ATM Network Performance Report

February 2018

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Summary

Overview

The combined 75th Percentile performance for Airborne Delay across the four major airports (Sydney, Melbourne, Brisbane & Perth) was **3.7** minutes, and the median was **0.7** minutes.

These monthly performance figures were:

- a modest improvement on the same time last year (a decrease of 0.2 minutes)
- an increase from the previous month of 0.9 minutes delay for the 75th percentile; and
- slightly above the KPI targets of 3.5 minutes and 0.6 minutes for the 75th percentile and median respectively.

Airborne Delay during February was impacted by 21 notable events. The primary trigger for these notable events was adverse weather.

These events and the extent of the Airborne Delay are depicted in **Figure 1**.

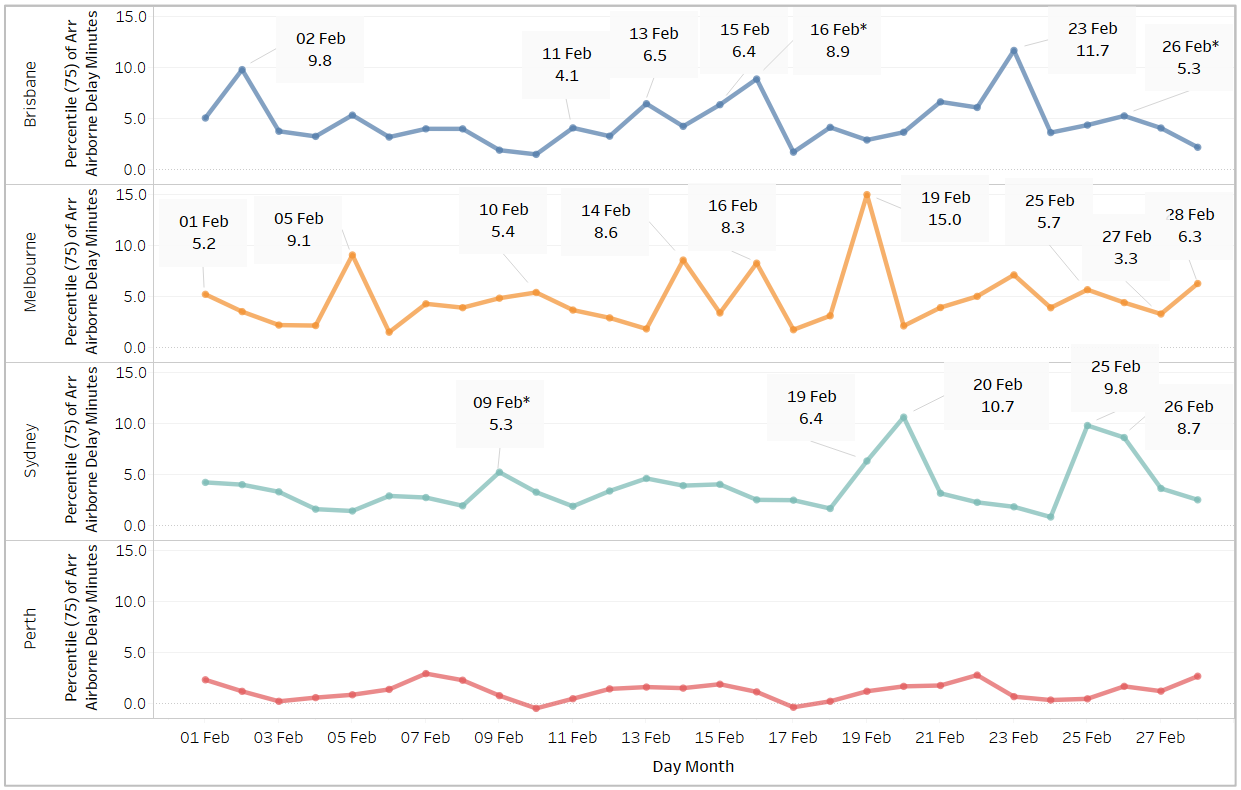

Figure 1: Notable delay impact events during February 2018.

Asterisk symbols in the labels (*) indicate that a Post Operational Performance Review (POPR) is available for that event. The reviews are included in Appendix A.

Nine of these notable events resulted in a prolonged and moderately elevated Airborne Delay for the entire day (i.e. 75th Percentile greater than 7 minutes across the entire day).

The remaining 12 events resulted in a shorter and more intense period of elevated Airborne Delay (i.e. 2 or more consecutive hours where the 75th Percentile was over 10 minutes). These are summarised in **Table 1** below.

