Community Aviation Consultative Group
Minutes of Meeting

Meeting:	Wednesday 6th November 2019, 09:00 – 12:00 (QLD Time)
Venue:	Visions Room, Twin Towns Services Club
Chairman:	Ron Brent
Secretary:	CACG@gcal.com.au

1. Welcome & Introduction

The Chair opened the meeting by acknowledging the traditional custodians of the land on which we were meeting, and paying our respects to their elders, past present and emerging. The Chair then welcomed the members of the Committee to the November CACG meeting. He acknowledged the full agenda and requested that, where possible, any additional items or questions not included in the agenda please be emailed and referenced as correspondence to be dealt with out of session and tabled at the next meeting.

2. Apologies

Apologies and attendees are listed at **Attachment 1.**

3. Minutes of Previous Meeting, 3 July 2019

Chair and secretary apologized for errors and omissions in the July minutes. July and March minutes to be carried forward to the first meeting in 2020 for approval.
Action: The correct versions of minutes of the March and July meetings to be emailed to members within a week of this meeting.

4. Action Items

The action items were reviewed, and the action list updated. The updated action list, including actions from this meeting, is at **Attachment 2**.

It was noted that the item 41 regarding flights over Kingscliff is being discussed at ANACC, but members believed it had no traction.
Action: Chair to write to AsA to emphasise the importance of responding to the information requests regarding departing flights over Kingscliff, and potential conflict situations that give rise to the departing flights going over Kingscliff.

5. CACG Strategic Work Program

Sustainable management of airport growth

John Hicks presented his agenda paper. **Attachment 3**. JH noted that the Chair had discussed some issues with him and would provide further information on those items.

Specific Issues for discussion:

1: Validation of aircraft noise models in Master Plans with actual on-ground noise monitoring (e.g. for verification of N60 and N70 contours)

The Chair advised that noise monitors can't be used to validate noise contours. When a new plane type is produced noise measurements are made using perhaps hundreds of noise monitors, and certainly many more than all the monitors that Airservices has, across all of Australia. These produce very detailed noise levels for the aircraft and include all variations such as how heavily loaded the aircraft is, how far from take-off or landing it is, and how far to the side of the flight track the measurement is. These very comprehensive data are used to put together tables that allow contours to be drawn based on the number of different types of aircraft, the location of the flight paths, the loads that the aircraft are expected to carry, and the height of the land below.

Noise monitors can only check the one location that they are positioned in and the particular aircraft/loading/location of those planes. This information is regularly used to check that the predictions from the tables mentioned above are accurate. Subject to the variability of weather that affects the precise outcome the data from such specific measurements around the world consistently accords with the modelled noise level predicted by the tables.

Formal motion: *The CACG asks Gold Coast Airport to provide more detail on noise monitoring and noise contours in its future Master Plans.*

2: Air pollution levels from aircraft emissions and their human health implications.

Airports don't have legislated engine emission levels, GCA is currently performing an air quality assessment the report of which is to be presented at the next CACG meeting. A new air quality monitor has been installed at Southport high school.

Eleanor Dun provided advice that aircraft emissions are being reviewed by DITCRD and a report can be provided to the committee once this review is complete.

Action: Eleanor Dun to provide more information on Federal Government consideration of aviation emissions to the Secretary.

Action: The Chair to write to QLD & NSW health departments for further information on what the state governments are doing, or can do, to monitor emissions from aircraft at Gold Coast Airport.

3: Monitoring and management of PFAS contaminated soil, surface water and groundwater

Norbert Benton advised that the next master plan will include more detail on PFAS management.

Action: The Chair will write to the Airport to request that more detail on PFAS issues be included in the next Master Plan.

Concerns were raised that Airservices in not providing the same level of priority and detailed reporting on Gold Coast Airport PFAS issues that defense is providing. Andrew Collins advised that very substantial work is being undertaken and that there is much more information available on the Airservices website than perhaps many members realized.

4: Long-term health risks to residents living in proximity to airports

The Airport Act does not contain specific obligations about reporting on the long-term health risks of living close to Airports. In part this is due to the limited scientific evidence available on this issue, especially in separating out those issues that are specific to airports. In Gold Coast's case the matter is made more complex because health matters are principally matters for state governments which makes this a cross jurisdictional responsibility.

Action: Eleanor Dun will provide links to an ICAO report on health consequences of living near airports. Members are to consider the material and identify any specific issues for this forum, to be brought back to a future meeting.

Eleanor Dun offered to facilitate direct discussions between the Department and John Hicks so that he can consider what might be included on a future agenda. JH will advise secretary in due course as to any items to be put on the agenda for a future meeting.

5: The Master Plan does not explain how the 250% increase in RPT traffic that it forecasts (and that approval of the Masterplan authorizes) is to be managed
The Chair advised that Master Plans does explain the management of increasing traffic, in the form of the noise forecasts and the air routes on which there are based. Unfortunately, this is not addressed explicitly and is therefore difficult for those outside the aviation industry to understand. The meeting requested the Airport to include more specific clarification of this issue in future Master Plans.
Action: The Chair will also raise, with the Airport, the request for more explicit clarification of how traffic growth will be managed to be included in future Master Plans.

6: Increasing number of departures over Kingscliff
Action: The increasing number of departures over Kingscliff is to be included on the March CACG agenda as a specific item.

6. Emergent issues from community representatives

Brett Curtis provided the following information in response to questions raised by community members:

- the new aircraft parking bays were commissioned before (and used during) the Commonwealth Games. There is currently limited use as the bays are not directly accessible from the terminal. During the terminal expansion works there will be aircraft bay closures and these new bays will be used as replacements to continue as business as usual.

- Brett thanked the CACG for the positive feedback about the new Aviramps that allow passengers to board aircraft via a ramp rather than stairs.

- the airlines own the wheelchairs but that GCA is currently reviewing the management of wheelchairs noting that they are due for upgrade and/or renewal.

- there are no current plans for a viewing platform (for 'plane spotters') however the new rooftop bar at the hotel will provide a great overview of the airfield.

It was asked why there were more lately.
Scott Stephens advised that there have been no changes to flight paths, and therefore there should be no flights over the Wollumbin/Mt Warning area although there may have been a weather related reason for such flights.
Action: Julie to provided details of occurrences of flights over the Wollumbin/Mt Warning area to the CACG secretary & AsA for review.

Norbert Benton advised that GCA is still working through the process of establishing further locations for air quality testing, and has committed to keep working with council to find suitable sites.

Members of the CACG reiterated concern that the Southern Noise Monitor should be reinstated. The Chair noted that this item is on the agenda of the ANACC.
Action: The Chair will to write to ANACC with a copy to Airservices requesting that the ANACC pursue the issue of reinstatement of the southern noise monitor as a priority and pointing out reference to the West Tweed monitor in the Master Plan.

7. Airport Developments

Brett Curtis provided a presentation to the Committee. **See Attachment 4.** This presentation included aircraft numbers, the announcement of the new Seoul service, AmbassadorPAW program update introducing Ranji, and the Community Benefit Fund. BC advised that for Project Lift STE (terminal expansion) all the piling works have been completed and visible infrastructure will start to appear. The hotel works are progressing well and construction is currently working on the 5th floor.

In response to questions Brett Curtis advised that:

- Security for the terminal expansion works will be handled by workers having dedicated gates and fences. There is also a two-way gate lock system in place, manned by a security guard, to baggage handlers to cross through the centre of the construction site, including crossing the access path for workers.
- external pick-up areas will be upgraded once the Airside and terminal works have been completed, as part of works moving to front of house improvements.
- there is no set date for when the southern access road will become available, however all the other works will need to be completed before the general public will be able to access the roadway.

It was asked when the Border Park Master Plan would be released as it was supposed to be available in the first quarter this year? Nick Tzannes advised that they are currently finalizing discussions with Southern Cross University, and the Master Plan is currently on hold.

8. Airservices Report

Chris McCormack introduced himself and provided the presentation at **Attachment 5.**
The presentation covered temporary noise monitor update, high level routes from the north, RNP AR use and online reporting portal.

Action: *AsA to provide* a direct link to the Noise monitor page on the website.

Action: *AsA to provide the* Runway data on runway usage for each runway, specifically divided up for RPT aircraft.

Members voiced their disappointment that community representatives won't be consulted during the Detailed Site Investigations planning for PFAS as there appear to be data gaps, such along on Cobaki Broadwater.
Andrew Collins advised that stakeholders can provide the information to the tenderer via AsA. This information will be passed to the successful tenderer for response AsA.

Concerns were raised around the sporadic nature of the testing, and samples being taken during dry periods. Andrew Collins advised that there have been comprehensive investigations since 2008. All data from the 2017 investigations have been published, AsA doesn't publish monitoring reports. Currently the monitoring is performed yearly. More frequent monitoring can be requested by the Committee, but it may be that the detailed site investigation will fill in the gaps perceived by the community. The testing that was performed in October will be provided to GCA which will then need to agree to any further release of that information. All Coolangatta Creek sample results have been below the Commonwealth levels for concern. Lindy advised the meeting that she had viewed data of other authorities on Coolangatta Creek to the outfall at Kirra Beach which showed PFAS levels well above HBV for fish consumption.
Action: Lindy Smith to provide written questions to identify the reports not published, seasonality issues & fluctuating PFAS levels, yearly testing and testing on the western boundary. She will include JA's comments around testing on the western side at the fire station.

Action: Andrew to discuss with AsA to see whether one or 2 nominated representatives of the CACG can meet with the successful tenderer for the DSI project.

9. ANACC Report

Jared Feehely provided an update on the last ANACC meeting, which included discussions on the ILS and the flights over Kingscliff issue. Jared also noted that ANACC nominations will be commencing shortly.
There was a request for ANACC draft minutes to be available at the CACG meetings so that members will have information on issues considered by ANACC in time to consider them before the following CACG meeting.
Action: Jared Feehely will ask the ANACC if it can share draft minutes with the CACG to allow the CACG to consider issues prior to CACG meetings.

10. Other Business

CACG Correspondence:
Nil

Action: GCA to provide an update on environmental monitoring at the ILS localizer monitoring site.

Action: RB to write formally to Asa to consider whether it can undertake a full review of Gold Coast flight paths.

Concern was raised about aircraft noise levels for the new hospital. The Chair advised that hospitals are normally well insulated, air conditioned and doors shut to reduce all outside noise. Accordingly, they are not necessarily a noise sensitive facility.

Strategic Work Program items for next meeting:

- Flights over Kingscliff

11. Actions from this Meeting

Actions were identified during the meeting. The action list at **Attachment 2** is the updated list.

12. Proposed Meeting Dates for 2019

Proposed dates are:
4th March
22nd July (This is a new date outside both NSW and Qld school holidays)
4th November
All meetings to be 3 hours from 9:00 a.m. to noon.

Attachment 1: Attendance List

Meeting: Wednesday 6th November 2019, 09:00 – 12:00 (QLD Time)

Venue: Visions Room, Twin Towns Services Club

Attendees

Matt Bender	Gold Coast Airport	Andrew Collins	Airservices
Brett Curtis	Gold Coast Airport	Mel Layton	Airservices
Jared Feehely	Gold Coast Airport	Chris McCormack	Airservices
Norbert Benton	Gold Coast Airport	Scott Stephens	Airservices
Melissa Pearce	Gold Coast Airport	Pat Tate	Banora Point & District Residents Assoc
Nick Tzannes	Gold Coast Airport	Chris Cherry	Tweed Shire Council
Emily Neal	Proxy - Karen Andrews	David Gray	Bilinga Neighbourhood Watch
Gregg Betts	Proxy – Karen Andrews	Garth Threlfall	Friends of Currumbin
Guy Proctor	Jetstar	Glenda Threlfall	Friends of Currumbin
Glenn Nott	Oxley Cove	Lindy Smith	Tweed Heads Pony Club
Peter Barrett	Neighbourhood Watch	Nathan Goldman	Department of Transport & Main Roads
Rod Bates	Proxy - Geoff Provest	Arthur Elliott	Cyclades Cres Neighbourhood Watch
Eleanor Dunn	DITCRD	John Alcorn	ACCA
Julie Murray	Kingscliff Ratepayer & Progress Assoc	Audra Topping	Tugun Progress Assoc
John Hicks	Gold Coast Lifestyle Association	Bill Pinkstone	ANACC

Apologies

Barry Jephcote	SECCA		
Gloria Baker	Bilinga Neighbourhood Watch	David Farndon	Department of Transport & Main Roads
Marion Charlton	Gold Coast Airport	Jason Thomas	Gold Coast Tourism
James Owen	Proxy – Jann Stuckey	Helen Gannon	DIRD
Rose Wright	Destination Tweed	John Sweeney	Proxy – Bill Pinkstone (ANACC)
Rob Anderson	Virgin Australia	Phillip Follent	Tugun West Neighbourhood Watch
Paul Burton	Griffith University	Anthony Nugent	Airservices
Bill Dennis	East Banora Residents Association	Ronni Hoskisson	Tweed District Residents
Helen Twohill	Fingal Head Community Association	Jeff Godfrey	Tweed Residents & Ratepayers Assoc
Jodie Bellchambers	Proxy - Justine Elliot		

Attachment 2: Action List

	Date of CACG Meeting	Action	Who	Target Completion Date	Progress Commentary
13	3 July 2019	To provide an update on the offset area management plans once the plans are approved.	Gold Coast Airport (Norbert Benton)	6 Nov 19	Awaiting response from department, will be published.
18	25 July 2018	To provide a clarification of markers for different types of PFAS	Airservices (Andrew Collins)	6 Nov 19	Completed
20	25 July 2018	To provide advice on whether the PFAS Management Plan or a summary may be able to be provided to the CACG.	Airservices (Andrew Collins)	6 Nov 19	Provided fact sheet Completed
23	25 July 2018	Follow up to identify the groundwater monitoring and report on the outcome.	Airservices (Andrew Collins)	6 Nov 19	Report to be circulated
25	25 July 2018	To investigate if an environmental expert can present to address the group about the DSI.	Airservices (Andrew Collins)	4 Mar 20	DSI to commence Jan2020
33	7 Nov 18	Rod to provide email to Neil to follow up	Rod Bates	6 Nov 19	Completed
34	7 Nov 18	Norbert to provide update at next meeting on the results of the air quality testing	Gold Coast Airport (Norbert Benton)	4 Mar 20	Report to be finalised early next year.
36	7 Mar 19	GCA to provide an update on the southern access road process at the next meeting	Gold Coast Airport (Brett Curtis)	4 Mar 20	No progress, to be pushed to the next meeting
39	3 July 2019	Circulate final minutes of 7 March 2019 meeting	Secretariat	August 2019	Replace by action item 47 Completed
40	3 July 2019	Airservices to consider whether a report on ILS arrivals can be provided to CACG meetings.	Airservices (Anthony Nugent)	4 Mar 20	Provide report to next meeting

	Date of CACG Meeting	Action	Who	Target Completion Date	Progress Commentary
41	3 July 2019	Chair to follow up with Rod Bates and Julie Murray on questions they have put to Airservices on which they are still awaiting a response. Due August 2019	Chair	6 Nov 19	Rod Bates response provided Julie Murry response superseded by item 48
42	3 July 2019	When the report in relation to the airports offsets becomes available, the secretariat will provide a link to the website.	Gold Coast Airport (Norbert Benton)	4 Mar 20	Awaiting response from department, will be published.
43	3 July 2019	Andrew Collins to give formal response to John to consider whether the successful tenderer for DSI can be asked to consult specifically with relevant members of this CACG prior to designing the investigation. The group also requested that in the next master plan, GCA make a commitment to significantly strengthen attention on the PFAS issue.	Airservices (Andrew Collins)	6 Nov 19	Completed. Unlikely that the tender would consult with individual members.
44	3 July 2019	Provide instructions to the committee on how to access the noise monitor results online.	Airservices (Anthony Nugent)	6 Nov 19	Completed New item to address this in more detail at item 56
45	3 July 2019	The Chair to follow up with DIRD on whether the Curfew Quota movements report can identify any ILS arrivals and the reasons for their curfew arrival.	Chair	4 Mar 20	Provide report to next meeting

	Date of CACG Meeting	Action	Who	Target Completion Date	Progress Commentary
46	3 July 2019	Airservices to consider whether a report on ILS arrivals can be provided to CACG meetings.	Airservices (Anthony Nugent)	4 Mar 20	Response to be presented at the next meeting
47	13 Nov 2019	The correct versions of minutes of the March and July meetings to be emailed to members within a week of this meeting.	Gold Coast Airport Secretariat	13 Nov 2020	Completed at time of drafting minutes
48	6 Nov 19	Write to AsA to emphasise the importance of responding to the information requests regarding departing flights over Kingscliff, and potential conflict situations that give rise to the departing flights going over Kingscliff.	Chair	4 Mar 20	
49	6 Nov 19	Eleanor Dun to provide more information on Federal Government consideration of aviation emissions to the Secretary.	Eleanor Dunn (DITCRD)	4 Mar 20	
50	6 Nov 19	Write to QLD & NSW health departments for further information on what the state governments are doing, or can do, to monitor emissions from aircraft at Gold Coast Airport.	Chair	4 Mar 20	
51	6 Nov 19	Eleanor Dun will provide links to an ICAO report on health consequences of living near airports. Membership to consider the material.	Eleanor Dunn (DITCRD)	4 Mar 20	

	Date of CACG Meeting	Action	Who	Target Completion Date	Progress Commentary
52	6 Nov 19	The Chair will write to the Airport to request that more detail on PFAS issues, and, more explicit clarification of how traffic growth will be managed**,** be included in the next Master Plan.	Chair	4 Mar 22	
53	6 Nov 19	Increasing departures over Kingscliff to be put on March Agenda	Chair/Secretariat	4 Mar 20	
54	6 Nov 19	Julie to provided details of occurrences of flights over the Wollumbin/Mt Warning area to the CACG secretary & AsA for review	Julie Murray	4 Mar 20	
55	6 Nov 19	Write to ANACC with a copy to Airservices requesting that ANACC pursue the issue of reinstatement of the southern noise monitor as a priority, and pointing out reference to the West Tweed monitor in the Master Plan.	Chair	4 Mar 20	
56	6 Nov 19	AsA to provide a direct link to the Noise monitor page on the website	Airservices (Anthony Nugent)	4 Mar 20	
57	6 Nov 19	AsA to provide the Runway data on runway usage for each runway, specifically divided up for RPT aircraft	Airservices (Anthony Nugent)	4 Mar 20	

	Date of CACG Meeting	Action	Who	Target Completion Date	Progress Commentary
58	6 Nov 19	Written questions to identify the reports not published, seasonality issues & fluctuating PFAS levels, yearly testing and testing on the western boundary. Questions will include JA's comments around testing on the western side at the fire station.	Lindy Smith	4 Mar 20	
59	6 Nov 19	Discuss with AsA to see whether one or 2 nominated representatives of the CACG can meet with the successful tenderer for the DSI project.	Airservices (Andrew Collins)	4 Mar 20	
60	6 Nov 19	Ask the ANACC if it can share draft minutes with the CACG to allow the CACG to consider issues prior to CACG meetings.	GCA (Jared Feehely)	4 Mar 20	
61	6 Nov 19	Provide an update on environmental monitoring at the ILS localizer monitoring site	GCA	4 Mar 20	
62	6 Nov 19	Write formally to Asa to consider whether it can undertake a full review of Gold Coast flight paths.	Chair	4 Mar 20	

Gold Coast Airport Community Aviation Consultation Group (CACG)
Meeting date: 6 November 2019

Agenda paper from: John Hicks, Gold Coast Lifestyle Association Inc

Subject: Sustainable management of airport growth

1.0 Recommendations

It is recommended that:

1. CACG discusses the specific issues listed in Section 3.0 of this paper; and records any recommendations for improvement arising from those discussions.
2. Department of Infrastructure, Transport, Cities and Regional Development (DITCRD) provides clarification/answers to CACG in relation to the questions raised in Section 3.0 of this paper, issues 1 to 5.

