5.80×10^{-7}	7.30×10^{-8}	5.20×10^{-8}	6.80×10^{-8}
Total risk per movement	7.81×10^{-7}	2.63×10^{-7}	7.93×10^{-8}	1.03×10^{-7}
Casual passenger (10/year) (x E6)	7.81	2.63	0.79	1.03
Frequent flyer (100/year) (x E6)	78.12	26.32	7.93	10.25
Crew member (500/year) (x E6)	390.60	131.61	39.64	51.26
Model B, without flight service				
Class D tower	1.20×10^{-7}	1.80×10^{-7}	2.00×10^{-8}	2.50×10^{-8}
En-route	8.12×10^{-8}	1.02×10^{-8}	7.46×10^{-9}	9.81×10^{-9}
CTAF	5.80×10^{-7}	7.30×10^{-8}	5.33×10^{-8}	7.01×10^{-8}
Total risk per movement	7.81×10^{-7}	2.63×10^{-7}	8.08×10^{-8}	1.05×10^{-7}
Casual passenger (10/year x 10^6)	7.81	2.81	0.81	1.05
Frequent flyer (100/year x 10^6)	78.12	28.11	8.08	10.49
Crew member (500/year x 10^6)	390.60	140.56	40.38	52.46
Change (percentage)	0.00%	6.80%	1.87%	2.34%
Model C, with flight service				
Class D tower	1.20×10^{-7}	1.80×10^{-7}	2.00×10^{-8}	2.50×10^{-8}
En-route	8.82×10^{-8}	1.08×10^{-8}	6.66×10^{-9}	8.72×10^{-9}
CTAF	6.37×10^{-7}	7.68×10^{-8}	4.76×10^{-8}	6.23×10^{-8}
Total risk per movement	8.46×10^{-7}	2.68×10^{-7}	7.43×10^{-8}	9.60×10^{-8}
Casual passenger (10/year) (x E6)	8.46	2.68	0.74	0.96
Frequent flyer (100/year) (x E6)	84.62	26.76	7.43	9.60
Crew member (500/year) (x E6)	423.09	133.78	37.13	48.01
Model C, without flight service				
Class D tower	1.20×10^{-7}	1.80×10^{-7}	2.00×10^{-8}	2.50×10^{-8}
En-route	8.92×10^{-8}	1.23×10^{-8}	6.85×10^{-9}	9.03×10^{-9}
CTAF	6.37×10^{-7}	8.75×10^{-8}	4.89×10^{-8}	6.45×10^{-8}
Total risk per movement	8.46×10^{-7}	2.80×10^{-7}	7.57×10^{-8}	9.85×10^{-8}
Casual passenger (10/year x 10^6)	8.46	2.80	0.76	0.99
Frequent flyer (100/year x 10^6)	84.62	27.98	7.57	9.85
Crew member (500/year x 10^6)	423.09	139.88	37.87	49.27
Change (percentage)	0.00%	4.56%	2.00%	2.61%

D.7 Safety case panel calculations

Using the relative risk comparisons between IFR conflict pairs for model C, the safety case panel developed a composite relative risk value of 3.13×10^{-7} for IFR to IFR conflicts. They then applied that factor to each flight service sector, and those results are presented in table D.4. The number of flight service conflicts was divided by 5 to produce an estimate of airspace risk model conflicts. The rationale for that conversion value was presented in appendix 2 of the safety case. Sector 2R was reduced by a factor of 2 as radar was being used by air traffic controllers to provide DTI in that sector. The last column of table D.4 presents an overall estimate of risk by multiplying the number of airspace risk model conflict pairs by 3.13 x 10-7.

Table D.4
CONFLICT PAIRS AND ESTIMATED COLLISION RISK FOR EACH FLIGHT SERVICE SECTOR (EXTRACTED FROM APPENDIX 2 OF THE AIRSPACE 2000 SAFETY CASE)

Sector	Estimate of airspace risk model conflict pairs per annum	Years between IFR-to-IFR collision
Sector 2R	420	7,633
Sector 3L	818	3,906
Brisbane FS1	168	19,011
Brisbane FS3	460	6,944
Brisbane FS4	197	16,207
Brisbane FS5	418	7,633
Brisbane FS7	667	4,784
Perth FS1	480	6,667
Perth FS7	720	4,444
Perth FS8	701	4,566
Perth FS9	497	6,452
Perth FS10	497	6,452
Adelaide FS4	469	6,802
Adelaide FS8	375	8,547
Adelaide FS9	386	8,264
Adelaide FS10	156	20,491
Adelaide FS11	448	7,142
Sydney FS3	1,445	2,212
Sydney FS4	3,124	1,022
Sydney FS5	818	3,906
Sydney FS6	2,555	1,282
Sydney FS3+5	1,058	3,021
Sydney FS4+6	1,277	2,500
Melbourne FS12	949	3,367
Melbourne FS14	448	7,143
Melbourne FS15	866	3,690
Melbourne FS17	3,160	1,011

Note: ‘FS’ refers to flight service. ‘FS3+5’ refers to when sectors 3 and 5 are combined.

No formal position regarding risk acceptability criteria has yet been promulgated for aviation in Australia. The Airways and Airspace Standards Branch in CASA developed draft criteria in early 1999. According to those criteria, risk to fare paying passengers in medium and high capacity regular public transport aircraft would infringe the scrutiny zone if accidents occurred more frequently than once every 2,000 to 14,000 years. Depending on the proportions of such aircraft involved in IFR to IFR collisions, risk in some of the sectors may infringe the scrutiny zone.

D.8 CASA-Airservices discussions on the risk modelling data

On 12 May 1997, a CASA employee wrote to the independent risk consultant used by Airservices, about the risk modelling used in the safety case. The employee had been involved in the development of the risk model since its beginning in 1994. He stated that there needed to be some discussion on which type of model should be used in the safety case for the analysis of the replacement of DTI. He noted that the problem of common mode failure needed to be examined.

A common mode failure refers to a situation that results in two or more control measures simultaneously failing. If such measures are connected over an AND gate, then the overall risk level will be under-estimated. For the 1995 version of the model, common mode failures were regarded as a second order effect and combined over an AND gate. For the 1996 model (Class C/D terminal areas), common mode issues were considered more significant and were addressed by combining the relevant factors over OR gates. Later versions of the model also addressed common mode issues.

For the uncontrolled terminal area model, common mode failures occur in the traffic alert phase in relation to radio failures and other communication activities. The CASA employee attached preliminary calculations to his 12 May 1997 memorandum which showed that, if all elements of the traffic alert phase were considered as common mode issues, there would be an order of magnitude increase in the relative risk when flight service was removed. Such an increase was much higher than that reported in the safety case. Subsequent preliminary versions of en-route airspace risk model models developed by CASA have considered only some of the traffic alert factors to be common mode issues, and the influence of common mode failures has been much less. The CASA employee stated during the investigation that the exact influence of the common mode failure issue for an en-route Class G model could not be established until such a model had been fully developed.

On 22 May 1997, the risk engineering consultants provided a draft report which incorporated common mode issues into model C. The final report was provided to Airservices on 18 June 1997. The revised calculations showed that when common mode failures were considered, the absolute risk increased in the en-route phase for VFR by 60%, IFR(L) by approximately 40% (with and without flight service), IFR(M) by approximately 135%, and IFR(H) by approximately 140%. The revised change in risk if flight service was removed was 2.48% for IFR(L), 0.73% for IFR(M), and 0.78% for IFR(H). The overall risk levels for a crew member associated with a movement between a Class D tower and a CTAF without flight service were revised to 644 (per million per year) for VFR, 157 for IFR(L), 75 for IFR(M), and 101 for IFR(H).

In June 1997, the same CASA employee contacted the risk consultant and stated that different see-and-avoid probabilities should be used for the models in appendix 6 of the safety case, according to agreements reached with the Industry Safety Panel during work on the Class C / Class D model. Appendix 6 models were based on see-and-avoid probabilities agreed for a terminal area environment for Class C and Class D towers. Essentially, higher probabilities

should have been used in an en-route environment, and lower probabilities should have been used in an uncontrolled terminal area environment. In July 1997, the risk consultant determined that the en-route risks should increase by a factor of 1.46, and the risks for the CTAF should be multiplied by 0.79. Those changes were not incorporated into the safety case as they were conducted after the safety case had been finalised. The overall risk levels for a crew member associated with a movement between a Class D tower and a CTAF without flight service were updated to 547 (per million per year) for VFR, 146 for IFR(L), 65 for IFR(M), and 86 for IFR(H).

During the investigation, CASA staff who had been involved in developing the airspace risk model stated that adapting a terminal area model to the en-route application by adjusting the probabilities of some factors was a simplistic approach. En-route models required different structures than terminal area models. Consequently, any conclusions based on the risk modelling undertaken as part of the safety case were questionable.