Location	Day	Local Time	Delay Event Descriptions (Contributing causes)
Sydney	9-Feb*	17-20	Thunderstorms – no movements for 15 minutes during busy period. Level 2 and 3 Revisions of Ground Delay Program required
	19-Feb	18-19	Low cloud reduced arrival rates leading to an increase in delay
	20-Feb	09-11 & 14-15	Exempt, early and late non-compliant aircraft shifting demand
	25-Feb	14-15 & 18-19	Strong southerly and thunderstorms reduced rates
	26-Feb	07-09	The extent of wind and rain was longer and more severe than forecast
Melbourne	1-Feb	18-19	Several late non-compliant aircraft during busy periods
	5-Feb	08-11	Low cloud persisted for longer than forecast
	10-Feb	15-19	High winds in circuit area
	14-Feb	07-10	Go around, low rates and large arrival time variations on exempt flights
	16-Feb	18-20	Late non-compliant and exempt flights with large arrival time variations
	19-Feb	07-12	Late non-compliant and exempt flights with large arrival time variations
	25-Feb	15-16	High winds and a recently departed flight with technical issue returned to land.
	27-Feb	07-09	LAHSO(Land & Hold Short Operations) planned, only single runway used due winds
	28-Feb	08-10	High winds and a recently departed flight with technical issue returned to land.
Brisbane	2-Feb	16-19	Exempt and late non-compliant flights leading into busy period
	11-Feb	20	Thunderstorms – no movements for one hour
	13-Feb	20-22	Thunderstorms resulted in 2 immediate runway changes
	15-Feb	19-20	Thunderstorms impacted earlier that forecast.
	16-Feb*	17-20	Thunderstorms, non-compliant flights, and off schedule internationals
	23-Feb	14-19	Low visibility and corresponding low arrival rates, multiple MEDEVACs and 2 go-arounds in the sequence.
	26-Feb*	19-20	Thunderstorms – prevented approaches for one hour.

Table 1: Notable event descriptions.

Asterisk symbols in the labels (*) indicate that a Post Operational Performance Review (POPR) is available for that event. The reviews are included in Appendix A.

Some events highlighted the critical importance of adequate and effective communication between all parties in order to ensure quality outcomes. In particular, the review of the event in Sydney on 09 February found that better communication and teamwork between all network players would have led to better network performance and may have alleviated the need for three flight cancellations.

Network Wide Performance

Airborne Delay

The combined median and 75th percentile Airborne Delay at the four major airports is indicated below. **Figure 2** indicates that the long-term trend is upwards.