2.0 CACG Strategic Work Program extract

To assist discussion the following text in this agenda paper has been copied verbatim from the CACG Strategic Work Program.

Issue

The Master Plan at page 53 states: "Gold Coast Airport forecasts 103,000 annual RPT aircraft movements by 2037, reflecting an average annual growth rate of 4.7 per cent over twenty years." That is, the number of aircraft movements is projected to increase 2.5 times over current levels over the next 20 years. Passenger numbers are projected to triple from 6 million to over 18 million.

A growing airport surrounded by a growing urban area means there is escalating potential for conflicts with the community over airport operations.

Current state

The Airport is a major infrastructure asset for the Gold Coast and northern NSW. It is also a large industrial enterprise that generates noise and pollutants, and these issues must be well-managed.

While there are many commendable provisions in Chapter 11.0 of the Master Plan – Environment and Sustainability, some crucial gaps remain in the environmental monitoring and management framework for the Airport. These gaps relate to:

- Validation of aircraft noise models in Master Plans with actual on-ground noise monitoring (e.g. for verification of N60 and N70 contours)
- Air pollution levels from aircraft emissions and their human health implications
- Monitoring and management of PFAS contaminated soil, surface water and groundwater
- Long-term human health risks to residents living in proximity to airports, as identified in international, peer-reviewed literature.

Responsibility for these issues is distributed across entities such as the Airport, Airservices and DIRDC.

Regardless of who is responsible, these gaps exist and raise important questions in the community about the adequacy of the current environmental monitoring and management framework for the Airport.

There is also an increasing number of objections being lodged by the Airport to development applications in Tweed Shire within the 'airport footprint', pointing to an upward trend that may continue.

Recently in the ANACC forum there has been a call for a "Noise Amelioration Program" to be investigated for the residential areas to the south of the Airport in response the increasing number of RPT overflights.

65% of the population of Tweed Shire lives under the flight paths to the south of the Airport. Existing aircraft numbers are already resulting in some runway 14 departures being directed by ATC to fly straight ahead to the south, for example over Kingscliff, to maintain separation from arriving aircraft. This is not a designated flight path and there are strong community concerns that a 2.5 times increase in aircraft movements will drive the need for more (new) flight paths over Tweed Shire, including the need for flight paths over areas previously unaffected by aircraft noise. The Master Plan does not explain how this substantial increase in RPT traffic is going to be managed in the airspace over Tweed Shire, and whether the designation of new flight paths over populated areas will be required.

Desired future state (where we want to be)

The community surrounding the Airport has confidence that:

- The environmental monitoring and management framework for the Airport is commensurate with its current size and keeps pace with its projected future growth
- all key impacts associated with its currently approved growth are monitored, managed and reported publicly
- the key modelling used by the Airport in its Master Plan and Major Development Plan applications will be validated by actual measurement (e.g. noise contour modelling; runway threshold noise monitoring, etc.)
- the potential locations of any new flight paths and their implications for the community are disclosed and deliberated in CACG, well ahead of the next Master Plan review
- concerns regarding sustainable management of airport growth are evaluated impartially by DIRDC and the Federal Minister, with the health and safety of residents as the highest priority.

Strategies and actions required

Actions and programs are put in place by the respective entities to address the crucial gaps identified in the environmental monitoring and management framework.

To provide CACG with greater insight a presentation is requested from DIRDC on how it assesses applications for airport growth and the adequacy of environmental management programs proposed in draft airport Master Plans.

How will progress be measured and monitored?

- By reporting and review of results from the new environmental monitoring and management programs.

3.0 Specific issues for discussion

1. Validation of aircraft noise models in Master Plans with actual on-ground noise monitoring (e.g. for verification of N60 and N70 contours). This recommendation has been unresolved in previous discussions. It is understood that CACG Chair Ron Brent can add further information here that will move us forward. The focus needs to be on the desired future state i.e. The community surrounding the Airport has confidence in the key modelling used by the Airport in its Master Plans and Major Development Plans (e.g. noise contour modelling; runway threshold noise monitoring, etc.)
2. Air pollution levels from aircraft emissions and their human health implications. It is appropriate the Airport provide a brief update on when its air pollution monitoring results will be published and confirm its intentions to make these results publicly available. Note: no briefing is sought at this meeting on the results. It is also appropriate that DITCRD clarify its requirements for inclusion of aircraft engine air pollution monitoring in airport Master Plans. Is it the case that the current Master Plan was approved with no requirement for aircraft engine pollution monitoring? If so, how can this be?
3. Monitoring and management of PFAS contaminated soil, surface water and groundwater. The recommendations of the CACG meeting 3 July 2019 were for GCA to make a commitment to significantly strengthen attention on the PFAS issue in the next iteration of the Master Plan. The lack of detail in the Master Plan regarding PFAS provides little confidence that this important issue is being adequately managed. It is appropriate that DITCRD clarifies its requirements for inclusion of PFAS monitoring and management information in the next GCA Master Plan.
4. Long-term health risks to residents living in proximity to airports. International, peer-reviewed literature substantiates there are long-term health risks to residents living in proximity to airports. However, these studies often relate to airports and cities much larger than the Gold Coast. Can DITCRD please clarify its requirements around this risk? Is it a matter that is required to be addressed in airport Master Plans? And if not, then why?
5. The Master Plan does not explain how the 250% increase in RPT traffic it authorises is to be managed. The growing communities surrounding this growing airport deserve clarity and transparency on proposed future management arrangements for this substantial increase in RPT aircraft movements. It is appropriate that DITCRD clarify its requirements for such information in Master Plans. Aircraft noise from flight paths is clearly an environmental impact and the Airports Act/Regulations require that Master Plans address how environmental impacts are to be managed. Yet the proposed management of flight paths at GCA is not clearly articulated in the Master Plan. If it is simply a matter of inserting some clarifying text that conveys 'the flight paths depicted in the Master Plan figures will carry the vast majority of RPT traffic for the next 20 years' then that needs to be done in the next Master Plan (noting the point below that the inclusion of the runway 14 departure over Kingscliff is not appropriate).
6. Increasing departures over Kingscliff. Existing aircraft numbers are already resulting in approximately 20% of runway 14 departures being directed by ATC to fly straight ahead to the south over Kingscliff, to maintain separation from arriving aircraft. This is not a designated flight path and there are strong community concerns that a 250% increase in aircraft movements will further exacerbate the problem. This issue has been running for over two years in ANACC. It is scheduled to be addressed by Airservices at the next ANACC meeting. Any information update from Airservices to this CACG would be helpful, but no detailed discussion is proposed.

Gold Coast Airport Community Aviation Consultation Group – 6 November 2019

Sustainable management of airport growth agenda paper – specific issues for discussion

General comment about airport master plans and growth

Airport operators of the federally leased airports are responsible for the development of airport sites within the confines of the legislative regime outlined in the *Airports Act 1996* and associated regulations.

Airport lease agreements between the Australian Government and the airport operator set out requirements in regards to airport development, including that the airport operator is required to invest in airport infrastructure (eg terminals, runways, taxiways, aprons, roads) that meets current demand and anticipates the level and nature of future demand for airport services.

An airport master plan is the document used by an airport operator to outline the strategic direction of the airport over a 20 year horizon. A master plan outlines to the Minister, different levels of governments, industry participants and surrounding community how it intends to meet the demand over the planning period and an assessment of the potential impact of implementing the plan.

The Minister decides to approve or refuse an airport master plan in accordance with the Airport Act and all future developments on the airport site must be consistent with an approved master plan.

1. Airport master plans and noise metrics

Inclusion of N70 contours in an airport master plan is not a statutory requirement of the Airports Act, however the Department of Infrastructure, Transport, Cities and Regional Development (the Department) strongly encourages airports to include the contours.

ANEFs provided in airport master plans are based on Australian Noise Exposure Index data (measured data from previous years), Noise and Flight Path Monitoring System (NFPMS) data (for example, Gold Coast Airport Noise monitors), and aircraft noise profiles from the Integrated Noise Model (INM) developed by the Federal Aviation Administration and the Airport Noise Monitoring and Management System (ANOMS).

Guideline A: Measures for Managing Impacts of Aircraft Noise and the *Supplementary Aircraft Noise Metrics* from the National Airports Safeguarding Framework provides some useful further reading about noise measures and tools used in conjunction with the Australian Noise Exposure Forecast (ANEF).
www.infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/nasf_principles_guidelines.aspx

Validation of Australian Noise Exposure Forecast (ANEF) and N70 Noise Metrics

As part of the manner of endorsement for the ANEF, Airservices Australia is required to undertake technical endorsement to ensure that all assumptions in the ANEF and N70 are accurate. Some Australian Airports have undertaken validation of the data within INM however; the majority of measured data has produced a variance of less than 2 decibels, which is indiscernible to the human ear in terms of noise impact. The accepted methodology is to use noise profile data from INM unless an aircraft type does not have an included noise model, e.g. A350, and in those instances an aircraft substitution model is used.

More information about the technical endorsement of ANEFs, including the Manner of Endorsement can be found on the Department's website www.infrastructure.gov.au/aviation/environmental/aircraft-noise/index.aspx.

2. Air pollution from aircraft emissions and human health impacts

The Airports Act and Airports (Environment Protection) Regulations 1997 regulates the impact of air pollution on the environment and does not regulate air quality against human health impacts. The legislation outlines an airport operator's obligations in regard to air pollution monitoring. Regulation 1.03 of the Airports (Environment Protection) Regulations outlines the limited application to aircraft activities, this includes pollution generated by an aircraft, and noise generated by an aircraft in flight or when landing, taking off or taxiing at an airport. For this reason, an airport operator is not required to address aircraft engine pollution monitoring in a master plan.

Aircraft Engine Emissions

Information about engine emissions can be found in the Air Navigation (Aircraft Engine Emissions) Regulations, which are 'sunsetting' in 2021. The Department will be consulting in 2020 on updating the Aircraft Engine Emissions Regulations to incorporate the new CO2 standard agreed by the Committee on Aviation Environmental Protection (CAEP) and the non-volatile particulate matter (nvPM) standard agreed by CAEP. Australia is also reviewing the NOx standard which applying to in-production aircraft types which is to be discussed at the CAEP Steering Group in South Africa in December.

Once these matters have been considered at the international level the Department will consult in 2020 on an updated set of regulations.

Aircraft engine emissions also comprise less than 2 per cent of emissions globally and aviation emissions are managed through the Carbon Offsetting and Reduction Scheme for International Aviation.

Air Quality

While the Airports (Environment Protection) Regulations do not specifically deal with air emissions from aircraft, all Australian states and territories conduct state-wide ambient air monitoring programs in accordance with the National Environment Protection (Ambient Air Quality) Measure and this requires annual reporting of the states air quality against the national standards.

Reports also tend to show trends, indicating where pollution is increasing (if applicable).

Queensland reports are available online and monthly bulletins are also issued with detailed data about air quality in South East, Central and Northern Queensland:

- QLD Website: https://www.stateoftheenvironment.des.qld.gov.au/pollution/air-quality.

NSW conduct an ambient monitoring program with some sites having hourly live updates (note: monitoring is not near the Gold Coast Airport, but still general monitoring is being conducted):

- NSW Website: https://www.environment.nsw.gov.au/aqms/hourlydata.htm.

Background

The National Environment Protection (Ambient Air Quality) Measure establishes a national ambient (outdoor) air quality management framework by setting national standard of six key pollutants and monitoring and reporting requirements. The goals set by the Ambient Air Quality NEMP drive the implementation of air quality management strategies in order to meet standards. The Air Quality NEPM is implemented by the states and territories.

The standards are set by the National Environment Protection Council under the National Environment Protection Council Act 1994. They are based on WHO guidelines to ensure adequate protection of human health from air pollution.

3. Management of PFAS on airport

Australia's first PFAS National Environmental Management Plan (PFAS NEMP) was released and endorsed by all Commonwealth, state and territory environment ministers on 16 February 2018**.** The Department has communicated to all federally leased airports the requirement for airports to manage PFAS in accordance with this document. The information provided in Gold Coast Airport's 2017 Master Plan met the requirements at the time.

PFAS is an emerging contaminant and the understanding, research and management of this contaminant is continually evolving as more research is undertaken.

The PFAS NEMP is the primary, risk-based, national framework for managing PFAS contamination throughout Australia. The Department continues to provide guidance to all 22 federally leased airports on risk-based approaches to manage PFAS contamination in accordance with the NEMP. NEMP 2.0 is expected to be released in the coming months.

The Department, in addition to being members of the National PFAS Taskforce run by the Department of the Environment and Energy, has formed its own PFAS taskforce to specifically address PFAS contamination on all federally leased airports and is working collaboratively with airports to ensure monitoring, management and remediation is in accordance with best practice.

The following websites provide more information:

- The Australian Government PFAS website includes information for community members, outlines government action, research, health advice https://www.pfas.gov.au/.
- Airservices Australia National PFAS Management Program has site investigations (including Gold Coast) and research and development activities they are undertaking, all monitoring reports were completed by specialist consultants and are available online.

Human health impacts

The May 2018, independent expert health panel established by the Australian Government concluded there is limited or no evidence to associate PFAS exposure with adverse health impacts. However, the panel recommended exposure to PFAS be minimised due to the persistence in humans and the environment. The panel's report is available on the Department of Health's website https://www1.health.gov.au/internet/main/publishing.nsf/Content/ohp-pfas-expert-panel.htm.

4. Long term health risks to residents living in proximity to an airport

The Department is heavily involved in the work of International Civil Aviation Organisation's (ICAO) Committee on Aviation Environment Protection (CAEP) and its Impacts and Science Working Group.

The CAEP Impacts and Science Group regularly reviews scientific evidence related to the health impacts of aircraft. The International Civil Aviation Environmental Report is produced every three years and includes an Aircraft Noise White Paper. Australia is an active participant in CAEP where these matters are discussed. The 2019 State of the Science Aviation Noise Impacts Report is available on ICAO's website and attached for more information.

5. Gold Coast Airport's 2017 Master Plan and increase in passenger movements

The 2017 Master Plan includes information about impacts and management of growth, by way of the forecast growth in section 4, the ANEF, N70 contours, flight paths and accompanying commentary in section 5, the proposed aviation development in section 6 to accommodate the growth, the environmental strategy in section 11 as well as other matters like the ground transport plan in section 10.

Section 5.5 of the 2017 Master Plan outlines the existing and proposed flights paths used in producing the 2015 ANEI and 2047 ANEF are included in figures 5.10-5.16. The Airports Act does not require this information to be provided in a particular way.

The information presented in the 2017 Master Plan meets the requirements of the Airports Act and was approved by the Minister for this reason.

The Department encourages the CACG to continue to engage with Gold Coast Airport in the development of the next master plan.

As noted under response 2, the regulatory regime established under the Airports Act establishes a framework for the management of on-ground environmental issues, including air, soil, water, noise and chemical pollution on-airport. There is limited application to aircraft activities including pollution generated by an aircraft, and noise generated by an aircraft in flight or when landing, taking off or taxiing at an airport.

6. Increasing departures over Kingscliff

The Department considers this topic should continue to be discussed by ANACC.

Aviation Noise Impacts White Paper

State of the Science 2019: Aviation Noise Impacts

V. Sparrow, Pennsylvania State University, Pennsylvania, United States
T. Gjestland, SINTEF, Norway
R. Guski, Ruhr-Universität Bochum, Germany
I. Richard, ENVIRONNONS, France
M. Basner, University of Pennsylvania, Pennsylvania, United States
A. Hansell, University of Leicester, United Kingdom
Y. de Kluizenaar, The Netherlands Organization for applied scientific research (TNO), The Netherlands
C. Clark, ARUP, United Kingdom
S. Janssen, The Netherlands Organization for applied scientific research (TNO), The Netherlands
V. Mestre, Landrum & Brown, California, United States
A. Loubeau, NASA Langley Research Center, Virginia, United States
A. Bristow, University of Surrey, United Kingdom
S. Thanos, University of Manchester, United Kingdom
M. Vigeant, Pennsylvania State University, Pennsylvania, United States
R. Cointin, Federal Aviation Administration, Washington, DC, United States

**This White Paper represents a summary of the scientific literature review undertaken by researchers and internationally-recognised experts. It does not represent a consensus view of ICAO.*

SUMMARY

This paper provides an overview of the state of the science regarding aviation noise impacts as of early 2019. It contains information on impacts including community noise annoyance, sleep disturbance, health impacts, children's learning, helicopter noise, supersonic aircraft, urban air mobility and unmanned aerial systems. The paper also considers the economic costs of aviation noise. This information was collected during an ICAO/CAEP Aviation Noise Impacts Workshop in November 2017 and in subsequent follow-on discussions.