D.9 Other issues

As discussed in section D.7, no formal risk acceptability criteria have yet been promulgated for aviation in Australia. However, the 1996 report on the airspace risk model (see section D.4) noted that the obligation to demonstrate that the cost of risk reduction is grossly disproportionate to the benefits become increasingly onerous as individual risk increases beyond 30 to 50 chances per million person-years. As can be seen in Table D.3, the overall risk levels for crew members of IFR(M) and IFR(H) aircraft were higher than 30 chances per million person-years. Later revisions of those figures, as discussed in section D.8, increased the risk levels to between 65 to 86 chances per million person-years. However, no cost-benefit analyses were undertaken to demonstrate that the cost of further risk reduction was impracticable.

ATTACHMENT E

BASI observations on the *Airspace 2000 Safety Case* risk modelling

As part of its investigation into the Class G demonstration, BASI reviewed the risk modelling component of the Airservices Airspace 2000 safety case, and associated documents (as discussed in attachment D). It should be noted it is not BASI's role to routinely review this type of information. Based on that review, the following observations were made for the risk modelling of the situation where DTI had been replaced by the NAF:

1. Table D.4 provides an estimate of the absolute risk for IFR to IFR conflicts for each flight service sector for the new system. This data was based on a composite risk factor of 3.13×10^{-7}, which was based on the relative risk results for model C without flight service. By following the same calculation process for the relative risk results with flight service, a value of 2.15×10^{-7} was obtained. Therefore, using the data for model C, the IFR to IFR risk increased 46% with the replacement of DTI with the NAF.

2. Modelling of the effect of flight service in the uncontrolled terminal area airspace risk model was rudimentary. Nominal error rates were used, and an Industry Safety Panel has not reviewed those rates. Errors certainly do occur in the flight service environment, and an appropriate estimate of those errors needs to be developed.

3. In changing the probabilities of model B, the safety case panel was adapting an uncontrolled terminal area model to an en-route application. However, they were also simultaneously changing the model from the current Class G airspace system to the Airspace 2000 system. Most of the proposed reasons for the changes to the factor probabilities were due to the Airspace 2000 changes, rather than the changes to the type of airspace (en-route versus terminal area). Therefore, a more appropriate comparison of the impact of flight service versus no flight service would have been between 'model B with flight service' versus 'model C with no flight service'. Such a comparison would produce a slightly larger increase in the en-route risk when flight service (DTI) is removed than was reported in the safety case.

4. The safety case panel made two changes to the original uncontrolled terminal area model (1995) probabilities for IFR1 factors. The Industry Safety Panel had approved the original probabilities. The suitability of making such changes without industry consultation was questionable. Both changes slightly reduced the risk of conflict involving IFR(L) aircraft. Nevertheless, model B only incorporated one of the two changes made to the IFR1 probabilities for the uncontrolled terminal area model. If the other factor was considered, the probabilities in model B would be slightly lower than those stated. Such a change would produce a slightly larger increase in the en-route risk when flight service is removed than was reported in the safety case.

5. There was a miscalculation of the absolute risk data for either model B or model C (in table D.3). For a comparison between model B with flight service and model C with no flight service, each of the relevant relative risks is either the same or lower in model B than in model C. Consequently, the absolute risks in model C should be higher for each aircraft type than in model B. For the en-route phase, the risks increase for VFR by 10% and for IFR(L) by 21%, but the risks decrease for IFR(M) by 6% and for IFR(H) by 5%. The exact nature of the calculation error could not be identified from the data available, and therefore the full effects of that error could not be ascertained.

6. A key assumption with the modelling was that the replacement of DTI with the NAF had no effect on the performance of VFR pilots. Although DTI is not specifically provided for VFR pilots, it is reasonable to expect that some VFR pilots would use the broadcasts on the

flight service frequency to avoid traffic conflicts. Therefore, the changes made by the safety panel to the various probabilities for IFR aircraft should also be applied, at least in part, to VFR aircraft. As the overall result of the changes for IFR aircraft was an increase in risk when flight service was removed, there would be a further increase in risk when the changes were applied to the VFR factor probabilities.

7. During the Class G demonstration investigation, it was identified that the impact of the removal of DTI on factors such as pilot workload, frequency management, NAF congestion, the accuracy of position reporting and the frequency of position reporting were not fully considered in the risk modelling contained in the Airservices' safety case. If those factors were considered, there would be a further increase in the en-route risk when flight service was removed.

8. As noted in section D.8, an en-route airspace risk model may need to consider the issue of common mode failure for traffic alert factors. Calculations by the risk engineering consultants found that the overall risk in the en-route phase (with and without flight service) increased by 40% for IFR(L) to about 140% for IFR(M) and IFR(H). Other preliminary calculations by CASA indicated that a consideration of common mode failures would increase the difference between models, comparing the effect of the presence versus the absence of flight service.

9. As noted in section D.8, the data for model B and model C included see-and-avoid probabilities relevant to a Class D tower environment. Due to pilot alertness factors, the Industry Safety Panel decided in 1996 that en-route models should use a higher failure rate, and uncontrolled terminal areas a lower failure rate for that factor. The introduction of those factors would increase the en-route risks by a factor of 1.46, and decrease the CTAF risks by a factor of 0.79.

10. The safety case results were based on the use of an uncontrolled terminal area model, with an assumption that both pilots were making radio calls 95% of the time. However, VFR pilots do not make such calls in the en-route environment. Results for the 1995 model showed that the percentage compliance with radio calls by VFR pilots had a large impact on risk levels. Therefore the VFR to IFR risk levels would appear to be understated for the en-route phases in the modelling. Correcting that factor should also increase the risk in the en route phase, relative to a terminal area.

11. Other results using the airspace risk model indicated that MBZs are associated with much less collision risk, up to an order of magnitude, than CTAF zones. The Airservices safety case assumed that the en-route phase in Class G airspace had 14% of the risk of a CTAF zone. Based on those results, the risk associated with the en-route phase would appear to be similar to that of a MBZ. Such a result would be more likely for the approach area rather than other parts of the en route phase.

12. To conduct an appropriate comparison of the change in individual risk by the replacement of DTI with the NAF in the en-route environment, the values for the CTAF zone should not change significantly. The major difference in risk would be in the en-route component, which is smaller than the CTAF zone component. However, the comparisons in the Airservices safety case also applied the NAF changes to the CTAF zone, and thereby increased the CTAF risk results as well for model C (with the NAF). That process led to the overall risk levels for model C being overstated.

Based on those observations, the following conclusions can be made:

1. There were a number of inappropriate assumptions and interpretations made during the development of the risk modelling data for the Airspace 2000 safety case, which seriously affected the validity of the results and conclusions that were presented. This conclusion is based on observations 2–12. Developing an airspace risk model for the en-route environment required much more development than simply adjusting the failure probabilities for a small range of factors for a terminal area risk model.
2. The increase in risk in the en-route phase when replacing DTI with the NAF was higher than that reported in the safety case. This conclusion is based on observations 3–8. The magnitude of the increase could not be reliably stated without actually developing an appropriate en-route risk model.
3. The risk in the en-route phase formed a larger component of the overall risk per movement than was reported in the safety case. This conclusion is based on observations 9-12, and indirectly 3–7. The increase would apply to situations where either DTI or the NAF was present. The magnitude of any changes could not be reliably stated without actually developing an appropriate en-route risk model.
4. The change in the overall risk per movement when replacing DTI with the NAF was probably different to that reported in the safety case, but the direction and size of that difference could not be determined. This conclusion is based on observations 2–12. Observation 12 would substantially reduce the probabilities. However, there were a number of other factors which would increase the risk of the en-route phase relative to a CTAF phase, and consequently the overall risk. In addition, the overall risk level would be lower if the second aerodrome was a MBZ rather than a CTAF zone. However, the increase in overall risk would also be more significant. No definitive conclusion about overall risk levels could be made without actually developing an appropriate en-route risk model.

ATTACHMENT F

Hazard log prepared by the Airspace Technical Expert Panel

The following extract contains the hazard log for changes to Class G airspace associated with Airspace 2000 prepared by the Airspace Technical Expert Panel in August 1997.

The risk assessment methodology used by the panel was based on documentation published by the UK National Air Traffic Services and the USA Federal Aviation Administration. Ratings of the likelihood or frequency for each hazard were made using the following scale: 'frequent', 'probable', 'occasional', 'remote' and 'improbable'.

Ratings of the severity or consequence were made using the following scale:

I Catastrophic: a mid air collision (or other accident) involving a commercial transport aircraft.

II Critical: a mid air collision (or other accident) not involving a commercial transport aircraft.

III Marginal: near miss.

IV Negligible: no near miss, but system did not operate as planned.