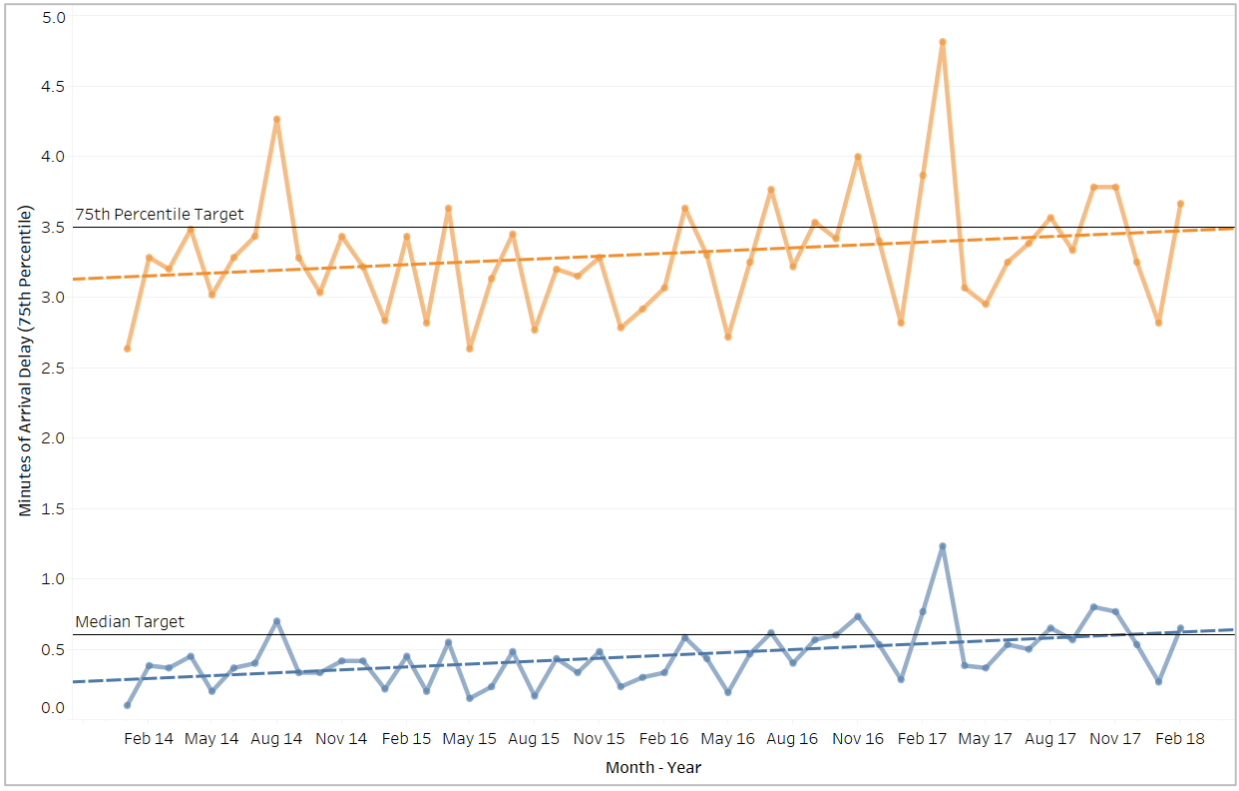

Figure 2: Long-term combined Airborne Delay median and 75th percentile (July 2014 to February 2018), and corresponding targets.

The long-term trends for each of the four major airports are depicted in **Figure 3**. The trends for Sydney and Melbourne are upwards. More detailed analysis for each airport is presented later in this report.

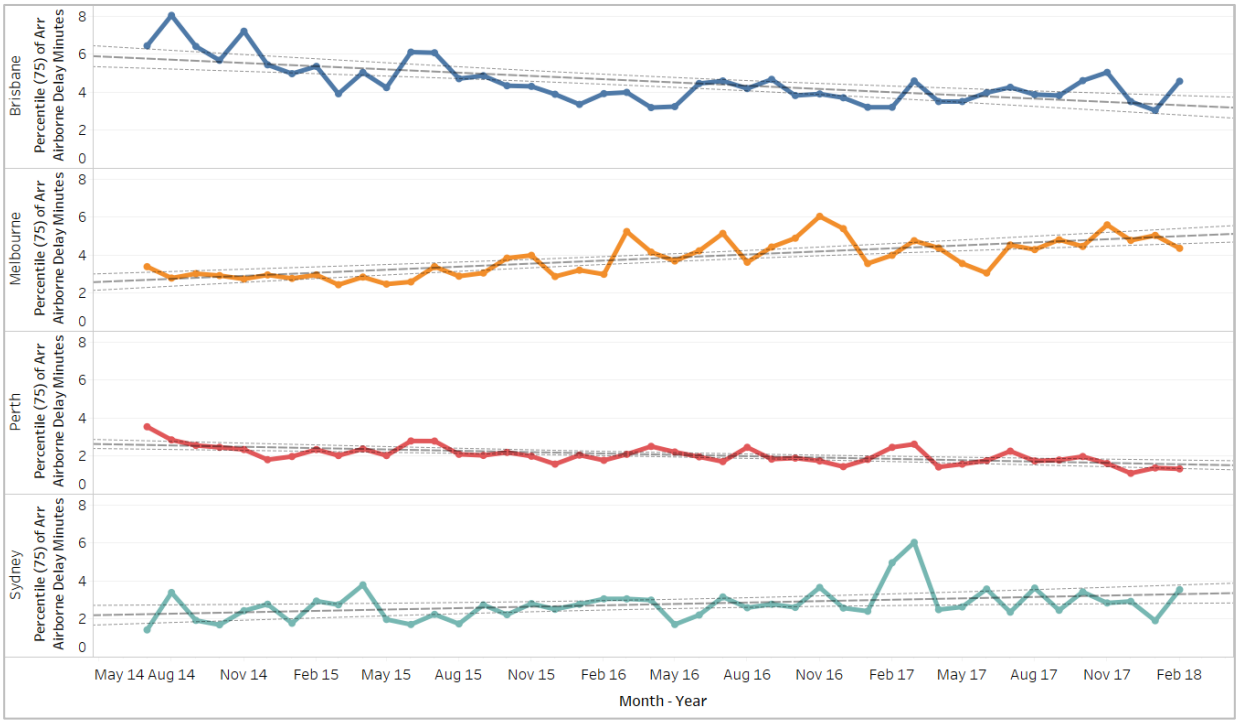

Figure 3: Long-term Airborne Delay 75th percentile by airport
(July 2014 to February 2018)

Sydney

Airborne delay

The 75th percentile performance figures for airborne delay at Sydney are indicated in **Figure 4**.

Airborne Delay during February (3.6 minutes) marginally missed the target (3.5 minutes). However, delay was lower than from the same period last year (5.0 minutes). The long-term trend for airborne delay at Sydney is upwards.