1. INTRODUCTION

The purpose of this document is to provide an overview of the state of the science in the area of aviation noise impacts. As part of its work programme, CAEP's Impacts and Science Group (ISG) was tasked with providing an updated white paper on the topic of aviation noise impacts. A white paper on aviation noise impacts was provided at the CAEP/10 meeting, and was later published in 2017 as an open access journal article[1], but it did not address some emerging areas in aviation. So instead of merely providing an update, the course taken was to extend the review to the above mentioned topics. An Aviation Noise Impacts Workshop was held for invited scientists and

other observers and guests in Montreal, Canada November 1-3, 2017. The purpose of this workshop was to lay the foundation for this white paper, and over 50 attendees participated. One specific topic requested by the CAEP was for ISG to address the non-technical environmental aspects of the public acceptability for supersonic aircraft noise, and ISG began to explore this topic. In addition, the authors found much material on supersonics that had not previously been summarized for CAEP, and these details are provided in a separate document[1]. Subsequent follow-up discussions led to additions to this white paper beyond those discussed at the workshop, and this includes urban air mobility (UAM) and unmanned aerial systems (UAS) noise. The basic of metrics for aircraft noise were defined in a Glossary which can be freely accessed at the ICAO public website[2] and those will not be repeated here.

2. COMMUNITY NOISE ANNOYANCE

2.1 Definition

Community noise annoyance refers to the average evaluation of the annoying aspects of a noise situation by a "community" or group of people. Annoyance, in this context, comprises a response that reflects negative experiences or feelings such as dissatisfaction, anger, disappointment, etc. due to interference with activities (e.g., communication or sleep) or simply an expression of being bothered by the noise.

To facilitate inter-study comparisons standardized annoyance questions and response scales have been introduced by the International Commission on Biological Effects of Noise, ICBEN.[2] These recommendations have been adopted by the International Standards Organization[3], ISO TS 15666, and translated into a number of new languages, following a standard protocol.[4]

2.2 Exposure-response relationships

Over the years, many attempts have been made to relate the percentage of respondents highly annoyed by a specific noise source to the day-night average noise exposure level, L_{dn}, or a similar indicator, e.g., day-evening-night average noise exposure level, L_{den}.[5,6] The standard ISO 1996: 2016 has tables with % HA as a function of L_{dn} and L_{den} for various transportation noise sources.[7] A review by Gelderblom et al.[8] confirms these data for aircraft noise. Another review suggests different relationships, particularly for aircraft noise annoyance.[9]

2.3 Generalized versus local exposure-response relationships

While exposure-response relationships have been recommended for assessing the expected annoyance response in a certain noise situation, they are not applicable to assess the effects of a change in the noise climate. Existing survey results reveal a higher annoyance response in situations with a high rate of change, for instance, where a new runway is opened.[10,11,12] Such heightened annoyance response seems to prevail.

Since airports and communities may differ greatly with respect to acoustic and non-acoustic variables, local exposure–response relationships, if available, may be preferred for predicting annoyance and describing the noise situation with desired accuracy. Still, generalized exposure–response relationships are desirable to allow assessment across communities and to establish recommended limit values for levels of aircraft noise.

2.4 Moderating variables

Analyses show that the common noise exposure variables *per se* explain about one third of the variance of individual annoyance responses. The annoyance response is moderated by a series of other factors, both acoustic and non-acoustic. Acoustic factors can be maximum levels, number of flights, fleet composition, and their respective distribution over time. Non-acoustic factors are for instance, personal noise sensitivity and attitude towards the noise source. In the aviation industry all "non- L_{dn} factors" are commonly referred to as "non-acoustic".

Two old meta-analyses on the influence of non-acoustic factors on annoyance[13,14] showed the factors of fear of

1 www.icao.int/environmental-protection/Noise/Documents/ICAO_Noise_White_Paper_2019-Appendix.pdf
2 www.icao.int/environmental-protection/Noise/Documents/NoiseGlossary2019.pdf

danger of aircraft operations, followed by noise sensitivity and age, had the largest effects. More recent results indicate that fear is no longer a dominating modifying factor. Other important modifying factors may be distrust in authorities and expectations of property devaluation.[15] Guski et al. suggested[9] that the rate of change at an airport with respect to noise and operational procedures could be an important moderating factor. They defined two types: LRC and HRC, low/high rate of change airport. Gelderblom et al. have shown that the average difference in the annoyance response between these two types of airports, LRC and HRC, corresponds to a 9-dB-difference (9 dB ± 4 dB) in the noise exposure.[17] Guski et al. reported a similar, but smaller difference, about 6 dB.[9] The difference between the two studies is likely due to different selections and weighting of survey samples.

An important non-acoustic factor seems to be the attitude towards the noise source and/or its owner. Contrary to common beliefs, people that benefit from the air traffic are not more tolerant to aircraft noise.[18] A lack of trust in the authorities, misfeasance, and a feeling of not being fairly treated will increase the annoyance.[15] People may adapt different coping strategies, i.e. to master, minimize or tolerate the noise situation. Noise sensitive people have more difficulties coping with noise than others.[19]

If the respondents in a survey are selected according to proper random procedures, and the number of respondents is large enough to be an accurate representation of the population, individual factors will have the same effect in all surveys. However, other factors are location specific, for instance number of aircraft movements, prevalence of night time operations, LRC/HRC categorization, etc. The survey results from different airports will therefore vary unless these location specific factors are the same, or that they are accounted for statistically. Hence the search for a common exposure-response function, a "one curve fits all" solution, may not be applicable for all purposes.

2.5 Temporal trends in aircraft noise annoyance

Systematic surveys on aircraft noise annoyance have been conducted regularly over a good half century. Analyses by some researchers indicate that there has been an increase in aircraft noise annoyance over the past decades.[20,21] These authors state that at equal noise exposure levels, people today seem to be more annoyed by aircraft noise than they were 30-40 years ago.

Other researchers, however, claim that they can observe no change provided that the comparisons comprise similar and comparable noise situations.[17] Gelderblom et al. point out that the trend observations made by others can be explained by variations in non-acoustic factors, such as the fact that the prevalence of HRC airports are higher among recent surveys than among older ones. When LRC and HRC airports are analyzed separately they claim that there has been no change in the annoyance response over the past 50 years. Guski et al. on the other hand, claim that even at LRC airports the prevalence of highly annoyed people is higher for all exposure levels compared to older studies.[9]

Survey results from different airports show a large variation in the annoyance response. The result of a trend analysis based on a limited sample of surveys is therefore highly dependent on the selection criteria.

2.6 Noise mitigation strategies

Annoyance due to aircraft noise has been recognized by authorities and policy makers as a harmful effect that should be reduced or prevented. Priority is given to noise reduction at the source (e.g., engine noise, aerodynamic noise) and reducing noise impact by adjusting operational procedures and take-off and landing trajectories. Attempts to modify the noise spectrum to produce a more agreeable "sound" were made in the EU-funded COSMA project.[22] Such changes gave little or no effect. Sound insulation of dwellings is often applied, but such measures have no consequences for the outdoor experience of aircraft noise. The observed influence on annoyance of personal non-acoustic factors such as perceived control, and trust in authorities suggests that communication strategies addressing these issues could contribute to the reduction of annoyance, alongside or even in the absence of a noise reduction.

2.7 Conclusions

There is substantial evidence that there is an increase in annoyance as a function of noise level, e.g., L_{dn} or L_{den}. The noise level alone, however, accounts for only a part of the annoyance. Location and/or situation specific acoustic

and non-acoustic factors play a significant role and must be taken into account.

There is conflicting evidence that there has been a change in the annoyance response in recent years. Under equal conditions, people today are not more annoyed at a given noise level than they were 30-40 years ago. However, due to changes in both acoustic and non-acoustic factors (more HRC airports, higher number of aircraft movements, etc.), the average prevalence of highly annoyed people at a given noise level (L_{dn} or L_{den}) seems to be increasing. Existing exposure-response functions should be updated and diversified to account for various acoustic and non-acoustic factors. The difference between a high rate change and a low rate change situation seems to be particularly important.

3. SLEEP DISTURBANCE

3.1 Sleep And Its Importance For Health

Sleep is a biological imperative and a very active process that serves several vital functions. Undisturbed sleep of sufficient length is essential for daytime alertness and performance, quality of life, and health.23,24 The epidemiologic evidence that chronically disturbed or curtailed sleep is associated with negative health outcomes (like obesity, diabetes, and high blood pressure) is overwhelming. For these reasons, noise-induced sleep disturbance is considered one of the most important non-auditory effects of environmental noise exposure.

3.2 Aircraft noise effects on sleep

The auditory system has a watchman function and constantly scans the environment for potential threats. Humans perceive, evaluate and react to environmental sounds while asleep.[25] At the same sound pressure level (SPL), meaningful or potentially harmful noise events are more likely to cause arousals from sleep than less meaningful events. As aircraft noise is intermittent noise, its effects on sleep are primarily determined by the number and acoustical properties (e.g., maximum SPL, spectral composition) of single noise events. However, whether or not noise will disturb sleep also depends on situational (e.g., sleep depth[26]) and individual (e.g., noise sensitivity) moderators.[25]

Sensitivity to nocturnal noise exposure varies considerably between individuals. The elderly, children, shift-workers, and those in ill health are considered at risk for noise-induced sleep disturbance.[24] Children are in a sensitive developmental stage and often sleep during the shoulder hours of the day with high air traffic volumes. Likewise, shift-workers often sleep during the day when their circadian rhythm is promoting wakefulness and when traffic volume is high. Sleep depth decreases with age, which is why the elderly are often more easily aroused from sleep by noise than younger subjects.

Repeated noise-induced arousals impair sleep quality through changes in sleep structure including delayed sleep onset and early awakenings, less deep (slow wave) and rapid eye movement (REM) sleep, and more time spent awake and in superficial sleep stages.[26,27] Deep and REM sleep have been shown to be important for sleep recuperation in general and memory consolidation specifically. Non-acoustic factors (e.g., high temperature, nightmares) can also disturb sleep and complicate the unequivocal attribution of arousals to noise.28 Field studies in the vicinity of airports have shown that most arousals cannot be attributed to aircraft noise, and noise-induced sleep-disturbance is in general less severe than that observed in clinical sleep disorders like obstructive sleep apnea.[29,30] However, noise-induced arousals are not part of the physiologic sleep process, and may therefore be more consequential for sleep recuperation.132 Short-term effects of noise-induced sleep disturbance include impaired mood, subjectively and objectively increased daytime sleepiness, and impaired cognitive performance.[31,32] It is hypothesized that noise-induced sleep disturbance contributes to the increased risk of cardiovascular disease if individuals are exposed to relevant noise levels over years. Recent epidemiologic studies indicate that nocturnal noise exposure may be more relevant for long-term health consequences than daytime noise exposure, probably also because people are at home more consistently during the night.[16,33]

3.3 Noise effects assessment

Exposure-response functions relating a noise indicator (e.g., maximum SPL) to a sleep outcome (e.g., awakening probability) can be used for health impact assessments and inform political decision making. Subjects exposed to noise typically habituate, and exposure-response functions derived in the field (where subjects have often been exposed to the noise for many years) are much shallower than those derived in unfamiliar laboratory settings.[34,35] Unfortunately, sample sizes and response rates of the studies that are the basis for exposure-response relationships were usually low, which restricts generalizability.

Exposure-response functions are typically sigmoidal (s-shaped) and show monotonically increasing effects. Maximum SPLs as low as 33 dB(A) induce physiological reactions during sleep, i.e., once the organism is able to differentiate a noise event from the background, physiologic reactions can be expected (albeit with a low probability at low noise levels).[34] This reaction threshold should not be confused with limit values used in legislative and policy settings, which are usually considerably higher. At the same maximum SPL, aircraft noise has been shown to be less likely to disturb sleep compared to road and rail traffic noise, which was partly explained by the frequency distribution, duration, and rise time of the noise events.[27,36] At the same time, the per cent highly sleep disturbed assessed via self-reports is typically higher for aircraft noise compared to road and rail traffic noise at the same L_{night} level.[37]

Although equivalent noise levels are correlated with sleep disturbance, there is general agreement that the number and acoustical properties of noise events better reflect the degree of sleep disturbance (especially for intermittent aircraft noise). As exposure-response functions are typically without a clearly discernible sudden increase in sleep disturbance at a specific noise level, defining limit values is not straight forward and remains a political decision weighing the negative consequences of aircraft noise on sleep with the economic and societal benefits of air traffic. Accordingly, night-time noise legislation differs between Contracting States.

3.4 Noise mitigation

Mitigating the effects of aircraft noise on sleep is a three-tiered approach. Noise reduction at the source has highest priority. However, as it will take years for new aircraft with reduced noise emissions to penetrate the market (and will thus not solve the problem in the near future), additional immediate measures are needed. For example, noise-reducing take-off and landing procedures can often be more easily implemented during the low-traffic night-time. Land-use planning can be used to reduce the number of relevantly exposed subjects. Passive sound insulation (including ventilation) represent mitigation measures that can be effective in reducing sleep disturbance, as subjects usually spend their nights indoors. At some airports, nocturnal traffic curfews have been imposed by regulation. It is important to line up the curfew period with the (internationally varying) sleep patterns of the population.

3.5 Recent evidence review

For sleep disturbance, a systematic evidence review based on studies published in or after the year 2000 was recently published.[37] According to GRADE[38] criteria, the quality of the evidence was found to be moderate for cortical awakenings and self-reported sleep disturbance (for questions that referred to noise) induced by aircraft noise, low for motility measures of aircraft noise induced sleep disturbance, and very low for all other investigated sleep outcomes. Significant exposure-response functions were found for aircraft noise for (a) sleep stage changes to wake or superficial stage S1 (unadjusted OR 1.35, 95% CI 1.22-1.50 per 10 dB increase in $L_{AS,max}$; based on N=61 subjects of a single study) and (b) per cent highly sleep disturbed for questions mentioning the noise source (OR 1.94, 95% CI 1.61-2.33 for a 10 dBA increase in L_{night}; based on N=6 studies including > 6,000 respondents). For percent highly sleep disturbed, heterogeneity between studies was found to be high (I^2=84%).

4. HEALTH IMPACTS

4.1 Introduction

There is good biological plausibility for health impacts of environmental noise, with potential mechanisms involving sleep disturbance, 'fight and flight' physiological response and annoyance.[39,40] The number of epidemiological studies investigating impacts of environmental noise on disease risk and risk factors has increased greatly since the previous ICAO white paper[1] and these have been used to define exposure-response relationships. Some variability is expected between epidemiological studies due to differences in populations, methodology, exposures and study design. Therefore, a combined estimate from a meta-analysis of studies with a low risk of bias is used to provide a state of the art estimate of the exposure-response relationship.

This section highlights main findings from the systematic literature reviews and meta-analyses published in 2017-2018. These reviews reference the noise and health literature up to August 2015 for cardiovascular outcomes[41] and December 2016 for birth outcomes.[42] This section also considers new publications up to end July 2018, including from the NORAH (http://www.laermstudie.de/en/norah-study/) and SIRENE (http://www.sirene-studie.ch/) studies in Germany and Switzerland respectively. Almost all studies available were conducted in European and North American populations.

In the following paragraphs it is important for the reader to be mindful of scientists' use of the terms association, correlation, and causation. The statistical finding of an association means that two variables are related. It needs additional clarification to say if it is statistically significant. For research investigating links between noise and impacts, linear correlation is usually too strong of a term to use, so the preferred term is association. Hence, associations do not necessarily mean causation. Determining causality requires a combination of evidence including biological plausibility, consistency across studies, and if available from experimental or natural experiment studies.

4.2 Aircraft noise and cardiovascular impacts

The systematic review on cardiovascular and metabolic effects of environmental noise was performed by van Kempen et al.[41] and described in detail in an RIVM (Dutch National Institute for Public Health and the Environment) report.[46] The authors reviewed studies on the association between environmental noise (different source types) and hypertension in adults (none were identified focusing on children), ischaemic heart disease, stroke and obesity published up to August 2015. Findings for aircraft noise were reported to be consistent with findings for road traffic noise, where there are more studies available.

For hypertension: the van Kempen et al.[41] meta-analysis included nine cross-sectional studies and provided an estimated increased risk of 5% (95% confidence intervals -5% to +17%) per 10 dB (L_{den}) aircraft noise (comprising 60,121 residents, including 9487 cases of hypertension). The one cohort study identified[50] (4721 residents and 1346 cases in Sweden published in 2010) did not show an overall association with hypertension incidence, but there were significant associations in subgroup analyses of males and of those annoyed by aircraft noise. The authors of the review ranked the quality of the evidence for noise from air traffic as "low" using the GRADE ranking system, meaning that further research is considered very likely to have both an important impact on confidence in the estimate of effect and to change the size of the estimate. Subsequent to the systematic review, a large case-control study (137,577 cases and 355,591 controls) from the NORAH study[51] found no associations overall for aircraft noise with hypertension, but an increased risk for the subgroup of those who went on to develop hypertension-related heart disease, i.e. more severe cases. A subsequent publication from a small cohort (N=420) with up to 9 years follow-up in Athens who formed part of the original HYENA (Hypertension and Exposure to Noise Near Airports) study found a 2.6-fold increased risk of hypertension in association with a 10 dB increase in night-time aircraft noise.[52]

Hypertension shows a positive but non-statistically significant association overall reflecting inconsistency between studies. This can be a difficult outcome to define precisely – the PURE multi-country study published in 2013 found nearly half of all cases of hypertension were

unrecognised.[198] There are various issues about defining hypertension by medication use, and recognised issues about measuring blood pressure in individuals. Also, hypertension may not be the only or most important mechanism contributing to potential impacts of noise on the heart – inflammation, small blood vessel function and sleep disturbance also need to be considered.[196,197]

For ischaemic heart disease (IHD) and heart failure, findings were more consistent than for hypertension: the van Kempen et al. systematic review[41] reported a statistically significant increased risk of new cases of ischaemic heart disease of +9% (95% confidence intervals +4% to +15%) per 10 dB L_{den}, derived from a meta-analysis of two very large registry-based studies of 9.6 million participants and 158,977 cases. Taking into account evidence relating to existing as well as new cases and to mortality, the authors of the systematic review concluded "Overall, we rate the quality of the evidence supporting an association between air traffic noise and IHD as 'low'" [using the GRADE ranking system] "indicating that further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate". Subsequent published analyses from the SIRENE project using data from the Swiss National Cohort covering 4.4 million people[53], reported associations between aircraft noise and myocardial infarction mortality with increased risk of +2.6% (95% confidence intervals +0.4% to +4.8%) per 10 dB L_{den}. Highest associations between noise and IHD were seen with intermittent night-time exposures.[54] A large case-control study in Germany (19,632 cases and 834,734 controls) forming part of the NORAH study found associations of aircraft noise with diagnosis of myocardial infarction at higher noise levels (>55 dB) in the early morning hours, although not for 24 hour average noise levels. A further large NORAH study analysis[55] found a statistically significant linear exposure-response relationship with aircraft noise for heart failure or hypertensive heart disease of +1.6% per 10 dB increase in 24 hour continuous noise level (analysis based on 104,145 cases and 654,172 controls).