The frequency and severity were combined into an overall risk rating using the following table adapted from the document *A Safety Risk Management Process for Air Traffic Requirements Projects* written by Keegan and Rice and published in the Journal of ATC (October 1996):

	Hazard categories			
Frequency of occurrence	**I Catastrophic**	**II Critical**	**III Marginal**	**IV Negligible**
(a) Frequent	R1	R1	R1	R3
(b) Probable	R1	R1	R2	R3
(c) Occasional	R1	R2	R2	R4
(d) Remote	R2	R2	R3	R4
(e) Improbable	R3	R3	R3	R4

Hazard log prepared by the Airspace Technical Expert Panel

CHANGE 1: Removal of DTI

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
1.1 Removal of DTI		• RIS, but with workload permitting	• AGREED (Note: 4 panel members did not agree)
		• Class E routes (Note: possible new hazard with introduction of E routes – see change 1 A below)	• AGREED
		• Segregated route structure (but IFRs do not have to fly designated routes)	• AGREED

CHANGE 1A: Introduction of Class E routes (mitigation for removal of DTI)

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
1A.1 Complexity of airspace		Not an issue	
1A.2 Possible delays in getting clearances with procedural E		Not a safety issue, traffic management problem	
1A.3 VFR frequency separation	R4		
1A.4 Crossing traffic	R4		

CHANGE 2: Removal of RAS.

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
Nil			

CHANGE 3: Establishment of RIS. Note: This is a mitigator, but…

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
3.1 Lack of continuous service in radar areas (continuous versus workload-permitting RIS)	R4, R3, R2	For R2, continuous RIS at times of known peak traffic.	NOT AGREED
3.2 RIS may give pilots false sense of security	R4, R3	Education	
3.3 Confusion as to whether service is continuous or ‘snapshot’	R4		

CHANGE 4: Loss of RIS

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
4.1 Loss of RIS due to radar failure.	R4		

CHANGE 5: Change MBZs to CTAFs (see note below).

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
5.1 No radio aircraft*	R3 (R2)	Procedures for no-radio (NORAD) aircraft – NORAD aircraft can enter MBZ to have an unserviceable radio fixed or maintenance completed on a one-off basis only	AGREED (Note: 3 panel members did not agree)
5.2 Aircraft with radio not participating	R3	Education	AGREED
5.3 Reduction of airspace area, therefore insufficient time to acquire other aircraft	R2, R3	• Call on entering approach/holding • Call with sufficient time/distance	• AGREED • AGREED
5.4 Because no defined area with CTAF then problems with reactivation of control zone	R3		
5.5 Misconception of need for extra calls, therefore frequency congestion	R4, R3	Education – review procedures and change use of word 'should'	AGREED
5.6 Confusion as to who is involved	R2, R3	Refer 5.3	

Note:

a) The panel believed that MBZs should be retained but could be reduced to 5 NM radius and 3,000 ft above ground level, and that CTAFs should not have set dimensions and other aerodromes should have a MULTICOM (as set out in the Airservices' safety case). NOT ALL PANEL MEMBERS AGREED THAT MBZs SHOULD BE RETAINED, AND NOT ALL AGREED THAT THE DIMENSIONS SHOULD BE REDUCED.

b) Given the above, the panel recommended that criteria be developed for establishing/discontinuing MBZs.

*Itinerant NORAD aircraft — unrestrained access: R2, R3

Fixed operation NORAD aircraft — unrestricted access: R2, R3

CHANGE 6: Level of alertness for IFR and VFR pilots reduced*

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
6.1 Reduced traffic awareness			
6.1a Do not hear aircraft that would normally get with DTI (communications problem)	West — R3, R4 East — R3 (R2)	• Last broadcast to be made within range	• AGREED
		• Procedural rules	• AGREED
		• RIS, but with workload permitting	• AGREED (Note: 4 panel members did not agree)
		• Availability of controlled airspace	• AGREED
6.1.b IFR pilot fails to assimilate traffic numbers and locations	There are areas where R2 exists	• Procedural Class E routes	• AGREED
		• Last broadcast to be made within range	• AGREED
		• Procedural rules	• AGREED
		• RIS, but with workload permitting	• AGREED (Note: 4 panel members did not agree)
6.1c Limitations of 'unalerted see-and-avoid' – unalerted unable to see and avoid in IMC	R4 (for cruise only)	Not required	
6.1d Filtering of traffic information removed	See 6.1b and 6.2		
6.2 Increased workload because of gathering and need for increased interpretation of traffic	R3 (R2)	• Education	• AGREED
		• Procedures	• AGREED
		• RIS, but with workload permitting	• AGREED (Note: 4 panel members did not agree)
6.3 Non-receipt of hazard alert information (e.g. SIGMET)	R3, R4	• Education	• AGREED

Note: 'EAST' refers to area under radar E airspace in the J curve; 'WEST' the remainder.

*Examined with respect to no DTI and no RIS.

CHANGE 7: Introduction of the NAF

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
7.1 Frequency congestion.	R4, R3	• Monioring program	• AGREED
		• Education — when and what to use	• AGREED
7.2 Non-receipt of hazard alert information (e.g. SIGMET)	Same as 6.3		
7.3 All aerodromes to have a MULTICOM frequency that is different to the NAF (transitting VFR/IFR would be unaware of aerodrome traffic)	R4		

CHANGE 8: More information for pilot to assimilate

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
8.1 Information overload.	Refer to 6.1b.		

CHANGE 9: Removal of flight following (refer to CASA)

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*
9.1 Long period of time after catastrophic event before SAR initiated.	R4?		

CHANGE 10: Suspend IFR (therefore IFR at VFR level and exposed to unalerted VFR traffic) (refer to CASA)

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*

CHANGE 11: Cancellation of IFR — not important for Airspace 2000 (refer to CASA).

Safety Hazard	*Hazard Risk Index*	*Mitigation*	*Panel Recommendation on Mitigation*

ATTACHMENT G

Airspace 2000: Program Definition Plan

This attachment contains the entire CASA document *Airspace 2000: Program Definition Plan*, Version 2.0, 30 April 1998.

The footer of the document has been amended to remove the author's name and to change the page numbering style.

Airspace 2000: Program Definition Plan

Table of Contents

Purpose of the Program Definition Plan

The purpose of this document is to provide an overall appreciation of the Airspace 2000 Program, and to gain approval so that the projects described may proceed to the Definition Phase.

This plan will be submitted to the Program Control Group for approval.

After this Program Definition Plan has been approved, it is intended that it will be given wider circulation within CASA, Airservices Australia, and industry, to explain how CASA will progress Airspace 2000.

Background

Changes to Australian airspace classifications and procedures, under the general heading of "Airspace 2000" have been under way since 1991.

However, since the first stage was introduced in December 1991 there has been major resistance to further change based on a cultural dependence on the previous airspace system where VFR aircraft were primarily "in the system."

Since that time, there has been no significant move forward in any sort of large scale, co-ordinated manner. Although some elements have been introduced and some are still progressing, others remain as little more than statements of intent.

It is therefore timely to review the current status of all the program elements, clarify the overall scope of what yet needs to be done, and set timeframes for completion.

It is intended that the program elements will proceed as a group of largely separate projects, with different implementation dates and timescales. This is so that the less contentious changes can proceed, and critical dependencies, with the potential for further delay, are not created by the need to confront the more contentious changes. The aim is to avoid putting elements together on the same critical path wherever possible.

The "Airspace 2000" identity will continue as all projects will be managed by the one Program Control Group, and they will proceed under the one Communications Strategy.

Program Objectives

The overall objective of the Program is:

> *To achieve the implementation of a complete new airspace system following proven safe procedures and standards from leading aviation countries to maximise the safety and efficiency of new technology by 31 December 1999.*

Key elements of the program include:

- Introduction of the concept of integrated system safety
- Harmonisation with world best practice

Guiding principles of the program include the introduction of a system which:

- Allocates safety resources most effectively by:
  - Making maximum use of TAAATS automation
  - Allowing a charging system which relates directly to the services provided
- Encourages high participation levels in aviation activities
- Recognises airspace as a highly valuable national resource to be managed efficiently in the national interest

Scope

The basis of the program is the document:

> *"A Plan for the Future Management of Australian Airspace" - Presentation to the Airspace Steering Group, Canberra, 22 July 1996.*

The program includes the phased introduction of new airspace classifications and procedures within Australian airspace.

The elements are listed in the table on the following page.

Implementation dates should not be regarded as fixed, but as nominal dates for project planning purposes, which may change if circumstances require.

Table 1: Program Elements (Refer to Table 2 for overall Program phases)

No.	Element	Nominal Target Implementation Date
1	Demonstration of increased use of radar in Class G airspace below current trial of Class E airspace between Canberra & Ballina • Provision of RIS to aircraft climbing to/descending from Class E airspace and to other aircraft operating in Class G airspace • National Advisory Frequency (NAF)	Aug 1998
2	Changed provisions for carriage of VHF radio above 5,000 in G & E airspace	Aug 1998
3	Demonstration of E airway in non-radar environment within G airspace • Establishment of criteria • Determination of dimensions	Dec 1998
4	Introduction of new terminal area designations and procedures • establishment criteria • alerting provisions • dimensions to relate to aircraft operations in a more practical and realistic manner • improved radio procedures • third party communications (unicom &/or certified air/ground operators)	Dec 1998
5	Replacement of A and B with C airspace	Dec 1998
6	Rollout of Class E airspace in the "J curve", including radar E above D, with RIS & NAF beneath E airspace	Jun 1999
7	Removal of DTI and replacement with E airways wherever criteria requires, or wherever required by industry	Dec 1999
8	Introduction of Class E airspace above Class D terminal areas in non-radar environment	Dec 1999
9	Consider for ACC assessment further changes to military airspace, to include: • Review of dimensions necessary • Evaluation of introducing Military Operations Areas (MOAs) for specific military operations • Assessment of merit in establishment of Alert Areas to replace Danger Areas where promulgated for flying training purposes	Start no later than Jun 98
10	Safety Promotion and pilot education with regard to: • Increase pilot awareness of the alerted see-and-avoid environment at non-tower airports (including an awareness of operating schedules of RPT services to non-controlled aerodromes) • Encourage VFR aircraft to be more aware of, and avoid where possible, routes or areas likely to have IFR traffic • Encourage suitably equipped (i.e GPS) IFR aircraft to fly up to 0.1 NM to the right of track	Jun 98 - Jan 99

Stakeholders

Key stakeholders in this program are:

- The travelling public
- The airline industry
- General aviation
- Airservices Australia
- the Minister
- the Australian Defence Force

Benefits

The prime benefit of Airspace 2000 will be the introduction of a total, integrated air traffic management system which maximises the overall safety of the travelling public through ensuring that resources are allocated to areas in which the total overall safety benefit is maximised.