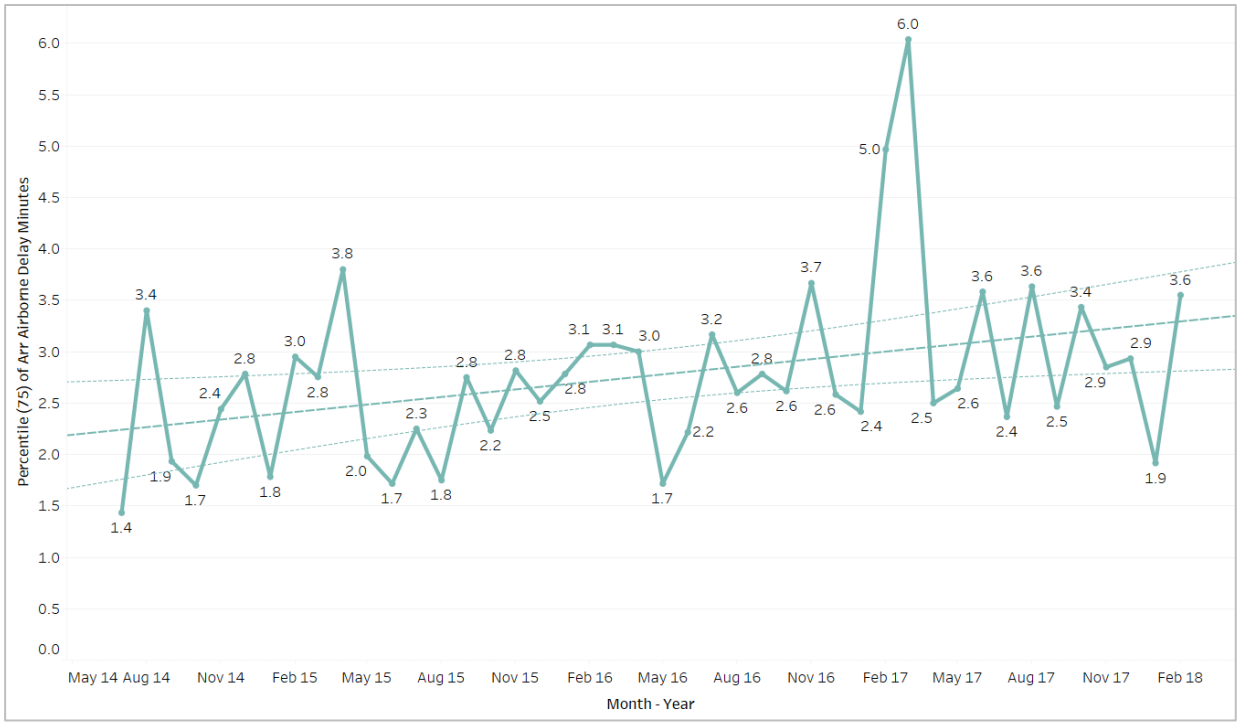

Figure 4: Sydney Airborne Delay 75th Percentile

Notable events

The following commentary describes the notable airborne delay events during February in Sydney:

- 09 February (1700-2000 Local)
  - Thunderstorms with no movements for 15 minutes during the period.
  - Level 2 GDP (Ground Delay Program) Revision conducted to mitigate the impact of more-severe-than-forecasted thunderstorms.
  - A Level 3 GDP Revision conducted later as a control to prevent yet-to-depart aircraft from potentially arriving after curfew.
  - A number of detailed conclusions and recommendations can be found in the full Post Operational Performance Review in Appendix A. In particular, better communication and teamwork between all network players would have led to better network performance and may have alleviated the need for three flight cancellations.

- 19 February (1800-1900 Local)
  - Arrival delays experienced in the evening peak required a traffic holding NOTAM (Notice to Airmen) for 35 minutes.
  - Tactical arrival acceptance rate was below the pre-tactical rate due to the on-set of cloud somewhat lower and earlier than anticipated during the METCDM (Metrological Collaborative Decision Making) process.
  - This was further compounded by late arrivals from the 05Z hour onwards.

- 20 February (0900-1100 & 1400-1500 Local)
  - Prolonged arrival delays were experienced during the morning peak in a program where demand was consistently above capacity.
  - Pre-tactical arrival rates of 38 per hour were consistently achieved apart for the last hour of the peak.
  - Airborne Delay was impacted by exempt, early and late non-compliant aircraft.