For stroke: the van Kempen et al. systematic review[41] considered seven studies of different designs including one cohort study (the Swiss National Cohort). Findings were mixed but the meta-analysis did not show statistically significant associations of aircraft noise with stroke outcomes. This result is consistent with subsequently published SIRENE study findings on stroke mortality also using the Swiss National Cohort but with improved noise exposure estimates.[53]

Comparisons with findings for road traffic noise: findings for aircraft noise and the cardiovascular disease outcomes presented above are consistent with those for road traffic noise as reported in the van Kempen et al systematic review.[41] In particular, for ischaemic heart disease, the systematic review rated the quality of the evidence supporting an association between road traffic noise and new cases of ischaemic heart disease to be high, providing an increased risk of +8% (+1% to +15%) per 10 dB L_{den} road traffic noise (as compared with findings for aircraft noise for this outcome of +9% (+4% to +15%) as noted above). Analogy with road traffic noise is meaningful, because, as well as impacts on annoyance, noise also functions as a non-specific stressor with non-auditory impacts on the autonomic nervous system and endocrine system. These stressor effects are seen with noise from different sources and result in adverse effects on oxidative stress and vascular function in experimental studies.[196,197]

4.3 Aircraft noise and metabolic effects (diabetes, obesity, waist circumference, metabolic biomarkers)

The van Kempen et al. systematic review[41] identified one Swedish cohort study considering aircraft noise,[56] which found a significant association between aircraft noise exposure and increased waist circumference over 8-10 years follow-up, but not for Body Mass Index (BMI) or type 2 diabetes. The authors of the systematic review concluded that further research would be likely to have an important impact on both size and statistical confidence in the estimate of effect. Three more recent publications also report some associations of aircraft noise with metabolic disturbance.[57-59] A 2017 Swiss cohort study analysis forming part of the SIRENE project suggested an approximate doubling of diabetes incidence per 12 dB L_{den} increase in aircraft noise exposure[57] and positive although non-significant associations of aircraft noise exposure with glycosylated haemoglobin, a measure of glucose control over the past three months and a predictor of diabetes.[58] A 2017 study in Korea of 18,165 pregnant women identified through health insurance records,[59] found

an association between night-time but not daytime aircraft noise exposure during the first trimester of pregnancy and risk of gestational diabetes mellitus.

Findings are consistent with a hypothesis that noise exposure is related to stress-hormone-mediated deposition of fat centrally and other impacts on metabolic functioning and/or adverse effects of disturbed sleep on metabolic and endocrine function, also with results from a small number of studies considering road traffic noise that also found associations with diabetes, but more studies are needed to strengthen the evidence base for this outcome.

4.4 Aircraft noise and birth outcomes

A systematic review by Nieuwenhuijsen, et al.[42] published in 2017 considered literature published up to December 2016. Six aircraft noise studies were included, but there were too few studies to conduct a meta-analysis. Four studies (published 1973-2001) considered birth weight and all studies found associations with aircraft noise exposure, but noise exposure levels in these studies were high (> 75 dB, various metrics). A further two studies conducted in the 1970s considered birth defects, of which one found significant associations – again, noise levels considered were high. Evidence was considered such that any estimate of effect is very uncertain. The authors commented that "there may be some suggestive evidence for an association between environmental noise exposure and birth outcomes" with some support for this from studies of occupational noise exposure (which were higher than most current environmental aircraft noise exposures), but that further and high quality studies were needed. No further studies relating birth outcomes to aircraft noise have been published to date.

4.5 Aircraft noise and mental health

There remain very few studies of aircraft noise exposure in relation to wellbeing, quality of life, and psychological ill-health. Since the previous ICAO paper and publication[1] in 2017, there has been one major German analysis[60] published from the NORAH study, which found a significant association with depression as recorded in health insurance claims. Risk estimates increased with increasing noise levels to a maximum Odds Ratio (OR) of 1.23 (95% CI=1.19-1.28) at 50-55 dB (24 hour average), but decreased at higher exposure categories. The reason for this is unclear but it may potentially be due to uncertainties related to very small numbers of exposed and cases at higher noise levels. A cohort study following 1185 German school children[61] from age 5-6 to 9-10 years did not find associations of aircraft noise exposure with mental health problems (such as emotional symptoms, hyperactivity and conduct problems), but as the study used parental noise annoyance at place of residence as the measure of exposure as opposed to objectively assessed (modelled or measured) quantitative exposure levels, it is difficult to draw firm conclusions.

4.6 Conclusions

There has been a large increase in studies in recent years examining associations of noise exposure with health outcomes. The best epidemiological evidence relates to cardiovascular disease, which includes analyses from population-based studies covering millions of individuals, in particular for new cases of ischaemic heart disease. Findings for aircraft noise are consistent with those for road traffic noise (for which more studies have been conducted and where the quality of evidence is rated as high). Results from epidemiological studies are also supported by evidence from human and animal field and laboratory experimental studie[45-49] showing biological effects of noise on mechanistic pathways relating to risk factors for cardiovascular disease. This experimental evidence, together with consistency with findings for road traffic noise, supports the likelihood that associations for aircraft noise with heart disease observed in epidemiological studies are causal. However, the exact magnitude of the exposure-response estimate for heart disease varies between studies and best estimates (obtained by combining results from good quality studies in a systematic review) are likely to change as further studies add to the evidence base.

There are important gaps in the evidence base for other outcomes. Perhaps surprisingly, few studies have been conducted in relation to impact of aircraft noise on mental health. There are also few studies relating to maternal health and birth outcomes including birth weight.

Generally, health studies to date have used L_{den}, L_{day} and L_{night} metrics, most likely as these were available and had been extensively validated in annoyance studies. There is a need to examine other noise metrics that may be more

relevant to health endpoints – some of the more recent studies are starting to include other metrics, including intermittency ratio,[43] maximum noise level and to examine specific time periods,[44] especially for night-time exposures. These new metrics should be additional, but not replace the standard equivalent metrics (L_{Aeq}, L_{den}) to allow for comparability of results, at least at present while the evidence base is being compiled.

5. CHILDREN'S LEARNING

5.1 Chronic aircraft noise exposure and children's learning

Several studies have found effects of aircraft noise exposure at school or at home on children's reading comprehension or memory skills[62] or standardized test scores.[63,64] The RANCH study (Road traffic and Aircraft Noise and children's Cognition & Health) of 2844 9-10 year old children from 89 schools around London Heathrow, Amsterdam Schiphol, and Madrid Barajas airports found exposure-response associations between aircraft noise and poorer reading comprehension and poorer recognition memory, after taking social position and road traffic noise exposure, into account.[65] A 5 dB increase in aircraft noise exposure was associated with a two month delay in reading age in the UK, and a one month delay in the Netherlands.[66] These associations were not explained by co-occurring air pollution.[67] Night-time aircraft noise at the child's home was also associated with impaired reading comprehension and recognition memory, but night-noise did not have an additional effect to that of daytime noise exposure on reading comprehension or recognition memory.[68] The recent NORAH study of 1242 children aged 8 years from 29 primary schools around Frankfurt airport in Germany found that a 10 dB (L_{Aeq} 08.00am-14.00pm) increase in aircraft noise was associated with a one-month delay in terms of reading age. The RANCH and NORAH studies examine the effect of aircraft noise on children's reading comprehension starting from a very low level of exposure. This enables the studies to adequately assess where effects of aircraft begin (i.e. identify thresholds): we should not be concerned by the inclusion of the examination of such low levels of aircraft noise exposure as both the RANCH and the NORAH study adjust the results for other noise exposures (e.g., road noise in RANCH and road and rail noise in NORAH) making the assessment meaningful in terms of considering other noise exposures and ambient noise exposure per se. Effects of aircraft noise on children's learning have been demonstrated across a range of aircraft noise metrics including L_{Aeq}, L_{max}, number of events above a threshold, and time above a threshold. [64]

Data from the RANCH study and the NORAH study enable the exposure-effect association between aircraft noise exposure and children's reading comprehension to be estimated[69,70] (see Figures 1 and 2). Both studies suggest that the relationship between aircraft noise and reading comprehension is linear, so reducing exposure at any level should lead to improvements in reading comprehension. In the RANCH study, reading comprehension began to

FIGURE 1: Exposure-effect relationship between aircraft noise exposure at school and reading comprehension in the RANCH study. The vertical axis shows the adjusted mean reading z scores and 95% confidence intervals for 5-dB(A) bands of aircraft noise at school (adjusted for age, gender, and country)[66]

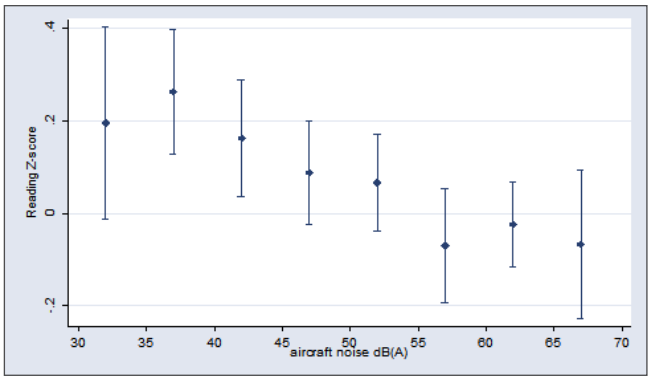
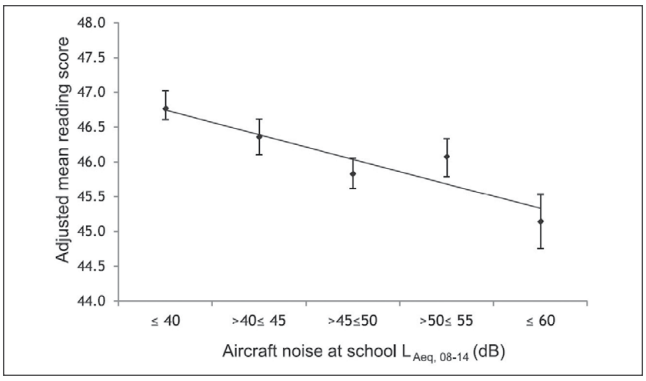


FIGURE 2: Exposure-response function between aircraft noise exposure at school and reading comprehension in the NORAH study [70]



fall below average at exposures greater than 55 dB L_{Aeq} 16 hour at school.

It is possible that children may be exposed to aircraft noise for many of their childhood years, but few studies have assessed the consequences of long-term noise exposure at school on learning or cognitive outcomes. Whilst it is plausible that aircraft noise exposure across a child's education may be detrimental for learning, evidence to support this position is lacking. A six-year follow-up of the UK sample of the RANCH study, when the children were aged 15-16 years of age, failed to find a statistically significant association but did suggest a trend between higher aircraft noise exposure at primary school and poorer reading comprehension at follow-up,[71] as well as a trend between higher aircraft noise exposure at secondary school and poorer reading comprehension at secondary school. This study was limited by its small sample size, which may be why it detects trends rather than significant associations. There remains an urgent need to evaluate the impact of aircraft noise exposure throughout a child's education on cognitive skills, academic outcomes and life chances.

5.2 How might chronic aircraft noise exposure cause learning deficits?

Aircraft noise may directly affect the development of cognitive skills relevant for learning such as reading and memory. A range of other plausible pathways and mechanisms for the effects have also been proposed. Communication difficulties might also account for the effects: teacher behavior is influenced by fluctuations in external noise, with a recent observational study finding associations between aircraft noise events and teacher voice-masking (when the teacher's voice is distorted or drowned out by noise) and teacher's raising their voice).[72] Effects might also be accounted for by teacher and pupil frustration, reduced morale, impaired attention, increased arousal – which influences task performance, and sleep disturbance from home exposure which might cause performance effects the next day.[73,74] Noise causes annoyance, particularly if an individual feels their activities are being disturbed or if it causes difficulties with communication. In some individuals, annoyance responses may result in physiological and psychological stress responses, which might explain poorer learning outcomes.

5.3 Interventions to reduce aircraft noise exposure at school

Studies have shown that interventions to reduce aircraft noise exposure at school do improve children's learning outcomes. The longitudinal Munich Airport study[75] found that prior to the relocation of the airport in Munich, high noise exposure was associated with poorer long-term memory and reading comprehension in children aged 10 years. Two years after the airport closed these cognitive impairments were no longer present, suggesting that the effects of aircraft noise on cognitive performance may be reversible if the noise stops. In the cohort of children living near the newly opened Munich airport impairments in memory and reading developed over the first two-year period following the opening of the new airport. A recent study of 6,000 schools exposed between the years 2000-2009 at the top 46 United States airports (exposed to Day-Night-Average Sound Level of 55 dB or higher) found significant associations between aircraft noise and standardized tests of mathematics and reading, after taking demographic and school factors into account.[64] In a sub-sample of 119 schools, they found that the effect of aircraft noise on children's learning disappeared once the school had sound insulation installed. These studies evidence the effectiveness of the insulation of schools that may be exposed to high levels of aircraft noise.

Sound-field systems, which ensure even distributions of sound from the teacher across the classroom, could provide a solution to improving children's learning in situations of aircraft noise. However, an evaluation of these systems in schools in the UK, which were not exposed to aircraft noise, found that whilst the systems improved children's performance on tests of understanding of spoken language they did not influence academic attainment in terms of test of numeracy, reading or spelling.[76] Whether such systems may be an effective intervention for children attending schools with high levels of aircraft noise exposure remains to be evaluated.

5.4 Conclusions

There is robust evidence for an effect of aircraft noise exposure on children's cognitive skills such as reading and memory, as well as on standardized academic test scores. Evidence is also emerging to support the insulation of

schools that may be exposed to high levels of aircraft noise. Whilst a range of plausible mechanisms have been proposed to account for aircraft noise effects on children's learning, future research needs to test these pathways, to further inform decision-making concerning the design of physical, educational and psychological interventions for children exposed to high levels of aircraft noise. Further knowledge about exposure-effect relationships in different contexts, using either individually collected cognitive performance data or standardized school test data, would also further inform decision-making. It would also be productive to derive relationships for a range of additional noise exposure metrics, such as the number of noise events. To date, few studies have evaluated the effects of persistent aircraft noise exposure throughout the child's education and there remains a need for longitudinal lifecourse studies of aircraft noise exposure at school and cognitive skills, educational outcomes and life chances.

6. HELICOPTER NOISE

6.1 Exposure-response relationships

Exposure-response relationships derived for annoyance by aircraft noise were viewed as not necessarily valid for specific sources such as helicopters, low-flying military aircraft or aircraft ground noise.[6] Although relatively little is known on annoyance induced by helicopter noise, some surveys performed in the past have shown that helicopter noise is more often reported as annoying than fixed-wing aircraft noise, at similar or even lower A-weighted outdoor noise levels.[78-82] This was found for heavy military helicopters as well as for lighter civilian helicopters. A more recent survey[83] was done in three residential areas under or adjacent to helicopter corridors that were used by light civilian helicopters. The study was limited to only three surveys, but it was clear that for light civilian aircraft there was not a pronounced difference between response to fixed wing and rotary wing aircraft. The study did show that there was a residual annoyance associated with helicopter operations that was not associated with noise exposure level.

6.2 Role of non-acoustic factors

Some field studies[81,84] have shown that helicopter noise annoyance is heightened by certain non-acoustic factors, in particular fear of a crash, lack of information on the reason of the flights, and low perceived necessity of the helicopter flights themselves (such as when the helicopter is viewed as 'rich person's toy') or of the noise that is produced by them (for instance when it is felt that the pilot or operator could reduce the disturbance by choosing a different flight pattern).

A more recent study[83] also found that for three surveys completed under or near light civil helicopter routes there was 'residual annoyance,' not a function of noise exposure level, an annoyance that was constant for all noise exposures with no evident tendency to approach zero at even very low noise levels. This lack of correlation between noise exposure level; and annoyance was associated with the strong influence of non-acoustic factors. These and earlier findings suggest that observed differences in annoyance between helicopters and fixed-wing aircraft may heavily depend on non-acoustic factors.

6.3 Role of impulse noise

Several laboratory studies have explored whether the degree of impulsiveness of the helicopter noise may contribute to annoyance.[85-89] No consistent differences in annoyance were found between helicopter and aircraft noise, again suggesting that observed differences in the field were partly due to non-acoustic factors, nor did annoyance depend on the degree of impulsiveness. Therefore, the overall consensus is that there is no evidence to justify the application of an impulse correction to the noise level of helicopters with impulsive characteristics.[90-91]

6.4 Role of rattle noise and vibrations

There is evidence that helicopter noise characterized by large low frequency components may impact the building and produce rattle (i.e. sounds of rattling objects or windows within the dwelling) or vibration (the perception of vibrating building elements or furniture), which in turn may lead to increased annoyance by the helicopter noise.[92] While rattle noise and vibration may also be induced by the low-frequency components of ground noise during

aircraft landing and take-off,[93,94] it is only sporadically induced by overflying fixed-wing aircraft.[95] In a large field study in the United States[96] it was found that noise from helicopters flying over was rated by subjects (seated in a wooden frame building) as more annoying than a control stimulus, but only when the helicopter induced rattle noise or vibration within the building. The results suggest a decibel offset of at least 10 dB to account for the extra annoyance when rattle or vibration were induced by the helicopter noise (i.e. the control stimulus had to be at least 10 dB higher to induce equal annoyance). An extension of this study suggested similar offset values of 10 and 8 dB for two helicopter types inducing rattle and vibration.[80] A recent study in the Netherlands suggests a lower offset, around 5-6 dB, for helicopter noise in combination with rattle noise induced within the building.[97] This conclusion is not supported for light civil helicopter surveys[83] where survey respondents did not report vibration or rattle as a source of annoyance. The relatively small degree of low frequency energy associated with light civil helicopters as compared to heavy lift helicopters is not expected to produce rattle noise, which is the most plausible explanation for the difference.