It aligns air traffic management with CASA's stated highest priority which is the fare-paying passenger.

Corporate Impact

This will be a very high profile program which will put CASA's reputation on the line. It is critical to CASA's perception in the aviation industry and in the wider community, both of which are sensitised to these issues as a result of failures in the past.

The implementation program will also present a major challenge to Airservices Australia, which is currently dealing with commissioning of TAAATS and will need to carefully manage workforce adjustments required by the adoption of the new procedures.

These concerns are addressed through the risk management strategy detailed in this paper. The key elements will be:

- careful and comprehensive planning, to ensure that the program proceeds in a structured and co-ordinated manner, and adheres to project management disciplines; and

- a communications strategy, which includes a strategic issues management process to ensure that CASA maintains the initiative, and does not begin to act in an ad-hoc, reactive, and ultimately self-defeating manner.

It may be expected that the program will bring into focus issues related to the division of responsibility between Airservices Australia and CASA.

Program Phases and Deliverables from Each Phase

This program is somewhat unique in that many of its elements have already been implemented and others are well under way. Hence, as program definition and planning is undertaken, some elements are already in an implementation phase.

Elements which have already happened include:

- the appointment of a Program Manager on 23 Feb 1998
- a Program Definition workshop was held on 16 & 17 Feb 1998

Elements currently under way include:

- the production of a video to promote and educate industry personnel on the benefits of new airspace standards and procedures
- the conduct of a trial of E airspace between Canberra and Ballina, including associated industry and media communications
- a trial of a certified air-ground radio operator
- development of a Communications Strategy

The main requirement is to ensure that as soon as possible, all elements are scoped and defined so that they can be brought under the direction of the Program Control Group and managed under the Communications Strategy.

Summary of proposed phases is as shown on the following page:

Table 2: Program Phases

Phase	Phase 1	Phase 2	Phase 3	Phase 4
	Overall Program Definition	**Planning of Project Elements**	**Implementation**	**Closeout**
Timing	23/2/98 - 15/5/98	Planning of each element to be dictated by implementation schedule	Completion by 31/12/99	1/1/00 - 1/2/00
Deliverables	• Selection of Program Manager • Program Definition Workshop • Preparation of Program Definition • Consultation with Airservices Australia and key industry groups • Determine Program Management Structure • Develop Communications Strategy • Produce video & present to key aviation industry decision makers • Certified air-ground operator trial - Wagga	• Produce Responsibility Assignment Matrix • Produce Project Schedules • Revise Risk Assessment • Write Project Plans • Identify resources required	• Deliverables and dates to be confirmed during Definition phase • At this stage, as shown in Table 1	• Finalise implementation • Conduct post-implementation review
Milestones	• Program Manager appointed • Program Approved • Agreement with Airservices & ADF on co-operation in program • Program Management structure approved • Communications strategy presented • Video produced • Brochure produced • Certified air/ground operator trial completed	• Risk Assessment, Responsibility Assignment Matrix & Project Schedule approved • Project Plans approved		• Program close
Estimated Funding Required	$135,000, breakdown as follows: • $30,000 for development of Coms. Strategy • $30,000 for video • $15,000 travel & accom. for presentations to key industry decision makers • $55,000 for brochure • $5,000 for certified air/ground operator trial	To be determined during planning for project elements. Major items are likely to include: • engagement of specialist technical consultants to undertake specific work packages • production and distribution of education and training materials for pilots and air traffic controllers • travel and accommodation for project team members		

Program Management Structure

It is important to note that Airservices Australia (Airservices) are currently responsible for airspace classification. However, CASA as the aviation safety regulator has the key role of setting the regulatory and policy environment which enables Airservices to classify airspace in a manner which delivers the highest possible overall level of system safety.

For the development and implementation of new procedures, it is CASA's role to carry out the assessment against proven safe international procedures and to conduct risk analyses where necessary. It is therefore appropriate that CASA have overall responsibility for the program.

The Australian Defence Force (ADF) is also a major airspace user, as well a being a service provider, and must therefore also be actively involved at a high level.

The Program Control Group will include the Director of Aviation Safety of CASA and the CEO of Airservices, as well as a suitable high level representative from the ADF.

The suggested program management structure is a shown below:

Airspace 2000: Program Management Structure

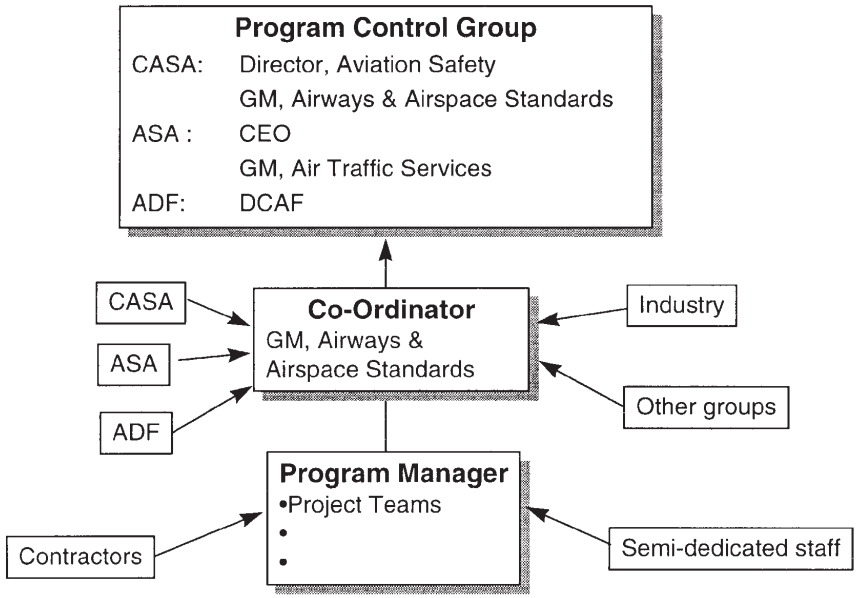


Table 3: Potential Risks	Risk*		Reason for Occurring	Risk Reduction Action	Fall back position
	Chance	Impact			
Opposition to proposed changes by stakeholders, e.g • Major airlines • Airline pilots' industrial groups, e.g. IPA, AFAP • Air Traffic Controllers • Flight Service Officers	High	High	Partial or incomplete understanding of the overall safety benefits	Development of a Communications Strategy, with key elements: • A comprehensive, pro-active Strategic Issues Management (SIM) process which engages all stakeholders in actively selling the benefits of the program • Internal and external communications • Development of timely and effective training and education materials to fully explain how the new system will operate and the benefits it will deliver	Proceed with implementation without support of stakeholder groups, so that acceptance & support builds as experience with the new procedures is built up
			Natural resistance to change		
			Generalised negative perceptions about the program, e.g: • "it's a GA or AOPA program" • program history • "not made here"		
			Concerns for personal welfare, such as the possibility of staff reductions as functions (e.g. flight service) are made redundant	Active engagement of management and unions in change process	Actions as required, eg: • retraining • redeployment • phased reduction • natural attrition
Political opposition to program at local, state or Federal level	High	High	Political or media activity by stake-holders listed above	To be addressed through SIM process described above	To be addressed through SIM process described above
Industry apathy	High	Medium	Inherent complexity of the total program	Phased implementation of project elements which reduce complexity	To be addressed as required
				A vigorous education campaign to ensure that the relevant people are fully aware of the changes and understand the new procedures	Targeted reinforcement as required in identified areas to ensure sufficient general levels of understanding
Slow, faltering or unco-ordinated implementation of changes	Medium	High	Unclear boundaries between CASA and Airservices	Clarify where required	Escalate to higher levels if unable to resolve
			Technical capability of CASA and/or Airservices staff	Careful selection of project team members with required level of skills and capabilities to ensure success	Greater use of external contractors where required
Rapid, ad-hoc and unco-ordinated implementation of changes	Medium	High	Perceived "opportunities" & frustration with pace of change	Timely planning and adherence to project management discipline	Recognition of risk to program if pursued & reporting to Program Management Group

** A risk assessment will be developed for each project including risk to schedule, budget and outcome*

Safety Risks

Many of the elements of Airspace 2000 which involve changes to long-standing procedures are perceived as safety risks by some members of the aviation community.