- 25 February (1400-1500 & 1800-1900 Local)
  - Strong southerly and thunderstorms reduced rates.
  - Level 2 GDP Revision was conducted with a reduced airport arrival rate of 30 down from the planned rate of 32.
  - Demand exceeded capacity and there was reduced airspace capacity in the northern ATC sectors due to the extent of the convective weather.

- 26 February (0700-0900 Local)
  - The extent of wind and rain was longer and more severe than forecast.
  - GDP Revisions conducted to manage demand/capacity imbalances.

Melbourne

Airborne delay

The 75th Percentile performance figures for airborne delay at Melbourne are indicated in **Figure 5.**

February performance (4.4 minutes) did not meet target (3.5 minutes) and performance was worse than the same period last year (4.0 minutes). The long-term trend for airborne delay at Melbourne is upwards.

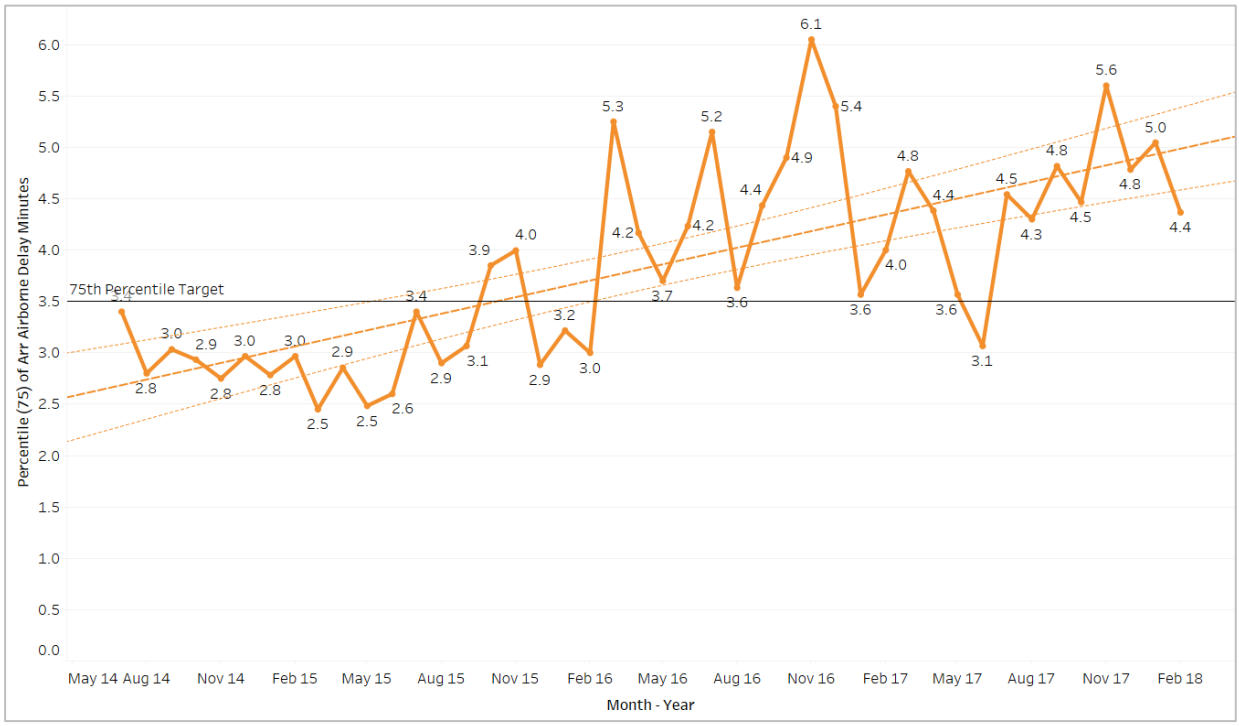

Figure 5: Melbourne Airborne Delay 75th Percentile

Notable events

The following commentary describes the most significant Airborne Delay events (9) during February in Melbourne:

- 01 February (1800-1900 Local)
  - Several late non-compliant aircraft caused high demand at already saturated capacity periods and lead to elevated Airborne Delay.

- 05 February (0800-1100 Local)
  - Low cloud persisted for longer than forecast.
  - Airborne Delay between 15-20 minutes with a maximum delay of 26 minutes.
  - Demand was evenly matched with capacity for the morning peak with higher than planned capacity delivered as cloud lifted somewhat quicker than planned.
  - Compliance was good and Airborne Delay was predominantly incurred by international aircraft.