7. EN-ROUTE NOISE FROM SUPERSONIC AIRCRAFT

7.1 Introduction

Sonic booms are the unique sounds produced by supersonic aircraft. This section summarizes many of the properties and impacts of sonic booms, as we know them today.

Conventional sonic booms are widely considered to be loud, and this forms the basis of current regulations in many countries that prohibit supersonic overland flight. However, new research has enabled aeronautical engineers the tools to develop quiet “low-boom” aircraft designs that may be available in 5 to 10 years. Hence, sonic boom research needs to clearly distinguish whether the sonic booms are the conventional N-wave sounds, so called because of their letter N pressure versus time shape, or the new low-booms which are considerably smoothed. The low-booms, or “sonic thumps”, can be as much as 35 dB quieter than conventional booms.

7.2 Human response studies

Studies have shown that sonic booms can be reproduced quite accurately in the laboratory, and this makes it possible to perform subjective experiments under controlled conditions. Although no supersonic aircraft has produced a low-boom signature yet, a similar surrogate sound can be created using a special aircraft dive manoeuver. This makes it possible to conduct tests with real aircraft outdoors for either N-waves or low-booms, complementing the laboratory tests.

A number of subjective tests have been conducted. One trend seen in studies from both the U.S. and Japan is that annoyance to sonic boom noise is greater indoors compared to outdoors. The findings show that indoor annoyance can be estimated based on the outdoor sonic boom exposure. There has been recent work to establish that both rattle and vibration contribute to indoor annoyance of sonic booms. One interesting point is that although conventional N-waves can be accompanied by a startle response, it turns out that low-booms are of low enough amplitude that they don’t induce a consistent physiological startle response.

There has been substantial work in recent years to establish metrics to assess sonic boom noise. Out of a list of 70 possible metrics, a group of 6 metrics has been identified for the purposes of use in certification standards and in developing dose-response curves for future community response studies. Clearly the low-booms are much quieter than the conventional N-wave booms, but additional community studies with a low-boom aircraft need to be conducted to assess public response.

7.3 Non-technical aspects of public acceptability for sonic boom

An additional aspect that should be considered for sonic booms includes the non-technical aspects of acceptability. The CAEP Steering Group specifically requested that ISG look into this topic. A preliminary discussion has revealed a strong resemblance to the non-acoustical factors of subsonic aircraft noise, previously mentioned in Section 2 “Community Noise Annoyance” of this white paper. There are currently no peer-reviewed studies on the topic of non-acoustical factors for sonic boom noise, but it seems plausible that the knowledge of subsonic aircraft

non-acoustical factors could be extended for application to sonic boom noise non-technical aspects.

7.4 Impacts of sonic boom on animals

Recently there has been renewed interest regarding the impacts of sonic boom noise on animals. Fortunately there is an extensive literature extending from before the days of Concorde to recent years, mostly for conventional N-wave aircraft.

There have been substantial studies for both livestock and other domesticated animals, and detailed studies of some wildlife species. For conventional sonic booms the animals usually show no reactions or minimal reactions, although occasionally they may startle just as humans do. There are no reported problems of developing fish eggs or of avian eggs due to sonic boom exposures. NASA conducted a number of studies in the late 1990s and early 2000s to assess the impact of overwater sonic booms on marine mammals. There is a good bit of knowledge as to how much sonic boom noise transitions from air into water, and fortunately, very little of the sound gets into the water. For the California sea lion, elephant seals, and harbor seals, careful lab experiments showed no temporary hearing shifts in those species.

In 1997 and 1998 a study of a colony of seals exposed to Concorde booms on a regular basis showed that the booms didn't substantially affect the breeding behavior of gray or harbor seals. It instead seems that these animals substantially habituated to hearing these N-wave sonic booms on a routine basis.

Most of what is known about noise impacts on animals comes from the literature of the effects of subsonic aircraft and other anthropogenic noise sources, not sonic booms, on animals. It is well known that human activities can interfere with animal communication, for example.

There have not been many specific studies on the effects of sonic boom noise on animals in recent years. Some species with good low-frequency hearing, such as elephants, have never been evaluated regarding sonic boom noise. But it makes sense that if the already tested animals were not negatively affected by sonic boom noise from conventional N-waves, that they will likely not be affected by the proposed lowbooms of the future. Long-term effects of sonic boom exposure on animals seem unlikely.

7.5 Conclusions

Much progress has been made to model and mitigate the effect of sonic booms from supersonic flight. Ongoing research to assess the impact on the public indicate that new supersonic aircraft designs will create quieter sonic thumps that are much less annoying than conventional sonic booms. Upcoming community tests with a low-boom demonstrator aircraft will collect the data needed on noise exposure and resulting public reactions.

8. UAM/UAS NOISE

8.1 Current status

New aircraft technologies for increased mobility are likely to lead to new sources of community noise. Urban Air Mobility (UAM) refers to a range of vehicle concepts and missions operating in a community, from small Unmanned Aerial Systems (sUAS) to vehicles large enough for several passengers. The sUAS are envisioned for package delivery, surveillance, agriculture, surveying, and other similar applications that can benefit from use of a small and agile autonomous system, while the larger vehicles are envisioned for on-demand urban passenger transportation.[165] Electric propulsion is seen as a key technology that could enable these kinds of systems, across the range of vehicle types and sizes.[165]

UAM vehicles have the potential to alter the community soundscape due to their noise characteristics that are qualitatively different from traditional aircraft.[166-168] In addition, similar to sonic booms from supersonic aircraft en route, the noise may not be concentrated around traditional airports. There is very little scientific research on the human impacts of noise from UAM aircraft, although there have been increased efforts to measure and model the noise generated by them and their components.[167,169-172] Two psychoacoustic studies are briefly described here.

A study[166] was conducted by NASA to evaluate human annoyance to sUAS noise, including the effect of variation in operational factors and a comparison of annoyance to

noise from road vehicles. The noise from four commercially available sUAS and four road vehicles, ranging in size from a passenger car to a step van, were recorded and presented to test subjects in a specialized simulation facility. For this limited set of noise sources, a systematic offset was found that indicates the noise of sUAS is more annoying than noise from road vehicles when presented at the same loudness.

Another NASA psychoacoustic study[168] concentrated on annoyance to noise from a simulated distributed electric propulsion (DEP) aircraft. Using auralizations from noise predictions of spatially-distributed, isolated propeller noise sources, the subjective study in a specialized psychoacoustic facility found that the number of propellers and inclusion of time-varying effects were significant factors in annoyance, while variation of the relative revolutions-per-minute (RPM) between propellers was not significant. The study also developed an annoyance model based on loudness, roughness, and tonality for predicting annoyance to these DEP sounds. Despite the limitations in prediction methods and simplifications, the study identified the relevant parameters and metrics that should be studied further.

8.2 Conclusions

Growing interest in UAM aircraft has been observed from different sectors, such as hobbyists, commercial entities, the military, government agencies, and scientists.[165] There is preliminary evidence that the public may be concerned with these new noise sources intended for transportation and package delivery.[173] Although there is only a very limited amount of research on subjective reaction to noise from these new aircraft types, indications that the noise characteristics differ from traditional aircraft warrant further research to understand and predict human perception of these sounds.

9. ECONOMIC COST OF AVIATION NOISE / MONETIZATION

9.1 Introduction

Sleep disturbance, myocardial infarction, annoyance, stroke, dementia, and other health effects are increasingly recognized as economic costs of noise.[174] Recent studies estimating annual noise costs around specific major world airports are useful in considering the scale of the challenge and include: Taipei Songshan Airport €33 million[175] and Heathrow £80.3 million.[176] An unpublished student thesis by Kish (2008) suggests annual costs for aviation noise at 181 airports worldwide in excess of $1 billion, which is not out of line with the individual airport estimates.[177] It is clear that noise can be a key factor when airport expansion is considered. Values of disturbance from aircraft noise are used in analysis and planning decisions affecting airport development and operations. Their main application is in estimating the costs or benefits arising from changes in noise levels and/or exposure. It is therefore important to look at the evidence that underpins these value estimates. There are three main approaches for monetizing noise costs, two of which value the nuisance according to individual preferences: revealed preference, usually hedonic pricing, and stated preference methods, which include contingent valuation and stated choice. The third type of approach, the impact pathway, links health effects of noise nuisance to monetary values from reducing morbidity risks that are typically derived from elsewhere. These are discussed in turn below.

9.2 Hedonic Pricing (HP)

The main method using revealed preference is hedonic pricing whereby the market for an existing good or service, in this case housing, is used to derive the value for components of that good, in this case the noise environment. House price in HP is modelled as a function of property characteristics that should include all social, spatial, and environmental factors. HP then provides the percentage change in house prices resulting from a 1 dB change in noise levels.[178,179] The method has been extensively applied to the problem of aircraft noise, especially in North America. Individual studies yield a wide range of price changes from 0% to 2.3% per dB.[180] Thus a key challenge is to derive values that are applicable or transferable in different contexts.

Meta-analyses have sought to estimate consensus values based on pooled evidence from individual studies.[181-183] These meta-analyses are based on a reasonably small number of, US dominated studies, observations of 30, 29 and 53 respectively. Nelson (2004) and Wadud (2013) converge on 0.5 to 0.6% house price fall in response to a

1 dB increase in aviation noise, with caveats concerning the broad range of estimates and a dearth of studies in less developed countries. Using data on income, Kish (2008) carried out a meta-analysis on US based HP evidence, estimating a model with a low but reasonable fit, which he found did not transfer well to UK data. He et al. (2014) built on this work[184] but their model fit was poor. The evidence from these studies also suggests that values in Canada are higher[182,183] or more generically that values outside the US are higher.[184] Interestingly, Kopsch (2016) reports a meta-analysis including air and road noise, finding that aviation noise increases the NDI by 0.4 to 0.6% relative to road.[185] To conclude, the best available evidence from the HP is that house prices fall by 0.5 to 0.6%, on average, per 1 dBA increase in aircraft noise, and there is also some support for country specific effects.[182,183]

9.3 Stated Preference (SP)

Stated preference approaches have been increasingly applied to value noise nuisance especially in Europe. These involve either direct questioning on value, contingent valuation, or trade-off approaches, stated choice or ranking. As with HP, individual studies exhibit a wide range in values per unit of noise. A data set of 258 values of transportation noise derived from SP studies, adjusted to 2009 prices, yielded an average value per decibel change per household per annum of $141.59, 95% Confidence Interval (CI) +/- $30.24 with a range from $0 to $3,407.67. However the aviation noise values within this data, 69, exhibit less variation with a mean of $292.24 and a CI of +/- $23.10 and smaller range of $15.05 to $1097.83. Such variation in values may reflect genuine variations in preferences, the impact of contextual variables, variations in approach, systematic study or country effects, and changing preferences over time or some combination of these effects.[186] Again, meta-analysis can assist in explaining some of this variation. Only one meta-analysis has been conducted on studies of transportation noise, utilising 258 values derived from 49 studies across 23 countries conducted over a 40-year period.[186] As might be expected, the value of noise reduction or the cost of noise increases were found to be dependent on level of annoyance and income. The income elasticity was close to one, suggesting that the value placed on reduced noise increases broadly in line with income; this is higher than estimates from cross sectional studies. There were no country effects found in this meta-analysis, suggesting that the model and values derived from it are transferable. Additionally, aviation noise was found to have a higher cost per dBA than road and rail noise. A result that is consistent both with studies of annoyance,[6] and HP meta-analysis.[185] Furthermore, comparison with the then HP-based approach applied by the UK Department for Transport at the time (2014) indicated that the values from the SP meta-analysis and the HP-based approach were broadly comparable. [186] This is also supported by the primary research of Thanos *et al.* (2015), applying SP and HP in the same context.[195]

9.4 Impact pathway

The third approach is rather different by exploring the impact pathway (IP) for noise effects on human health, and expressing those endpoints in terms of Disability Adjusted Life Years (DALYs) or Quality Adjusted Life Years QALYs) to quantify healthy life years lost. The World Health Organization adopted this approach[174] and identified disability weights (DW) for cardiovascular disease, sleep disturbance, tinnitus and annoyance resulting from environmental noise. The evidence on the health impacts in all areas has been growing over the years. However, the evidence base underpinning the DWs for sleep disturbance and annoyance is extremely sparse, with a high degree of uncertainty.[180] This is reflected in the WHO (2011, p: 93) weight on annoyance where "a tentative DW of 0.02 is proposed with a relatively large uncertainty interval (0.01-0.12)". This DW is only applicable those who are "highly annoyed", so any individuals experiencing annoyance who are not highly annoyed are assigned a value of zero.

There is uncertainty around the value of a healthy life year lost, which is combined with the DW weights to derive monetary values. In practice, value of life has been derived from stated preference studies of traffic fatalities in the UK,[188] or reduced mortality risk based on stated preference studies in Europe.[189] As these values do not stem from analysing the health risks of noise nuisance, there is an added element of uncertainty regarding transferability of values from diverse contexts. Furthermore, the impact pathway approach has many steps each with potential to add error and uncertainty

to the value/cost estimates. As Freeman et al., (2014, p: 441) put it, "significant work is needed to improve and update the values of reducing risks that lead to morbidity and/or mortality."[190] Nevertheless, the method has been adopted into policy analysis by the UK Department of Transport[191] in assessing transport schemes and by the European Commission in evaluating the environmental noise directive.[192]

9.5 The abatement and mitigation costs of dealing with noise

The costs imposed by noise lead to efforts to measure, manage and mitigate. Airports can bear substantial costs, for example at the high end of the scale, Amsterdam Schiphol spent approximately €644.6m largely on insulation between 1984 and 2005.[193] Nevertheless this only amounted to €0.58 per passenger. Whilst manufacturers have produced quieter aircraft, there is a trade-off between achieving energy efficiency and quieter design and operation. The benefits of any mitigation activity should outweigh the costs. The costs of mitigation are relatively straightforward to estimate, as they have a market price of implementation and maintenance, in the case of noise insulation or barriers, or of estimating forgone benefits, for instance, of noise curfews. It is also rational to compare the costs of different routes to achieving a noise reduction target, for example through regulation or market incentives. Once both the costs of noise and any additional costs of mitigation are established; cost benefit analysis (CBA) can be used to guide towards solutions with the highest net benefits.

9.6 Conclusions

Economic valuation of noise nuisance and health effects is necessary and robust values are available. Most importantly, these values are applied and used in decision making. Meta-analysis of both hedonic pricing and stated preference studies suggests that these approaches, when properly applied, deliver robust values of noise nuisance. These preference-based approaches do not capture the health effects of noise that are not perceived by the exposed population. The impact pathway approach provides nonmarket values for these health effects. However, IP does not value annoyance at levels less than "highly annoyed", has a less well developed evidence base than HP and SP, and requires more steps that have the potential to introduce more error. Furthermore, HP and SP meta-analyses have improved the transferability of values providing confidence intervals for their variation, whereas there is no robust evidence on value transferability for the IP approach. This approach should be viewed with caution in the absence of a well-developed evidence base, and especially in the case of annoyance effects perceived by the exposed populations, for which robust values of noise nuisance can be delivered by tested methods.

10. OVERALL CONCLUSIONS AND FUTURE WORK

This paper has provided an overview of the many different aircraft noise impacts. There is substantial evidence that increases in noise levels lead to increases in community annoyance, but there are other nonacoustical contributors to annoyance. In future work, existing exposure-response functions should be updated and diversified to account for various acoustic and non-acoustic factors. The difference between a high rate change and a low rate change situation seems to be particularly important.

Undisturbed sleep is a prerequisite for high daytime performance, well-being and health. Aircraft noise can disturb sleep and impair sleep recuperation. Further research is needed to (a) derive reliable exposureresponse relationships between aircraft noise exposure and sleep disturbance, (b) explore the link between noise-induced sleep disturbance and long-term health consequences, (c) investigate vulnerable populations, and (d) demonstrate the effectiveness of noise mitigation strategies. This research will inform political decision making and help mitigate the effects of aircraft noise on sleep.

Epidemiological evidence from a systematic review published in 2018 covering studies up to 2016 and subsequent published studies involving several million participants show associations of aircraft noise with ischaemic heart disease. This is consistent with the evidence for road traffic noise, with larger numbers of studies. There is biological plausibility for impacts of noise on health and experimental evidence of effects of noise on the mechanistic pathways relating to cardiovascular disease, supporting the likelihood that associations are causal. Associations between aircraft noise and hypertension or stroke are less consistent across

epidemiological studies, but other biological mechanisms than hypertension are available to explain associations with heart disease. However, the evidence base for aircraft noise remains limited and further research may result in changes to exposure-response relationships with cardiovascular disease, such as those derived from the systematic review of studies published in 2018. The evidence base is limited for non-cardiovascular outcomes; further research is particularly needed on diabetes and obesity, mental health, and pregnancy and birth outcomes. Further research is also needed using additional noise metrics, including those that better characterise air traffic events than average sound level (e.g., number of events above a certain noise threshold) and that consider time period (e.g., late evening and early morning).

There is robust evidence for an effect of aircraft noise exposure on children's cognitive skills such as reading and memory, as well as on standardized academic test scores. Future research needs to test the different mechanisms and to inform key individuals who can intervene on the behalf of exposed children. Longitudinal studies over the lifecourse need to be conducted.

While some surveys suggest a higher response to helicopter noise than to noise from fixed-wing aircraft, any observed differences in annoyance seem to heavily depend on non-acoustic factors. Overall, there is no evidence for a pronounced difference between response to fixed-wing and to rotary wing aircraft at equal noise levels that would justify a stricter evaluation of helicopter noise. Only when the helicopter noise is characterized by a large degree of low-frequency energy, which may produce rattle noise or vibration in buildings, there is evidence that annoyance is markedly increased. Further research should consider the consequences of rattle noise to the evaluation of helicopter noise, as well as the important role of non-acoustic factors.