The program will be guided by CASA policy that adoption of international standards and practices will be a starting point for legislation and process development, with modification only where unique Australian context warrants.

With respect to this program in particular, the Chairman has stated that:

> *"the proposal would be initially assessed against proven safe international practices and would only be introduced after full qualitative and quantitative evaluation by technical experts, and would be further cross checked by an independent expert panel."*

In the process of introducing the various elements of Airspace 2000, it will be necessary to proceed by:

- assessment against proven overseas practices
- application of professional judgement
- data collection
- cost/benefit analysis
- risk analysis

A good deal of this work has been done already - it is not intended to "re-invent the wheel" where information is already available.

The intention is to proceed, without further analysis, with those elements which:

- have already been fully investigated through the safety case process and accepted by CASA; or
- are clearly an increase over present safety levels; or
- are a straighforward adoption of proven, safe overseas practices; or
- in the judgement of CASA, do not require further work to be undertaken; or
- may require further work, but are judged sufficiently safe that a trial can proceed while more data is gathered.

Where it is judged that further work is required, where possible these elements will be isolated and addressed in manner that does not delay the implementation of other elements.

Program Assumptions

Key program assumptions are that:

- the program has full support at all levels within CASA and Airservices
- program resources are made available as required (subject to reasonable notice being given)
- where management decisions are required, these are made in a timely manner
- once decisions have been made on policy and procedures, there will be no late, ad-hoc changes
- once implementation dates have been agreed, these will not be changed or cancelled
- once changes have been implemented, these will not be reversed
- project management disciplines are adhered to

Staff Consultation Plan

This will be addressed in the Communications Strategy, within which internal communications within the organisation will be an important component.

Related Projects

The most significant related project is the introduction of TAAATS by Airservices Australia.

This program provides the operational framework which ensures that the maximum safety and efficiency benefits of the TAAATS system are achieved.

Also closely related is the current Class E airspace trial.

Current related CASA projects include:

- PAP & Review Program
- Restructure of CASA

Technology Requirements

There may be some technology requirements (e.g. radio communications at MBZs), which will be better defined during the program definition and planning phases.

Although the program itself is not technology-intensive, it should be borne in mind that it is the operational and procedural counterpart to the TAAATS, which is a major technology project.

Specialist Resources

There will be requirements for specialist resources in key areas of:

- flight operations
- airways engineering
- project management
- education and training
- communications

These requirements will become more clearly defined during the program planning phase.

Relevant Policy & Legislative Issues

Airspace 2000 is fully in accord with current CASA policy, as outlined in the Corporate Statement 1996-97 to 1998-99.

The potential for legislative impact will be examined more closely as the Draft Final Rules for Class G and Classes A, B, C, D and E are developed.

Present indications, however, are that the changes required will be limited to AIP, MATS and associated publications, and will not require changes to either Civil Aviation Regulations or to the Act.

ATTACHMENT H

Aeronautical Information Publication Supplement 48/98

This attachment contains the entire Airservices Australia document *AIP SUPP H48/98: Extension of radar information services in Class G airspace and demonstration of the national advisory frequency* 8 October 1998.

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AIP SUPPLEMENT

AIRAC

H48/98

FILE : 98/01515

DATE : 8 OCT 98

EXTENSION OF RADAR INFORMATION SERVICES IN CLASS G AIRSPACE AND DEMONSTRATION OF THE NATIONAL ADVISORY FREQUENCY

1. INTRODUCTION

1.1 This AIP Supplement (SUP) provides notification of, and pilot procedures for, the extension of radar information services in non-controlled airspace (Class G) and the demonstration of the National Advisory Frequency (NAF) in the airspace shown in Annex A, including that Class G airspace beneath the control area steps.

1.2 Detailed pilot procedures for use in the demonstration area are shown at Annex B.

1.3 This demonstration responds to BASI recommendations to maximise the use of available radar coverage for the provision of air traffic services, particularly in areas used by Regular Public Transport (RPT) flights.

2. BACKGROUND

2.1 A number of changes to the Australian airspace architecture have been proposed in the recent past, particularly those associated with the Airspace 2000 initiatives.

2.2 Changes associated with these initiatives have undergone rigorous examination through an Airservices developed safety case and through the

CASA public consultation process by the issuance of a Notice of Proposed Rule Making (NPRM).

2.3 CASA published NPRM 9702RP on 25 August 1997 for public consultation, in which the necessary amendments to safety standards to give effect to the changes relevant to Class G airspace were proposed.

2.4 Following an examination and detailed consideration of responses to NPRM 9702RP, CASA are finalising Final Rule 9702RP to amend the standards and requirements for operations in Class G airspace.

3. CHANGES TO BE INTRODUCED

3.1 Changes that will be introduced as part of this demonstration for operations in Class G airspace include:

a. provision of an ATC-provided Radar Information Service (RIS) where radar coverage exists;

b. cessation of the directed traffic information service provided by Air Traffic Services (ATS);

c. implementation of a National Advisory Frequency (NAF);

d. revision of position reports and broadcasts currently required in Class G airspace;

e. changes to flight notification requirements for IFR RPT flights remaining entirely in Class G airspace to submit flight notification and SARTIME to ATS, or to the company;

f. amendment to the requirements and provision of SAR alerting services to permit SARTIME by IFR flights and to nomination of SARTIME for arrival as a minimum for RPT flights;

g. amendment to the flight notification requirements such that only those pilots requiring a SARTIME service in Class G airspace from ATS are required to submit flight notification to ATS;

h. deletion of the requirement for IFR flights to report to ATS position, and changes of track and level in Class G airspace, except as prior notification to ATC when associated with a clearance request, when receiving a RIS, or when leaving the demonstration area; and

i. introduction of the requirement for all IFR flights operating within radar coverage in Class G airspace to carry and operate a Mode C transponder.

4. SERVICES TO BE PROVIDED

4.1 Services available in Class G airspace for the period of the demonstration will be:

a. Radar Information Service;

b. Flight Information Service; and

c. SARWATCH, Emergency Alerting and In-flight Emergency Response.

5. TIMING OF THE DEMONSTRATION

5.1 The demonstration of the amended procedures for use in Class G airspace will commence 9810071600 UTC.

6. TRANSPONDER REQUIREMENTS

6.1 IFR flights operating within radar coverage in Class G airspace must carry and operate a serviceable Mode C transponder. VFR flights must have an operating Mode C transponder if pilots of these flights wish to use the ATS-provided Radar Information Service (RIS).

7. COMMUNICATIONS AND FREQUENCY USE

7.1 127.7MHZ has been allocated as the primary frequency for use in the specified airspace for en route broadcasts and pilot-to-pilot communications in Class G airspace. This frequency is known as the National Advisory Frequency (NAF).

7.2 Pilots of IFR flights should make broadcasts on the NAF in accordance with the pilot procedures at Annex B.

7.3 The Flight Information Area (FIA) VHF frequency, published on ERC (L), and HF will continue to be available during the period of the demonstration for contact with ATS for the provision of in-flight information and SAR Alerting. The callsign for this service is "FLIGHTWATCH".

7.4 In the case of Brisbane FIAs 130.4MHZ, 126.8MHZ and 120.3MHZ, Flightwatch services are available on 128.15MHZ.

8. TRAFFIC INFORMATION

8.1 Traffic information services will be upgraded to an ATC provided RIS, where radar coverage exists, for the period of the demonstration within the specified airspace. The provision of a non-radar-based directed traffic information service to pilots of IFR and MLJ flights will be discontinued.

8.2 Radar-based traffic information will be provided when, in the opinion of the controller, it is warranted by the proximity of the aircraft to each other.

8.3 Broadcasts of the progress of military aircraft on the low level portion of a Military Low Jet (MLJ) flight will not be provided.

9. RADAR INFORMATION SERVICE

9.1 During the demonstration, where radar coverage is available to the controller, ATC will provide a Radar Information Service (RIS) on a workload permitting basis to all flights and for all phases of the flight.

9.2 Provision of this service is not optional on the part of the controller, but will be done as the work situation permits. Many factors, such as the limitations of radar, volume of traffic, controller workload, or communications frequency congestion could prevent ATC from providing this service.

9.3 Controllers possess complete discretion for determining whether they are able to provide this service in a specific case. The controller's reason against providing, or continuing to provide the service, in a particular case is not subject to question, nor need it be communicated to the pilot.

9.4 The Radar Information Service provides traffic information and safety alerts based on radar observed traffic. This service is not intended to relieve the pilot of the responsibility for continual vigilance to see and avoid other aircraft.

9.5 In addition, pilots may request position information and navigation assistance which will be provided if radar identification is possible.

9.6 Responsibility for terrain avoidance remains with the pilot in command.

9.7 Pilots wishing to use these services must be in direct VHF communication with ATC on the overlying ATC frequency as shown on ERC (L), and the aircraft must be equipped with a serviceable transponder.