- 10 February (1500-1900 Local)
  - Low rates were planned due to winds aloft, turbulence and wind shear conditions.
  - Instrument STARs in use to facilitate the stable arrivals and minimise the likelihood of missed approaches. This reduced tactical flexibility and impacted on Airborne Delay.
- 14 February (0700-1000 Local)
  - Go-around, low planned and tactical arrival rates and large arrival time variations on exempt flights caused increased airborne delay.
- 16 February (1800-2000 Local)
  - Thunderstorms, non-compliant flights, and off-schedule internationals caused increased airborne delay.
- 19 February (0700-1200 Local)
  - Several international arrivals were off-schedule and two itinerant operators early in the morning peak.
  - With a full arrival program there was limited flexibility and an increase in Airborne Delay ensued.
  - An industry teleconference was conducted to discuss a GDP Revision. Airlines preference was for ongoing holding rather than a GDP Revision. The airspace capacity of the ATC sectors was considered and no GDP Revision occurred.
- 25 February (1500-1600 Local)
  - High winds and a recently departed flight that returned with a technical issue resulted in increased Airborne Delay.
- 27 February (0700-0900 Local)
  - Airborne Delays of approximately 20 minutes when the ability to accommodate the high capacity mode of LAHSO was lost due to higher than forecast wind speed.
- 28 February (0800-1000 Local)
  - High winds and a returned flight with technical issue caused increased airborne delay.

Brisbane

Airborne delay

The 75th Percentile performance figures for airborne delay at Brisbane are indicated in **Figure 6**.

January performance (4.6 minutes) did not meet the target (3.5 minutes) and airborne delays were also higher than same period last year (3.2 minutes). The long-term trend for airborne delay at Brisbane is downwards.

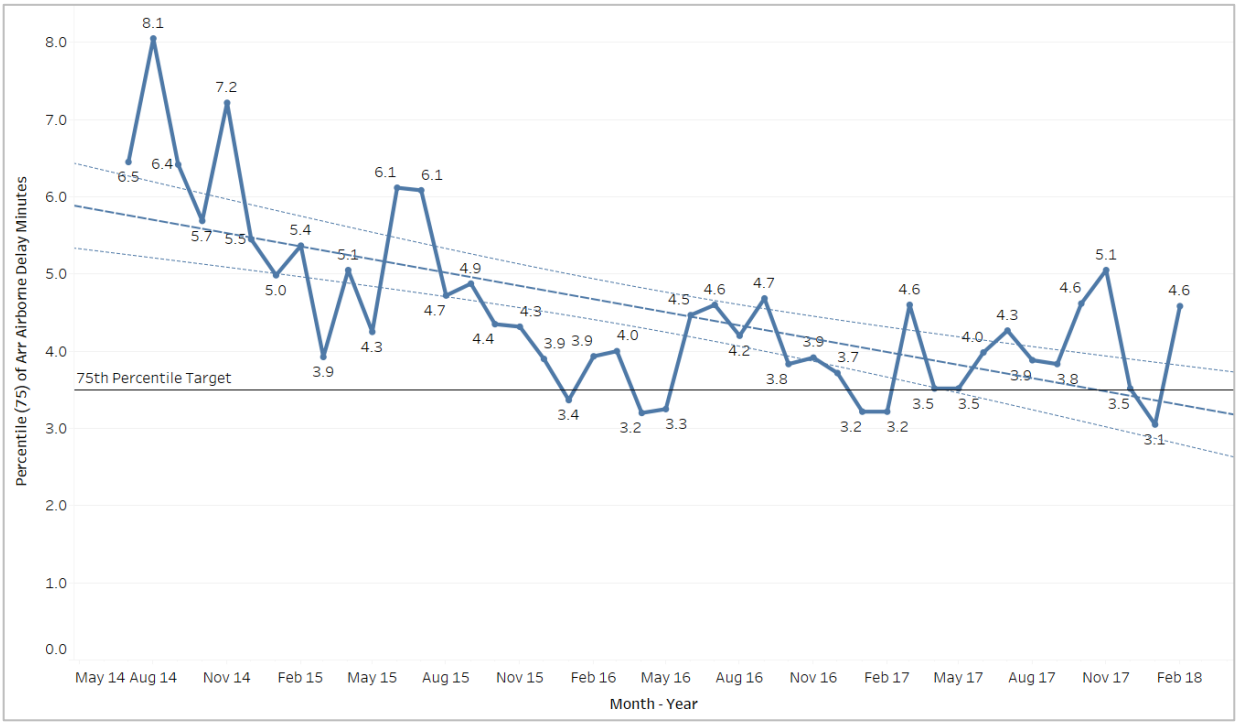

Figure 6: Brisbane airborne delay 75th Percentile

Notable Events

The following commentary describes the most significant airborne delay events during February in Brisbane:

- 02 February (1600-1900 Local)
  - Exempt and late non-compliant flights leading into busy period caused a period of elevated Airborne Delay.