Using laboratory simulators and testing in the field with special aircraft manoeuvers, progress has been made on understanding and predicting human response to sonic boom noise from overflight of new proposed quiet supersonic aircraft. To confirm these results and extend the applicability of derived models, a new low boom flight demonstrator aircraft is being built to conduct sonic boom community response studies. Plans are underway for designing these experiments to develop exposure-response models for this new kind of quiet supersonic aircraft. Several aspects of human response to low-boom supersonic flight still remain to be researched. Subjective studies have not fully investigated perception of focus booms, booms from other parts of the trajectory outside the cruise portion, noise in the shadow zone beyond lateral cut-off, Mach cut-off booms, and secondary booms. In addition, sleep disturbance relating to low-boom supersonic cruise flight or any of these other conditions has not been studied. Finally, community studies are needed using quiet supersonic aircraft in areas where people are not accustomed to hearing sonic booms, in order to develop a dose-response relationship for this new sector of commercial transportation. Regarding the non-technical aspects of public acceptability for supersonic aircraft noise, there is nothing in the literature that directly applies. However, it may be possible in the future to draw from the existing literature on the topic of non-acoustical factors for subsonic aircraft noise. We are fortunate that there already have been many studies on how animals react to conventional sonic booms, and current thinking is that the new low-boom aircraft would even have less of an impact. It is still unknown if large animals with good low-frequency hearing such as elephants will respond any differently compared to the medium and small sized animals that have already been studied.

There is preliminary evidence that the public may be concerned with the new UAM noise sources intended for transportation and package delivery. Although there is only a very limited amount of research on subjective reaction to noise from these new aircraft types, indications that the noise characteristics differ from traditional aircraft warrant further research to understand and predict human perception of these sounds.

Evidence from hedonic pricing and stated preference studies suggests that these approaches, when properly applied, deliver robust monetary values of noise nuisance. Although the impact pathway approach additionally provides non-market values for health effects, it should be viewed with caution especially in the absence of a well-developed evidence base and evidence on value transferability. There remains a need for further research to improve the robustness of the impact pathway approach and comparisons with other approaches. A further issue is that of evidence for lower income countries which is very sparse.

Comparisons between aircraft noise impacts and other noise source impacts, such as rail, road, and industrial noise, are beyond the scope of this current white paper. Others have already pointed out some of the similarities and differences in impacts between different types of noise sources, so much of that information is currently available.[194]

11. ACKNOWLEDGMENTS

V. Sparrow's, M. Vigeant's and M. Basner's participation in the CAEP/ISG Aviation Noise Impacts Workshop and this white paper was supported by the Federal Aviation Administration of the United States. The opinions, conclusions and recommendations expressed in this material are those of the authors and do not necessarily reflect the views of ASCENT sponsor organizations. Regarding the effects of sonic booms on animals, V. Sparrow thanks Dr. Kevin Shepherd and Dr. Sandy Liu for providing many of the references and to Dr. Shepherd for careful editing.

The authors thank the ICAO Environmental Officers Neil Dickson and Bruno Silva for their unwavering help in hosting the Aviation Noise Impacts Workshop and in the development of this paper. They also thank Prof. David Lee, Manchester Metropolitan University, United Kingdom for many useful conversations and spirited support.

REFERENCES

The complete list of references used in this report is available at:

https://www.icao.int/environmental-protection/Documents/Noise/ICAO_Noise_White_Paper_2019-References.pdf

Gold Coast Airport

November 2019 CACG Presentation

GOLD COAST AIRPORT

Passenger numbers

- June = 475,000 (down 8% on prior year)
- July = 584,000 (down 1% on prior year)
- August = 529,000 (down 4% on prior year)
- September = 549,000 (similar to prior year)

RPT Flight numbers (arrivals and departures)

- June = 3,150 or 735 pw
- July = 3,670 or 830 pw
- August = 3,260 or 740 pw
- September = 3,390 or 790 pw

Air New Zealand

- Additional 22,000 seat between GCA and Auckland
- From March 2020, increase to daily service
- April, July and October holiday periods up to 9 services per week
- A321neo and B787-9 aircraft

Seoul Service

- Service to commence 8 December 2019
- Jetstar's Boeing 787 Dreamliner
- Departing to Seoul Sunday, Wednesday and Friday (midday)
- Arriving from Seoul Monday, Thursday and Saturday (mid-morning)

Introducing Ranji, our new therapy dog

- French Bulldog Ranji joined the team in September
- Gary, a golden Labrador cross, first commenced December 2018
- Gary and Ranji, take turns in the terminal every morning Monday to Friday

Community Benefit Fund

- A total of 30 community groups will this year receive about $1000 each towards a specific initiative
- Areas including health and wellbeing, community safety, education, environment, arts and culture and indigenous projects.
- Full list of 2019 Community Benefit Fund recipient available on GCA website
- The fund will reopen in early 2020 through the GCA website

- Piling works complete
- Two nine-tonne tower cranes installed

Project LIFT – Southern Terminal Extension

GOLD COAST AIRPORT

Airport Hotel

GOLD COAST AIRPORT

Gold Coast CACG

6 November 2019

Chris McCormack ATC/Line Leader
Scott Stephens ATC/UTS

Airservices Update

- Action items
- Gold Coast ILS Noise Monitor Update and feedback
- High level routes from the north
- RNP AR use update
- Online reporting

Action Items

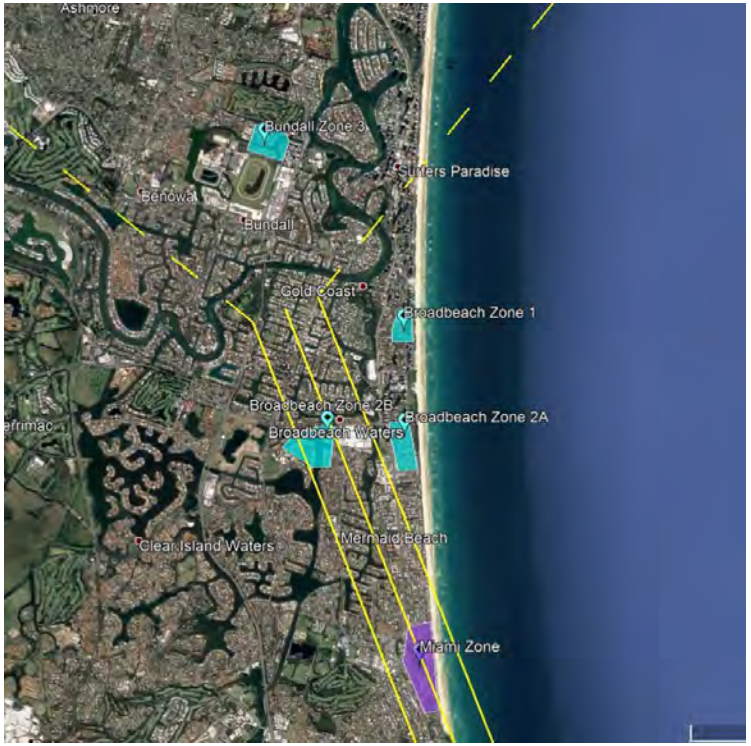
- PFAS concerns were responded to by Airservices specialist Environment (PFAS) Team directly to the Chair

- Airservices responded directly to the Chair on:
  - Question to Mr Rod Bates
  - Question to Ms Julie Murray
  - Noise monitoring on ASA website

Temporary Noise Monitor Update

Airservices sought feedback from the CACG/ANACC on the proposed zones for installation of a second temporary noise monitor (TNM)

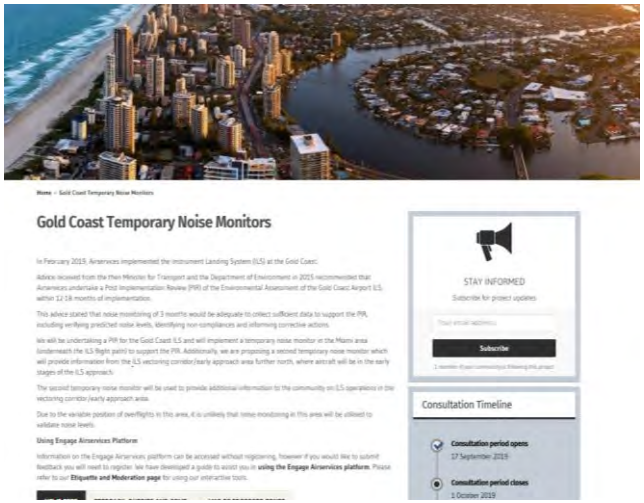
- Airservices incorporated feedback received from the designated CACG/ANACC contact.
- This resulted in extending the boundary of proposed Zone 2, and renaming this Zone 2b.



Temporary Noise Monitor Update

Community Consultation

- Airservices initiated engagement and community consultation on 17 September 2019
- Airservices used the “Engage” platform to manage the consultation
  - https://engage.airservicesaustralia.com/gold-coast-temporary-noise-monitors
  - Airservices provided 2 fact sheets, FAQ’s and an interactive map of the proposed zones. Community members can continue to access these materials through the Engage platform.
- Airservices invited feedback from the community on potential noise sources to inform our decision on a zone for the second TNM
- The engagement period closed on 1 October 2019



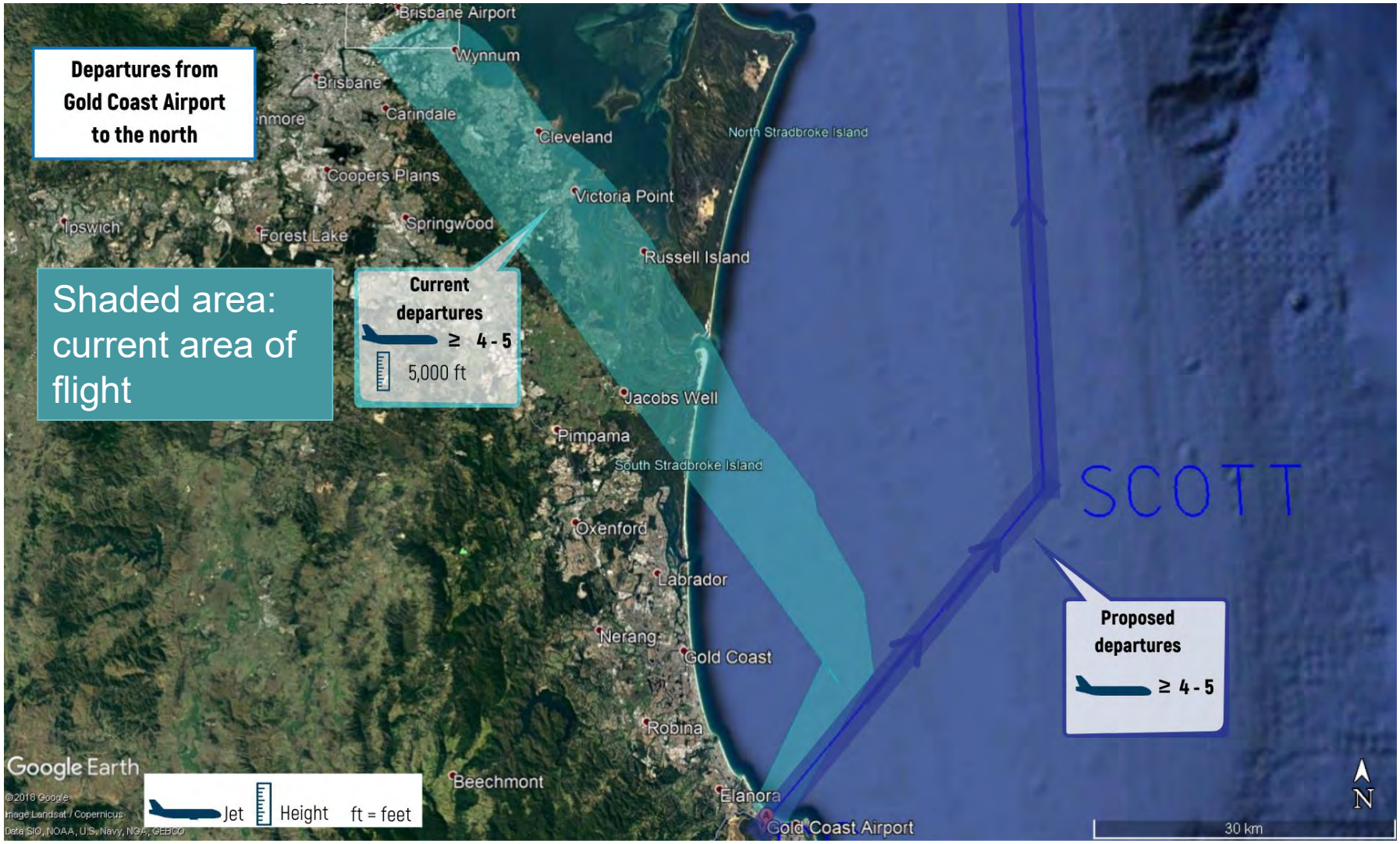
Temporary Noise Monitor Update

- Airservices released a Summary of Feedback to the Engage Airservices Temporary Noise Monitor project page on 24 October 2019
- While we had 58 page visits to the Engage Airservices Temporary Noise Monitor project page, we did not receive community feedback on potential noise sources via our Engage Platform
- The second TNM will be installed within Zone 2b
- The installation of both the Miami TNM and the second TNM was completed on 28 October 2019 and both are now operational
- Community members can access data from both TNMs via WebTrak http://www.airservicesaustralia.com/aircraftnoise/webtrak

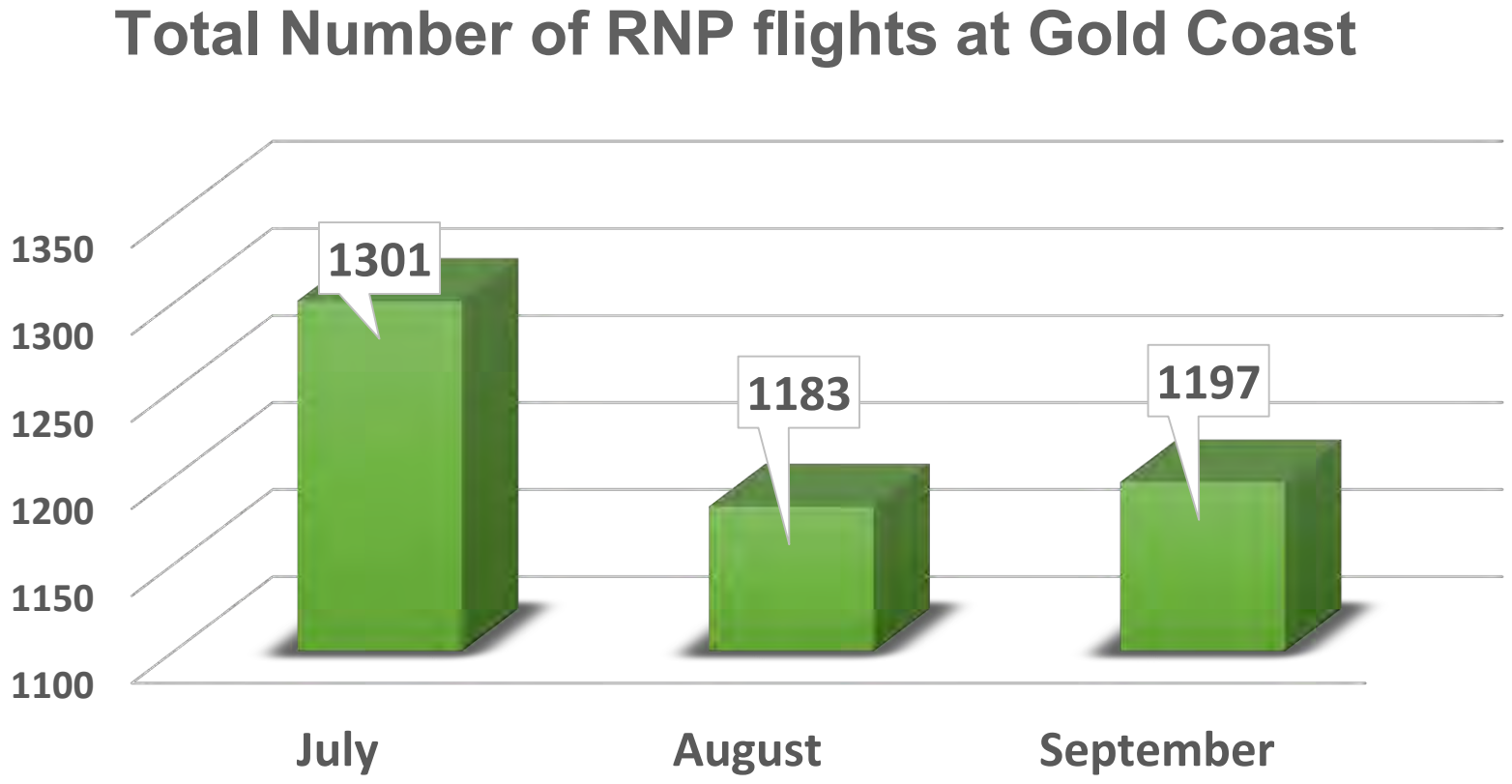
Information: Northern flight paths from Gold Coast Airport

- From May 2020, Airservices proposes to make changes to flight planning requirements for aircraft departing Gold Coast Airport towards northern destinations such as Cairns and Asia
- This change will ensure these aircraft remain over water after departure instead of crossing back over land to the north of the Gold Coast
- Information about this change will be available on Airservices website