10. ALERTING SERVICE

10.1 Pilots wishing to contact ATS for SAR purposes, including nomination, amendment or cancellation of SARTIME, or for emergency communications, may do so by contacting Flightwatch.

10.2 ATC will maintain a SAR alerting service on those aircraft being provided with an ATC service including a RIS, irrespective of the airspace classification. SARWATCH for entry into controlled airspace will be held by ATC when a clearance has been issued or when clearance is not immediately available, but a time has been established for the pilot to call again. When clearance will not be available in controlled airspace, SARWATCH will not be held by ATC. Where ATC services cease, SARWATCH by ATC will also cease.

10.3 When an ATC SARWATCH cannot be provided, pilots requiring a SARTIME should contact Flightwatch.

11. PROVISION OF ON-REQUEST IN-FLIGHT INFORMATION SERVICE

11.1 An on-request in-flight information service is available from Flightwatch to pilots operating in the demonstration Class G airspace. Information provided in this service includes:

a. weather;

b. NOTAM;

c. Hazard Alerts; and

d. Area QNH.

11.2 Except where the pilot is being provided with ATC services, SAR alerting will not be maintained on these contacts with ATS.

12. PILOT PROCEDURES

12.1 Pilot procedures at Annex B for operations in Class G airspace supersede those shown in AIP dated 16 July 1998, for the period of the demonstration, for operations within the specified airspace.

13. EDUCATION AND FURTHER INFORMATION

13.1 Representatives from CASA, Airservices, the Department of Defence and the aviation industry will be conducting a staff and pilot education program prior to the commencement of the demonstration of the amended Class G procedures. Details of the education program, including the timing of seminars and briefings will be advised separately.

14. CANCELLATION

14.1 This SUP will be cancelled when the provisions have been incorporated into the AIP or on termination of the demonstration.

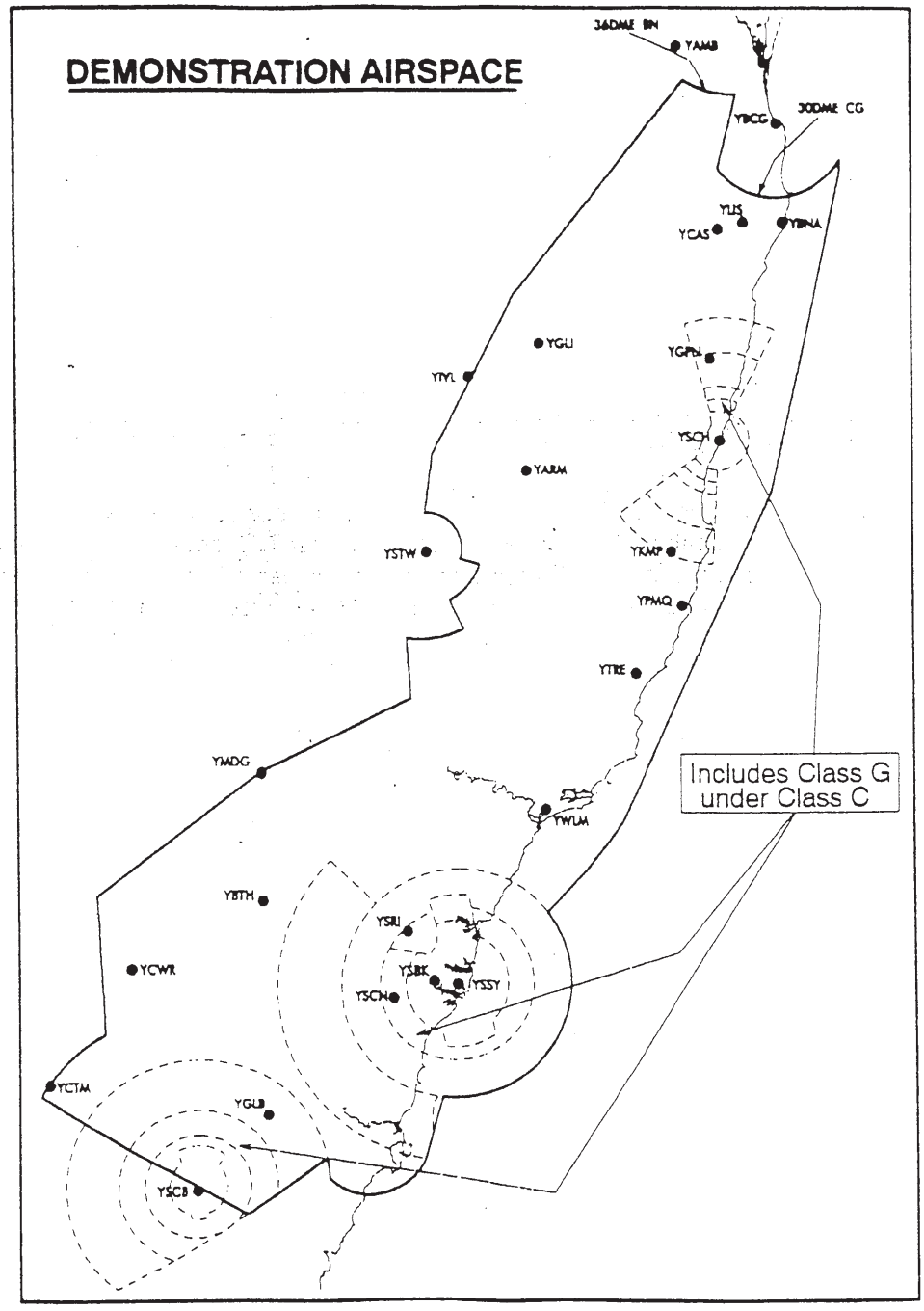
15. DISTRIBUTION

All AIP holders	last issue H47/98
All MATS holders	last issue H47/98.

Annex:

A. Demonstration Airspace
B. Demonstration of the National Advisory Frequency Pilot Procedures

ANNEX A TO
SUP H48/98



ANNEX B TO
SUP H48/98

DEMONSTRATION
of the
NATIONAL ADVISORY FREQUENCY
PILOT PROCEDURES

1. FLIGHT NOTIFICATION

1.1 For SAR alerting, pilots of RPT flights operating in Class G airspace must submit flight notification to ATS or to the company. Pilots of IFR and VFR flights requiring a SARTIME service from Airservices, must submit flight notification to Air Traffic Services (ATS).

2. COMMUNICATIONS

2.1 Selection of the correct common traffic frequency and broadcasts of relevant information to other pilots is fundamental to safe operations in non-controlled (Class G) airspace and at non-controlled aerodromes. Use of the appropriate common traffic frequency, combined with visual alertness and application of recommended good operating practices, will enhance the safety of flight into and out of non-controlled aerodromes.

2.2 IFR flights in Class G airspace must carry and use VHF radio, and, where necessary, HF radio for communication with ATS.

2.3 As a recommended practice, whenever weather conditions permit, pilots of other than RPT flights should operate to the VFR and at a VFR level to minimise congestion on the National Advisory Frequency (NAF). Pilots requiring an IFR service from ATS should flight plan in controlled airspace.

2.4 127.7MHZ has been allocated as the NAF. Pilots should use this frequency for pilot-to-pilot communications and broadcasts in the specified airspace, except when necessary to operate on the CTAF or MBZ frequency.

2.5 126.7MHZ should be used for local broadcasts at those aerodromes that do not have a published CTAF or MBZ frequency.

2.6 Position reports to ATS are not required within the specified airspace during the demonstration, except when associated with a clearance request to ATC. Pilots of IFR flights should make broadcasts on the NAF at position reporting points indicated on ERC (L) 2 & 3. Other recommended points,

and the information to be provided in the broadcasts, are contained in Section 4.

2.7 At some aerodromes, a Universal Communications (UNICOM) service may be operating on a designated aerodrome MBZ frequency/CTAF. Further details of UNICOM services are provided in AIP COM – 4 para 3.3.

3. OPERATIONS IN THE DEMONSTRATION CLASS G AIRSPACE

3.1 GENERAL

3.1.1 Pilots of those flights planning to enter controlled airspace shortly after departure should attempt to contact ATC prior to departure to facilitate air traffic management.

3.1.2 The recommended points that follow for pilots to make broadcasts are not intended to substitute for pilot judgement. There will be times when additional broadcasts will be necessary (eg, crossing routes) and other times when broadcasts may not be practical (eg, when receiving a RIS or when descending through Class G airspace when time constraints may preclude effective use of the NAF).

3.1.3 **Recommended practices for pilots of IFR flights**:

a. where practical, maintain a listening watch and make recommended broadcasts on the NAF;

b. use radio alerted see-and-avoid techniques to resolve potential conflicts when in VMC; and

c. arrange separation by radio when in IMC.

3.1.4 **Recommended practices for pilots of VFR flights**:

a. avoid published IFR routes, published military low jet routes and airspace used for instrument approaches whenever practicable;

b. where practicable, maintain a listening watch on the NAF; and

c. use radio alerted see-and-avoid techniques to resolve potential conflicts.