- 11 February (2000 Local)
  - Low arrival rates were planned due to the risk of thunderstorms in the evening. Thunderstorms approached the airport 30 minutes earlier than planned, with personnel off-ramp and no movements for one hour.
  - Multiple diversions to alternate airports ensued. The maximum Airborne Delay reached 75 minutes.
  - The arrivals rates achieved subsequently were higher than planned but did not offset the demand that had built up and a Level 2 GDP Revision was conducted.

  - Subsequently, it was determined that a Level 3 GDP Revision was required with too many aircraft in flight (holding patterns) and due to airspace capacity in the surrounding ATC sectors, all flights destined for Brisbane were held on the ground.

- 13 February (2000-2200 Local)
  - Thunderstorms resulted in 2 immediate runway changes leading to increased arrival and departure delay.

- 15 February (1900-2000 Local)
  - Thunderstorms developed west of the airport in the afternoon and there was some risk of disruptions. However, the thunderstorms moved fast and dissipated before reaching the airport
  - Due to aircraft off-track deviations for weather avoidance, there was an increase in Airborne Delay.

- 16 February (1700-2000 Local)
  - Thunderstorm activity in the terminal area, subsequently moving overhead the airport combined with some non-compliant flights and off-schedule international arrivals.
  - The outcome was close to optimal as all network management levers were exercised as designed. Most flights were complaint and the storm was planned for with appropriate arrival rates. Further details and the full review can be found in Appendix A.

- 23 February (1400-1900 Local)
  - Showers were planned for, resulting in reduced capacity and comparatively higher demand in the evening peak and elevated Airborne Delay.
  - Level 2 GDP Revision conducted to re-set arrival rates and a subsequent revision was conducted due to an ATC staffing constraint in the surrounding ATC sector reduced airspace capacity and the ability to manage prolonged elevated Airborne Delay.

- 26 February (1900-2000 Local)
  - Thunderstorms and a southerly change forecast with corresponding low arrival rates.
  - The impact of the thunderstorms was higher than planned, particularly in the vicinity of the approach path, resulting in only 4 landings during a one-hour period.
  - A detailed review of this event is available in Appendix A.

Perth

Airborne delay

The 75th Percentile performance figures for airborne delay at Perth are indicated in **Figure 7**.

January performance (1.3 minutes) met the target (3.5 minutes) and airborne delay was also lower than same period last year (2.5 minutes). The long-term trend for airborne delay at Perth is downwards.