Northern flight paths from Gold Coast Airport - departures



RNP AR (Smart Tracking) use – Jul, Aug, Sept 2019



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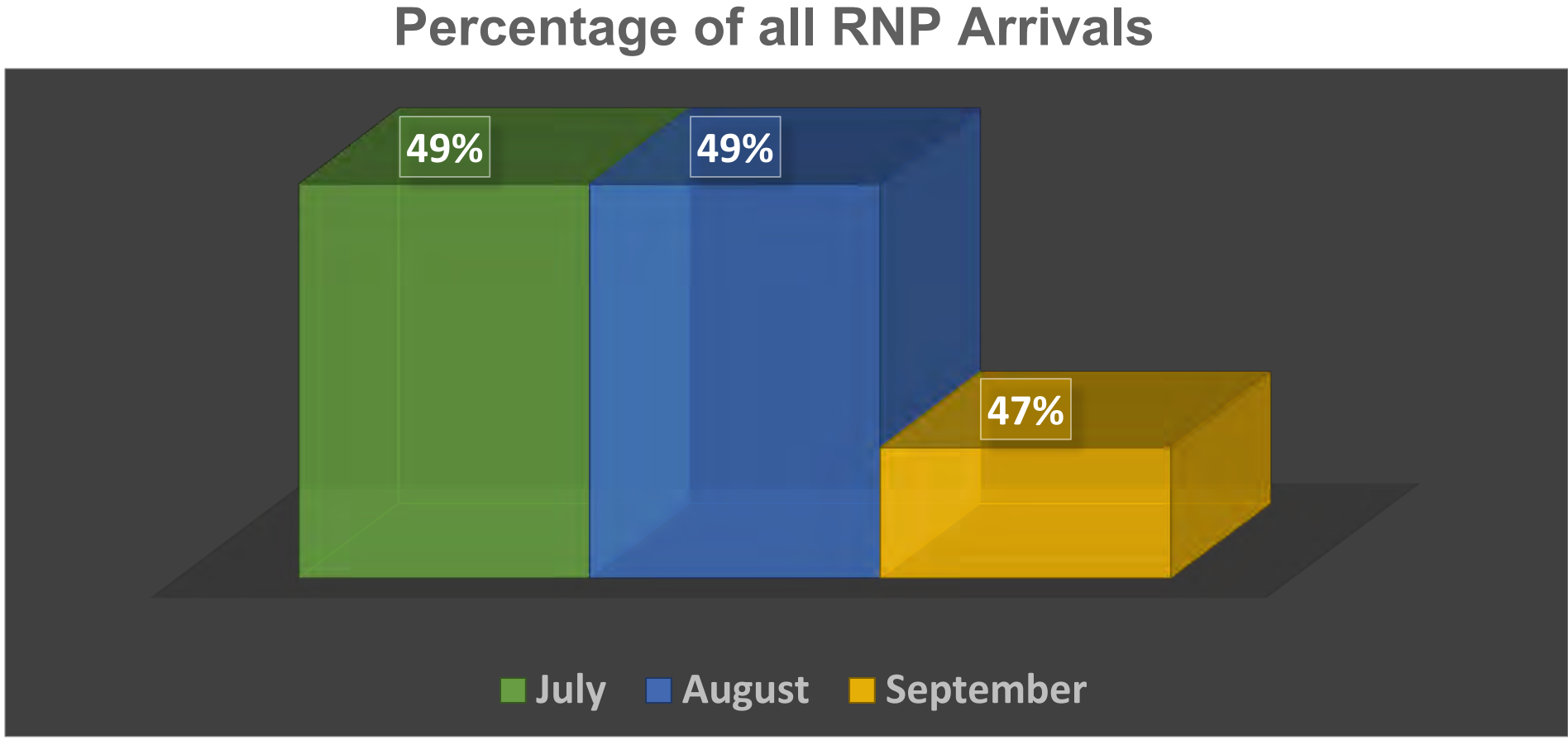

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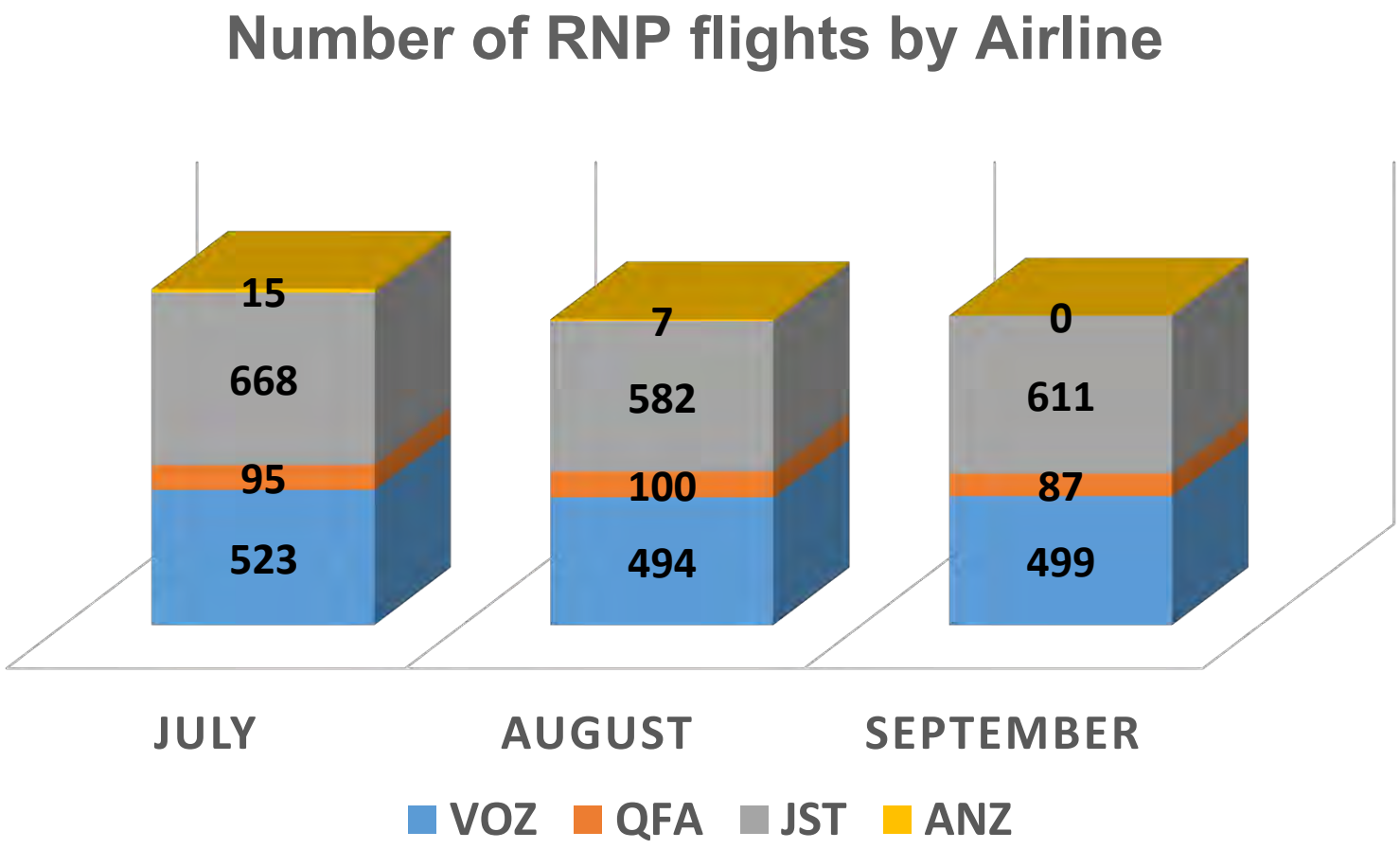

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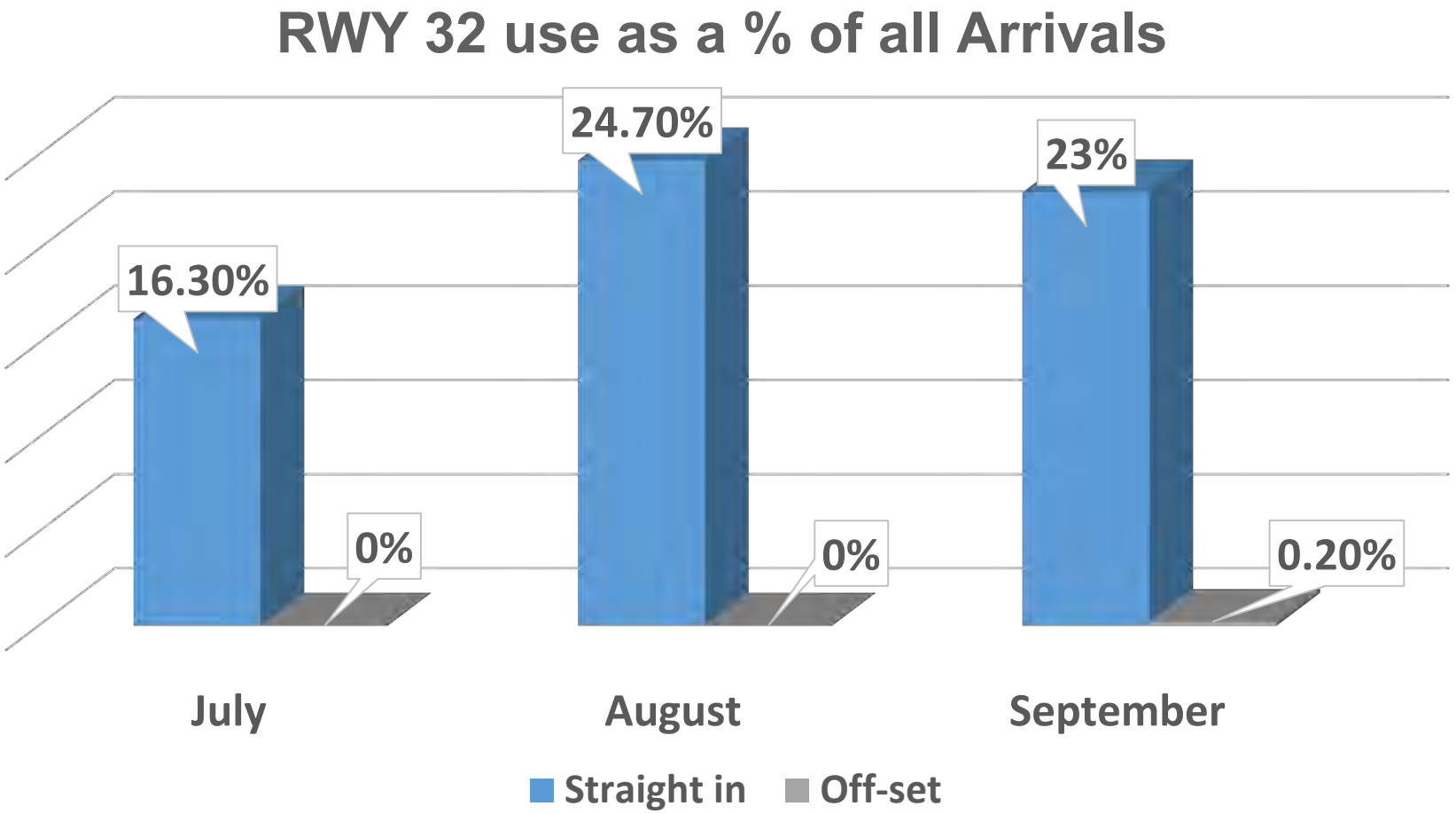

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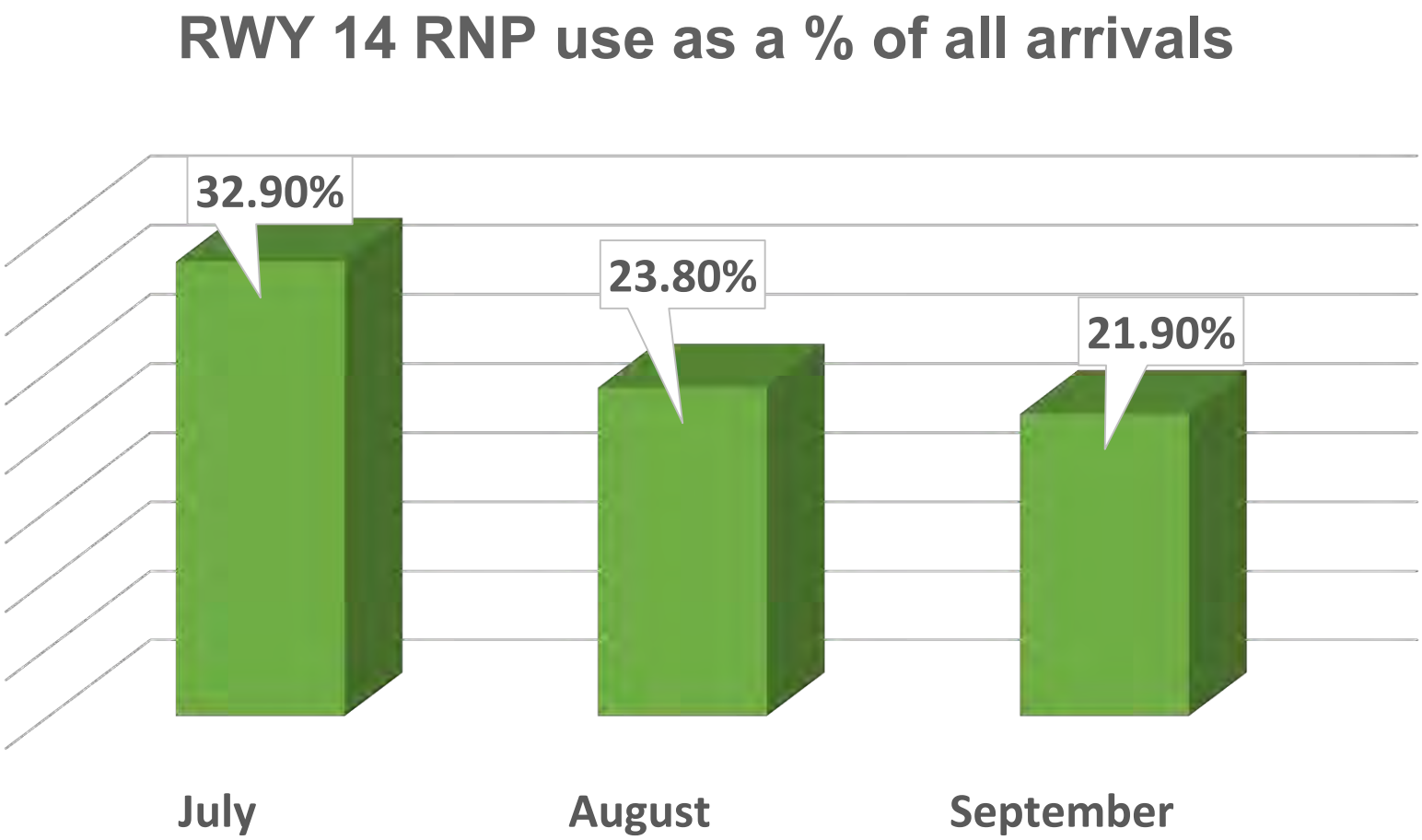


Airservices online reporting

- Airservices online reporting is available on our website at:
  - http://www.airservicesaustralia.com/aircraftnoise/airports/, select Gold Coast and then select complaints

Airservices online reporting

- New interactive online reporting will become available for the Gold Coast at the normal link over the next few months

- You can view what to expect at the new Sydney Portal at:

https://aircraftnoise.airservicesaustralia.com/complaints/

Select a page :

Complainants | Issues and Classifications

Select a month : Sep-19

Complaints

Number of complainants by airport

Issues

Suburbs

Suburb	Complainants	Last 12 months Avg. Complainants	Issues
Emu Plains	6	5	1
Blaxland	3	6	1
Marrickville	3	1	1
Pymble	3	1	1
Chipping Norton	2	1	2
Lane Cove West	2	4	1
Newtown	2	1	1
Springwood	2	2	1
Winmalee	2	1	1
Alexandria	1	1	1
Belfield	1	0	1
Bexley	1	1	1
Centennial Park	1	1	1
Cobbitty	1	1	1
Daceyville	1	0	1
Hunters Hill	1	1	1
Hurstville	1	0	1
Kellyville	1	1	1
Kingsford	1	2	1
Lane Cove	1	1	1
Lewisham	1	0	1
Linden	1	0	2
Maroubra	1	4	1
Mascot	1	2	1
Minchinbury	1	1	1
Mount Riverview	1	2	1
North Strathfield	1	1	1
Paddington	1	1	1
Randwick	1	4	1
St Clair	1	1	1
Stanmore	1	1	1
Toongabbie	1	1	2
Wentworth Falls	1	2	1
West Pymble	1	1	1
Total	**50**	**50**	**37**

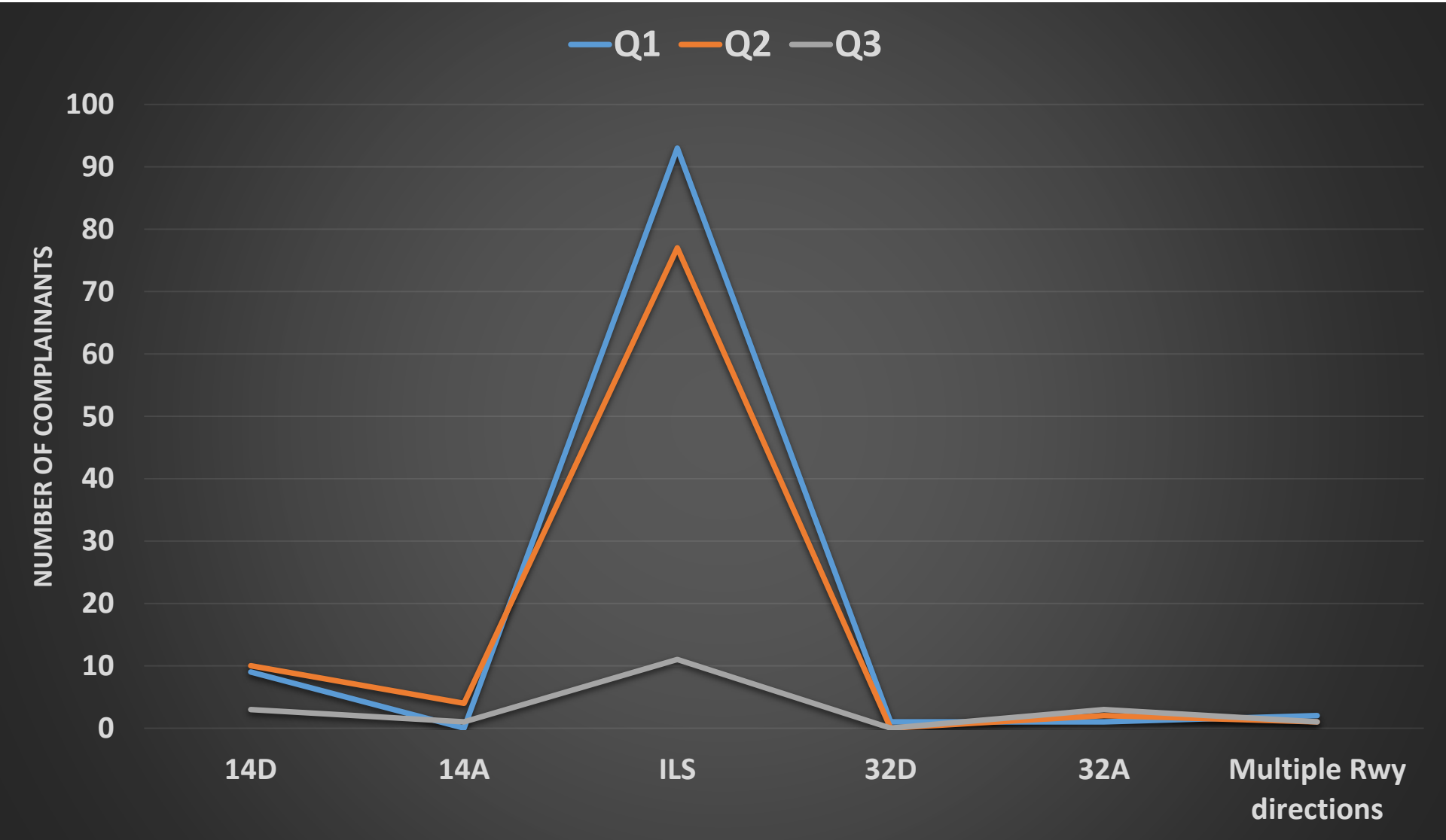
Click here for 'Help'

Q3 2019 – Complainants

- 35 complainants in Q3, a significant decrease from 111 complainants in Q2

- Standard flight path movements including ILS usage remain the main concern affecting 54% of complainants

Q3 2019 – Issues – Runway Directions and ILS usage



Q3 2019 – Suburbs

- 22 suburbs recorded complainants
  - A single complainant was recorded in 16 separate suburbs
  - Burleigh Heads was the only suburb that recorded five or more complainants

- Suburbs recording the most complainants
  - Miami (4)
  - Tweed Heads and Surfers Paradise three complainants each

Action items this meeting

- Airservices requests the CACG to determine the priority of the two action items for this meeting

BY EMAIL
ron@3fidi.com

Mr Ron Brent
Chair
Gold Coast CACG

25 Constitution Avenue
(GPO Box 367)
CANBERRA ACT 2600

t 07 3866 3809

e communityengagement@airservicesaustralia.com

www.airservicesaustralia.com

ABN 59 698 720 886

14 November 2019

Dear Mr Brent,

RE: Changes to northern flight paths to and from Gold Coast Airport

I am writing to inform you that Airservices Australia (Airservices) will implement changes to flight planning requirements for aircraft arriving and departing Gold Coast Airport from May 2020.