3.2 TAXIING

3.2.1 Pilots operating from non-controlled aerodromes should broadcast on the designated MBZ/CTAF:

a. taxiing (mandatory at MBZs); and

b. when entering the runway for departure.

3.2.2 Additionally, pilots operating from non-controlled aerodromes should broadcast a taxi call on the NAF if a broadcast is considered relevant to aid the situational awareness of other pilots in the area.

3.2.3 Taxiing broadcasts should include:

a. location of departure aerodrome;

b. callsign of the aircraft;

c. aircraft type;

d. IFR (if operating IFR)

e. destination, or departure quadrant or intentions; and

f. runway direction to be used.

3.3 DEPARTURE

3.3.1 Pilots should establish flight on the departure track as soon as practicable after take-off and within 5NM of the aerodrome, except that, at aerodromes that have published standard instrument departure procedures, an IFR aircraft may depart in accordance with those procedures.

3.3.2 At non-controlled aerodromes, departure broadcasts on the NAF should include:

a. location of the departure aerodrome;

b. callsign of the aircraft;

c. departure time;

d. tracking details;

e. intended cruise altitude or flight level; and

f. next en route position or destination.

4. CLIMB AND CRUISE

4.1 **Recommended points for IFR pilots to broadcast position, level and intentions on the NAF:**

a. on departure from an aerodrome within the designated area;
b. reaching cruising level;
c. at ERC position reporting points or other pilot tracking points;
d. when intending to amend route or deviate from track;
e. before changing level; and
f. before entering Class G airspace within the designated area.

4.1.1 Broadcasts of position should include:

a. callsign and type of the aircraft;
b. position (place, abeam place, place – bearing and distance, or latitude/longitude);
c. time at that position;
d. altitude or flight level; and
e. next position and estimate for that position.

Example:

"All Stations, Delta Echo Foxtrot, Navajo, Glen Innes Two Six, Seven Thousand, Armidale Four Five."

5. DESCENT AND ARRIVAL

5.1 Pilots making inbound broadcasts associated with operations at non-controlled aerodromes should take aircraft performance into consideration when determining an appropriate distance from which these broadcasts will be made. Broadcasts must be made in sufficient time to enable pilots to acquire an effective awareness of traffic before entering the MBZ or CTAF area.

5.2 Pilots of IFR flights intending to conduct an instrument approach in IMC and who have not been able to confirm that the aircraft's radio is functioning and on the correct frequency for the aerodrome, either from another aircraft, through a third party, a UNICOM or an Aerodrome Frequency Response Unit, should contact the ATC unit providing services in the overlying airspace and request known IFR traffic. Provision of this service by ATC will not necessarily include information about all IFR traffic in the area.

6. RADAR INFORMATION SERVICE

6.1 Pilots may request a radar information service as follows:

Example of a pilot request for radar information service:

"Brisbane Centre, Delta Echo Foxtrot, request radar (traffic) or (position) or (navigation) information service."

6.2 Identification and Termination of RIS

6.2.1 Prior to providing a particular Radar Information Service, ATC will identify the aircraft and notify the pilot that the aircraft has been "IDENTIFIED". ATC may assign a specific transponder code prior to, or during, the provision of RIS. Pilots receiving a RIS must notify ATC of any intention to change track or level.

6.2.2 When ATC is unable to provide RIS, pilots will be advised "RADAR SERVICE NOT AVAILABLE". Requests for emergency assistance should be prefixed by "MAYDAY" or "PAN PAN", and will receive priority.

6.2.3 When RIS is terminated, ATC will advise "RADAR SERVICE TERMINATED – FREQUENCY CHANGE APPROVED". When services have been terminated, the pilot should squawk code 1200 if VFR, or Code 2000 if IFR.

7. PROCEDURES FOR IFR FLIGHTS ENTERING OR LEAVING CLASS G AIRSPACE WITHIN WHICH THE NAF IS BEING DEMONSTRATED

7.1 Pilots of IFR flights entering Class G airspace within which the NAF is being demonstrated must broadcast on the NAF before entering the airspace to alert other pilots of their position and intentions. Broadcasts must be made on the NAF in sufficient time before the boundary for the pilot to acquire an awareness of the traffic inside the Class G demonstration area.

7.2 Broadcasts should include:

a. callsign and type of the aircraft;

b. position (place, abeam place, place – bearing and distance, or latitude/longitude);

c. time at that position;

d. altitude or flight level;

e. next position and estimate for that position.

Example:

"All Stations, Delta Echo Foxtrot, Navajo, Departed Dubbo Zero Two, Seven Thousand, Bathurst Three One."

7.3 Pilots of IFR flights leaving the demonstration Class G airspace must report to ATS on the appropriate frequency for the airspace being entered (ATC or FS) to obtain either a clearance to enter controlled airspace (Class C, D or E) or to participate in the directed traffic information service (Class G airspace). Reports must be made in sufficient time before the boundary to obtain traffic information, an ATC clearance, and to alert other traffic in the area being entered.

7.4 Reports required by paragraph 7.3 must include:

a. callsign and type of the aircraft;

b. position (place, abeam place, place – bearing and distance, or latitude/longitude);

c. time at that position;

d. altitude or flight level;

e. next position and estimate for that position.

Example:

"Sydney and All Stations, Delta Echo Foxtrot, Cowra One Five, Eight Thousand, Parkes Three Two."

8. CHANGING FLIGHT RULES

8.1 Pilots of IFR and VFR flights changing the flight rules to which the flight is being operated and operating in the demonstration Class G airspace within radar coverage must:

(a) change to the appropriate transponder code, either 1200 or 2000;

(b) make a broadcast as appropriate;

(c) change to a level in accordance with the IFR or VFR Table of Cruising levels; and

(d) contact ATC if requiring a clearance.

9. SARTIME

9.1 Pilots may nominate a SARTIME to Flightwatch for departure, en route or arrival.

Example:

"Flightwatch, Delta Echo Foxtrot, SARTIME FOR DEPARTURE Taree 2330."

Example:

"Flightwatch, Delta Echo Foxtrot, SARTIME OVER Goulburn 2345."

Example:

"Flightwatch, Delta Echo Foxtrot, SARTIME FOR ARRIVAL Kempsey 0015."

9.2 Only one SARTIME may be current at any one time.

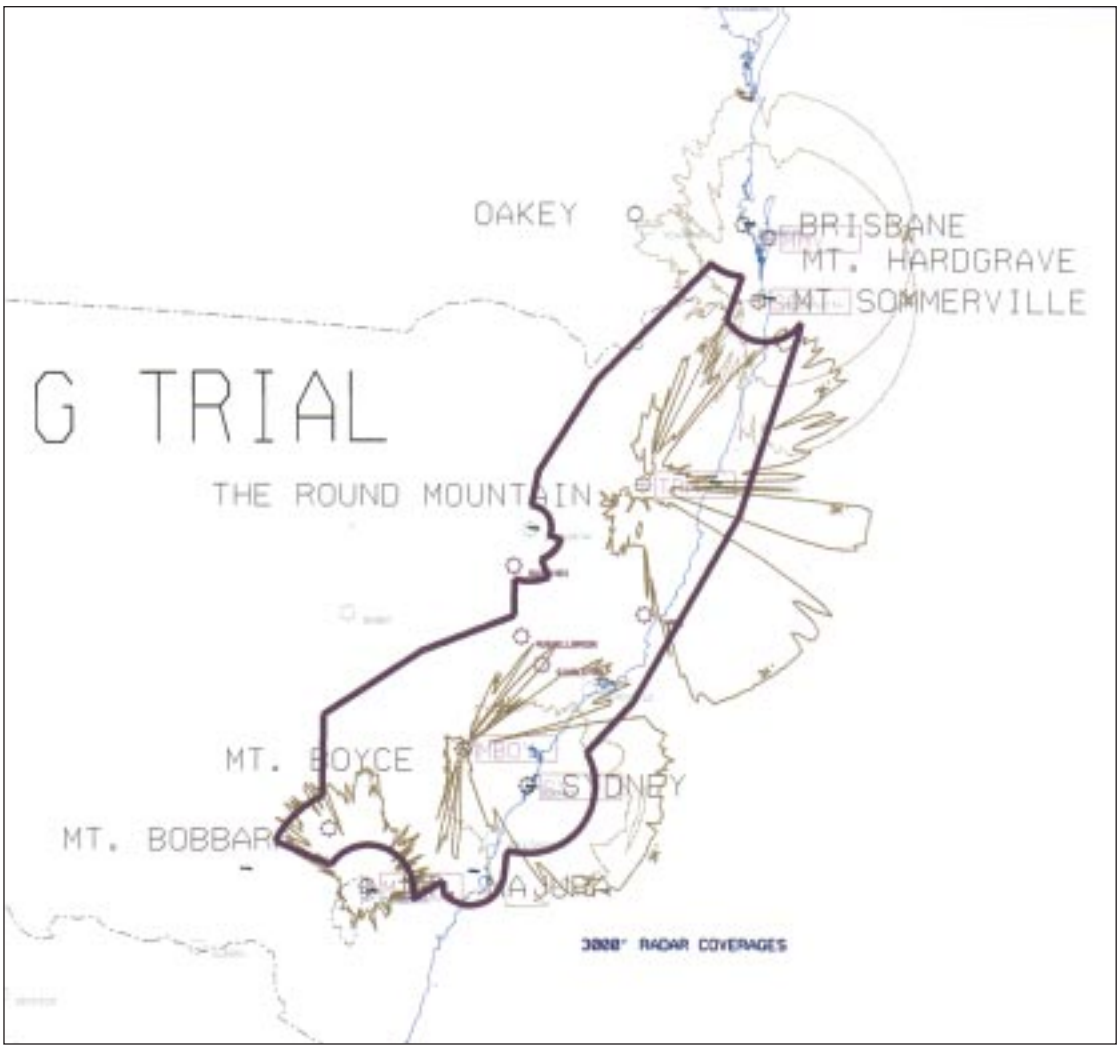
9.3 Pilots must always cancel SARTIMEs nominated for operations in the demonstration Class G airspace with Flightwatch.

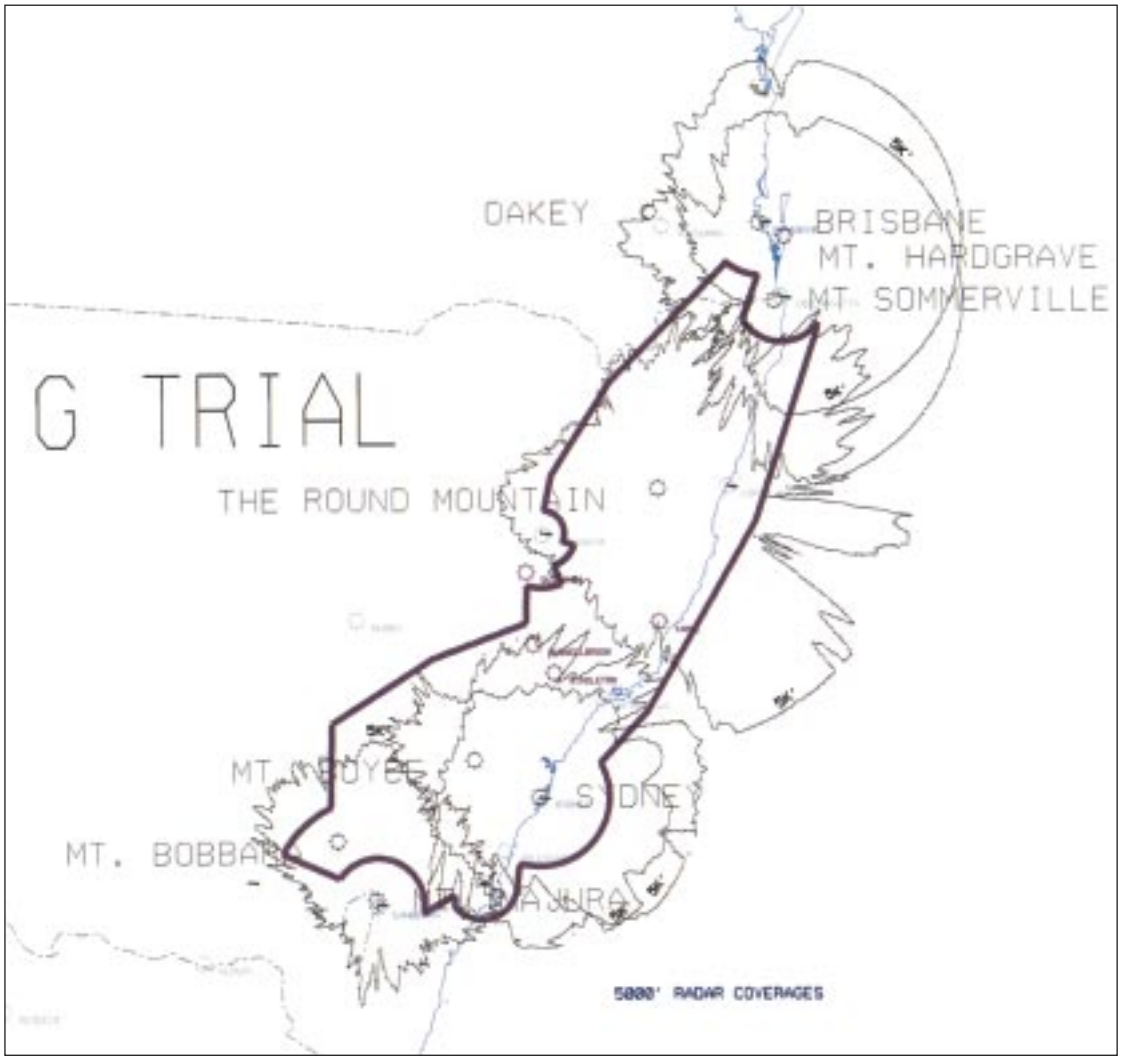
9.4 This also applies when pilots are in contact with ATC and receiving a FULLSAR alerting service. A SARTIME nominated to Flightwatch remains active until cancelled by the pilot.

ATTACHMENT I

Maps showing predicted radar coverage in the demonstration area

This attachment contains Airservices Australia charts showing predicted radar coverage in the Class G demonstration area at 3,000 feet, 5,000 feet, and 8,500 feet.

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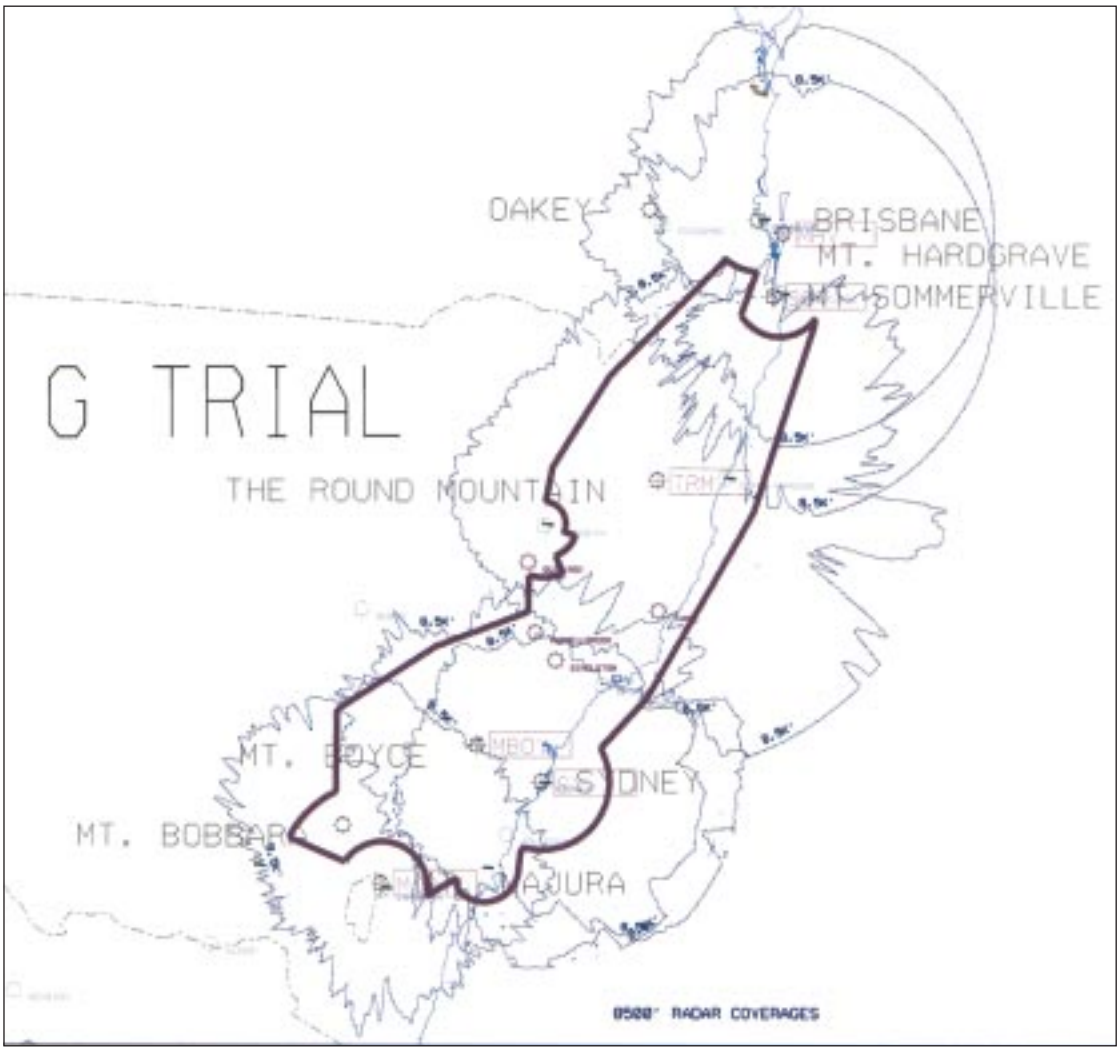
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