The proposed change is designed to reduce complexity of operations between Brisbane Airport airspace, and the arrivals and departures at Gold Coast Airport, which will reduce workload for pilots and air traffic controllers.

The change will reduce the effects of aircraft operations on some communities which currently experience noise and visual impacts from aircraft operating to, and from, the north of Gold Coast Airport. Some communities will see a small increase in aircraft operations on the current arrival flight path that tracks from Brisbane Airport, near Cleveland and out to water.

Noise levels will remain at current levels of below 60dB(A).

These flights will be subject to Gold Coast Airport's curfew.

The change will not affect current movements to and from Brisbane and Archerfield airports.

Please find attached community information which provides further detail about the change.

This information is available on the Airservices website at (http://www.airservicesaustralia.com/projects/flight-path-changes/gold-coast-airport-changes-to-northern-flight-paths/) and has been provided to community members in suburbs near the changes who are registered with our Noise Complaints and Information Service (NCIS).

Information has also been provided to local Councillors in the Redland Bay area and Divisions 1 and 14 of Gold Coast City Council.

Should you have any questions, please contact us via communityengagement@airservicesaustralia.com.

Yours sincerely

Fiona Lawton
Community Engagement Manager
Air Navigation Services
Airservices Australia

NORTHERN FLIGHT PATHS TO AND FROM GOLD COAST AIRPORT

From May 2020, Airservices will make changes to flight planning requirements for aircraft operating north of Gold Coast Airport.

WHAT IS THE CHANGE AND WHY IS IT NEEDED?

The changes will require jet aircraft arriving from, and departing to, the north of Gold Coast Airport to plan via set routes.

The proposed change is designed to reduce complexity of operations between Brisbane Airport airspace, and the arrivals and departures at Gold Coast Airport, which will reduce workload for pilots and air traffic controllers.

The change will reduce the effects of aircraft operations on some communities which currently experience noise and visual impacts from aircraft operating to, and from, the north of Gold Coast Airport. Some communities will see a small increase in aircraft operations on the current arrival flight path that tracks from Brisbane Airport, near Cleveland and out to water.

WHAT IS GOING TO CHANGE?

Arrivals:

Currently jet aircraft arriving to Gold Coast Airport from the north and northwest can operate within a broad area including tracking over water to the east of Moreton Bay (Figure 1 pink shaded area).

Communities including Victoria Point, Cleveland, Thornlands, Russell Island, Coochiemudlo Island, Dunwich (North Stradbroke Island) and Macleay Island, currently see and hear up to seven (7) jet aircraft on a busy day arriving to Gold Coast Airport. These aircraft track on a concentrated flight path from overhead Brisbane Airport to the ESTER flight planning waypoint, and then on to the Gold Coast Airport (Figure 1 yellow flight path).

These aircraft are commonly on descent from approximately 13,000 feet to between 8,000 feet and 5,000 feet at ESTER (with the heights varying depending on the runway in operation at Gold Coast Airport).

Following the change, a small number of aircraft from locations including Asia, Cairns and Rockhampton will also operate on this flight path, resulting in a total of ten (10) jet aircraft arrivals on a busy day.

Departures:

Aircraft departing from Gold Coast Airport to the north for destinations such as Cairns and Asia, can currently plan within a corridor across the northern Gold Coast Council and Redlands City Council areas (Figure 2 blue shaded area).

Communities to the north of Gold Coast Airport can see or hear 4 to 5 jet aircraft on a busy day on climb and tracking to the north overhead Brisbane or Brisbane Airport.

Following the change, aircraft departing to the north will now fly over the ocean via the SCOTT flight planning waypoint (Figure 2 dark blue flight path). Communities in the north of Gold Coast City Council and Redland City Council that currently experience these aircraft operations will now see these aircraft tracking over the ocean instead.

How can I get more information?

For Queries regarding information about this change please contact Community Engagement:

- Via email to communityengagement@airservicesaustralia.com
- Via Mail to the Community Engagement Manager, Airservices Australia, Locked Bag 74, Eagle Farm QLD 4009

For matters relating to current aircraft operations, contact the Noise Complaints and Information Service (NCIS) on:

- http://www.airservicesaustralia.com/aircraftnoise/about-making-a-complaint/
- 1800 802 584 (free call)
- 131 450 (interpreter service)

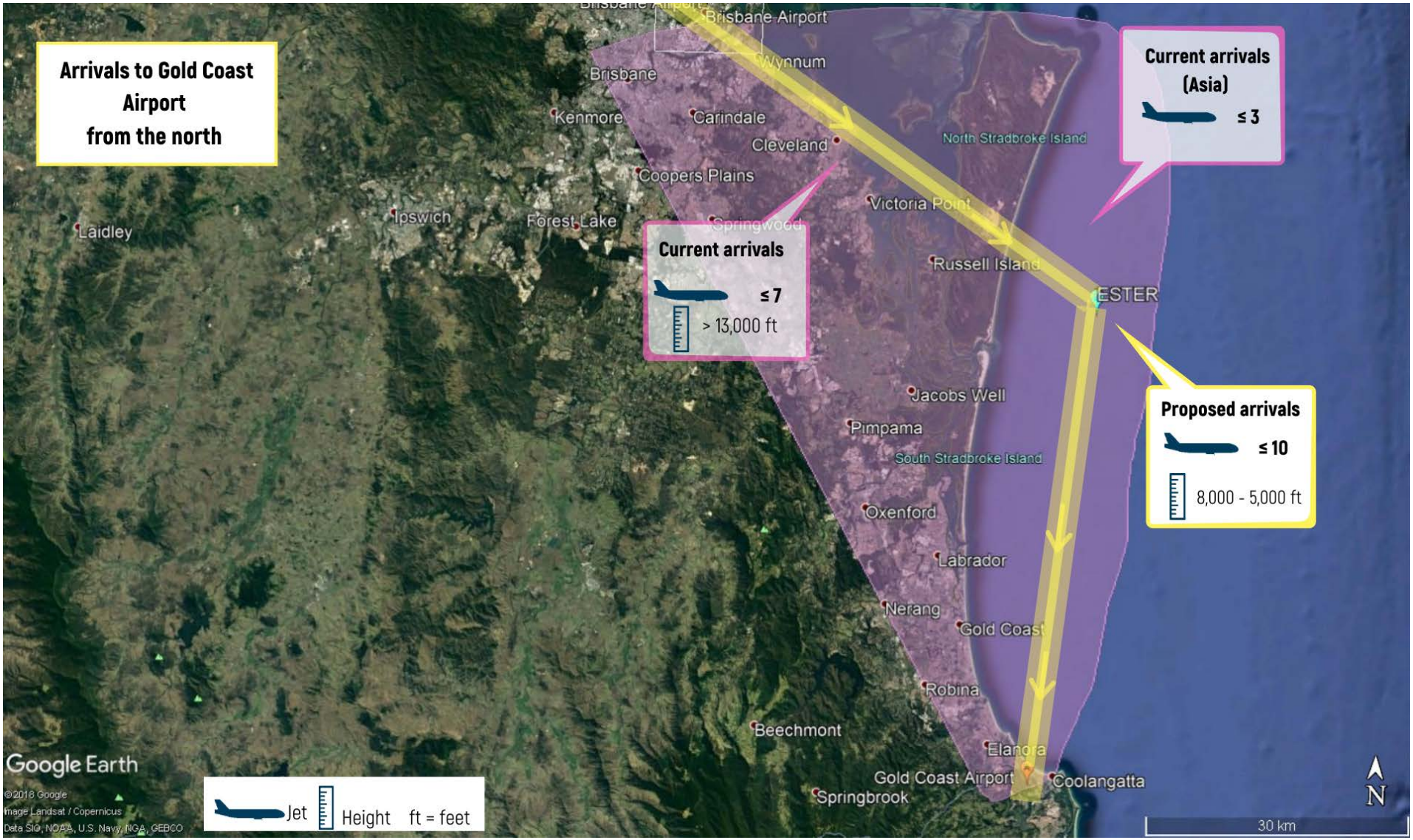


Figure 1: *Area of current arrivals from the north and northwest (within area of pink shading) and proposed route via ESTER waypoint (yellow). (Source: Airservices Operational Data Analysis Suite**)***

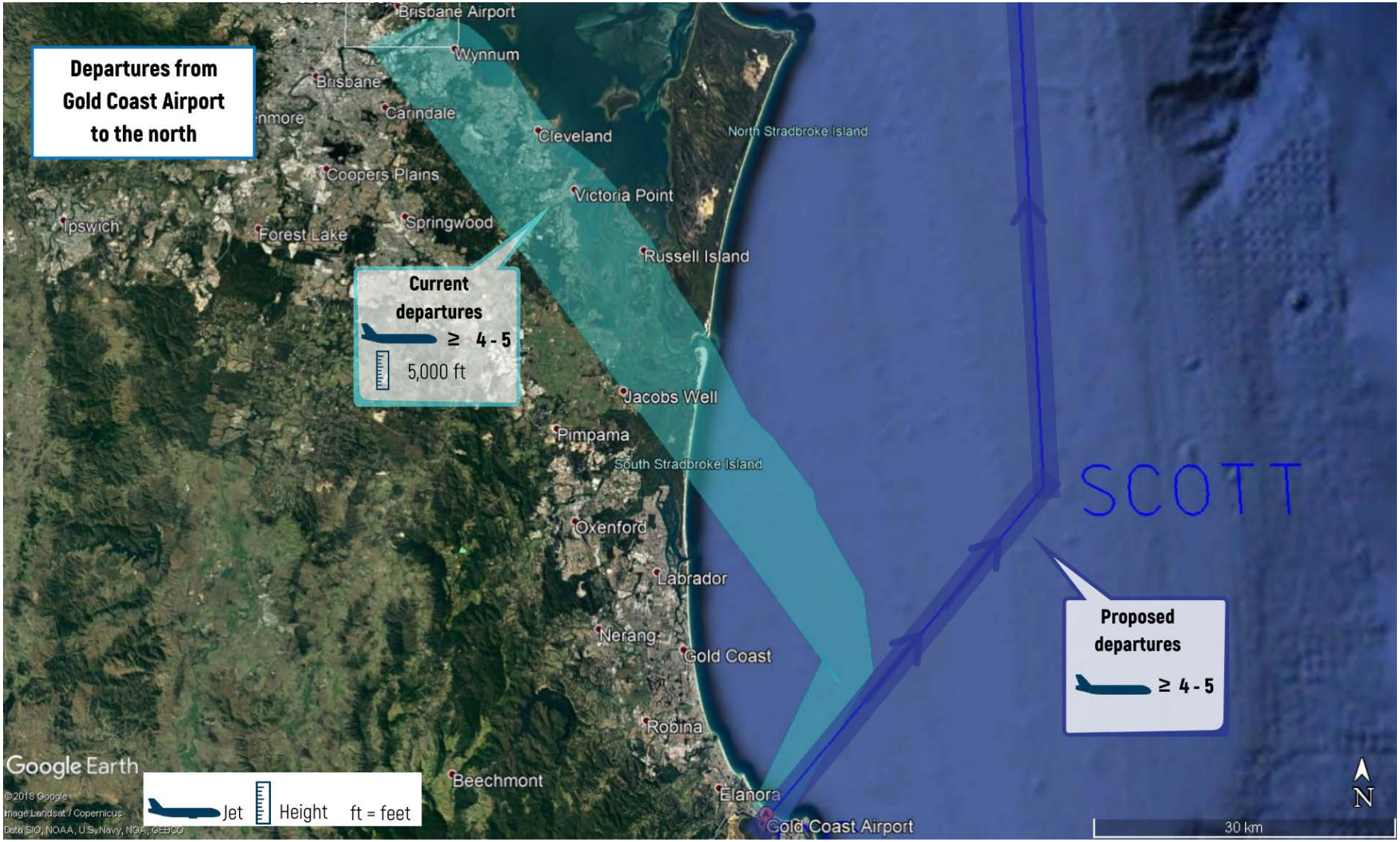


Figure 2: *Current corridor for departures to the north over Brisbane or Brisbane Airport (within area of blue shading) and proposed route concentration via SCOTT waypoint (dark blue route). (Source: Airservices Operational Data Analysis Suite)*

AIRCRAFT OPERATIONS DURING GOLD COAST AIRPORT CURFEW

1 June to 30 September 2019

SUMMARY

Dispensations Granted	Pre-curfew Taxi Clearance	Curfew Quota Movements	Emergency & Search/Rescue Movements	Permitted Jet Movements	Permitted Propeller Driven Aircraft	Diversions
7	2	10	10	9	22	0

Dispensation

- There were seven dispensations approved during the June to September 2019 period.
  - On 3 July 2019 Jetstar Airways flight JQ442 was granted a dispensation to land no later than 11:50pm. The aircraft landed at 11:45pm.
  - On 4 July 2019 a dispensation was granted to Qantaslink flight QF1574 to land no later than 11:55pm. The aircraft landed at 11:42pm.
  - On 12 July 2019 Jetstar Airways flight JQ446 was granted a dispensation to land no later than 11:30pm. The aircraft landed at 11:20pm.
  - On 21 July 2019 Jetstar Airways flight JQ446 was granted a dispensation to land no later than 11:20pm. The aircraft landed at 11:05pm.
  - On 26 July 2019 Jetstar Airways flight JQ446 was granted a dispensation to land no later than 11:15pm. The aircraft landed at 11:05pm.
  - On 26 July 2019 Virgin Australia flight VA761 was granted a dispensation to land no later than 11:40pm. The aircraft landed at 11:10pm.
  - On 6 September 2019 Qantas Airways flight QF868 was granted a dispensation to land no later than 11:15pm. The aircraft landed at 11:12pm.

Pre-curfew Taxi Clearance

- There were two pre-curfew taxi clearance movements.
  - Tigerair Australia flight TT579 departed at 11:02pm on 11 July 2019.
  - Tigerair Australia flight TT579 departed at 11:01pm on 18 July 2019.

Curfew Quota movements

- There were ten curfew quota movements conducted by airlines during the June to September 2019 period.
    - Jetstar Airways flight JQ446 arrived at 11:11pm on 1 July 2019.
    - Virgin Australia flight VA545 arrived at 11:09pm on 7 July 2019.
    - Virgin Australia flight VA1696 departed at 11:20pm on 7 July 2019.
    - Tigerair Australi flight TT579 departed at 11:27pm on 7 July 2019.
    - Virgin Australia flight VA1696 departed at 11:12pm on 14 July 2019.
    - Qantas Airways flight QF868 arrived at 11:19pm on 26 July 2019.
    - Virgin Australia flight VA1695 arrived at 11:23pm on 9 August 2019.
    - Qantas Airways flight QF868 arrived at 11:24pm on 9 August 2019.
    - Jetstar Airways flight JQ982 departed at 11:41pm on 21 August 2019.
    - Virgin Australia flight VA1695 arrived at 11:20pm on 23 August 2019.

Diversions

- There were no diversions to Gold Coast Airport.

Emergencies/ Search and Rescue

- There were ten aeromedical flights, using such aircraft as Cessna 525's, Learjet 45's, Beechcraft Super King Air's, a PC12 and an AgustaWestland AW139 helicopter.

Other approved aircraft movements:

- There were 22 approved propeller driven aircraft movements. These aircraft included: 6 x Cessna Caravan's; 3 x Cessna 172's; 3 x Cessna 441's; 3 x Cessna Comanche's; 2 x Saab 340's; 2 x Beechcraft Baron's; 1 x Cessna 402; 1 x Cessna 210; and 1 Beechcraft Bonanza.

- There were nine business jet movements. These were from 3 x Cessna 510's; 1 x Cessna 525; 1 x Embraer EMB-505; 1 x Falcon 900; 1 x Cessna 650; 1 x Falcon 50 and 1 x Global Express.