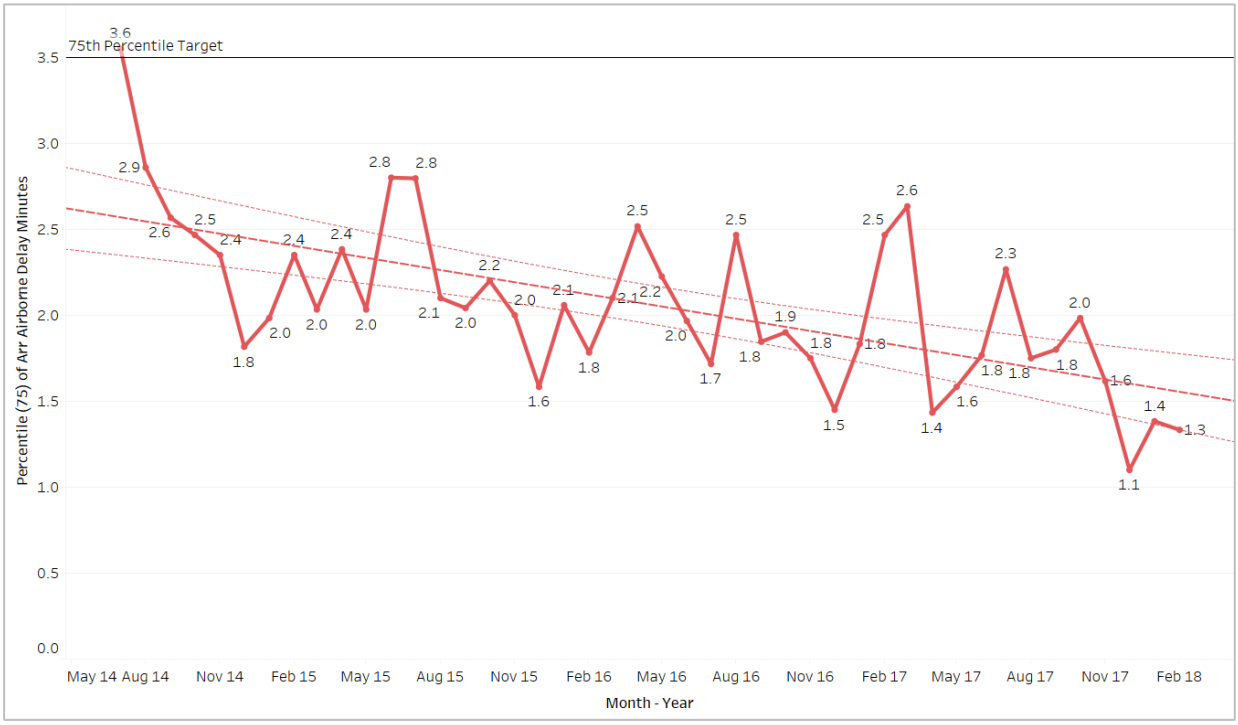

Figure 7: Perth Airborne Delay 75th Percentile

Notable Events

There were no notable events for Perth, however a review was initiated for the 07 February (see Appendix A) and found that during the late morning, arrivals at Perth showed a marked increase in Airborne Delay despite the number of arrivals being relatively low.

The review found the cause of this delay was due to an imbalance in the hourly demand that presented, with a group of 10 flights planning to arrive at the airport within a very short time window (about 10 minutes). In addition to causing delays to these ten flights, it also triggered a cascade that increased the average delay of all following flights and was not fully resolved until more than 90 minutes later.

Appendix A

Post Operational Performance Review

Sydney Airport – 09 February 2018

Purpose

A review was initiated for operations at Sydney Airport on the 09 February 2018 in relation to two specific events:

- Level 2 GDP Revision at 0620z to mitigate the impact of more-severe-than-forecasted thunderstorms.
- Level 3 GDP Revision at 1017z as a control to prevent not-yet departed aircraft from potentially attempting to arrive after curfew.

Event Description

Figure 8 shows arrivals (grey), tactical rates (red) and pre-tactical MET-CDM/ATFM rates (green) by hour for 09 February at Sydney.

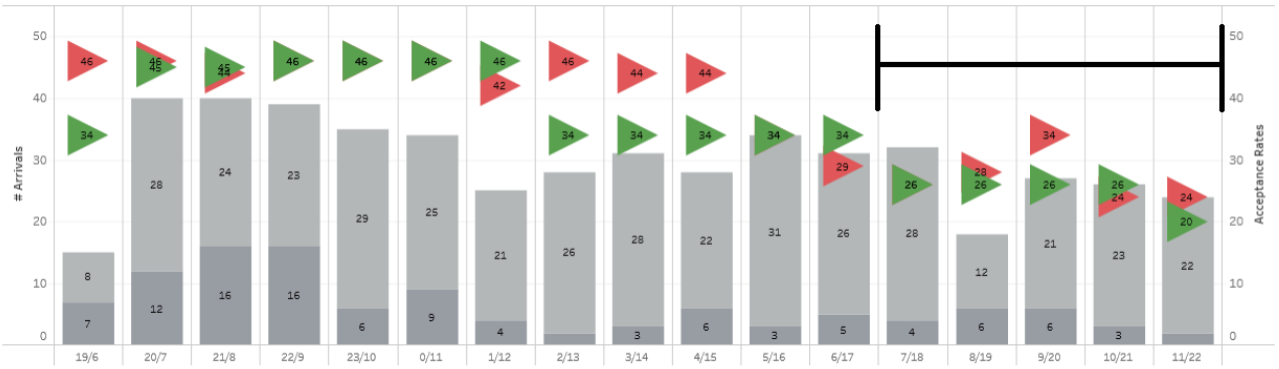

Figure 8 – Arrivals by hour, tactical and pre-tactical rates for 09 Febraury 2018 by hour (UTC/local) @ SY. Domestic arrivals in light grey, internationals in dark grey. Pre-tactical rates shown in green, tactical rates shown in red. The black bar indicates the hour blocks with elevated arrival delay. (source: EDW & NOR)

A MET-CDM update performed around 0100z (Run 3) identified that thunderstorms were forming on the ranges to the west and possibly impacting the edge of the TMA from around 0500z, but the chance of these moving into within 20nm of the airport was deemed low due to more stable conditions along the coast. ATFM rates beyond 0500z were therefore set to 34 (Business Rules rates for TS>20nm).

Beyond 0800z, there was a chance of low cloud and given the broader risk of thunderstorms in the TMA area, the MET-CDM/ATFM rate of 34 was maintained, with the typical transition rate of 12 for the last half hour pre-curfew.

Met advice received during the afternoon highlighted the potential for sudden and unexpected wind changes and the possibility of required runway changes. Subsequently, the Level 2 Revision at 0620z reduced the MET-CDM/ATFM rate to 26 from 0700 onwards (and the pre-curfew transition rate of 12 for the last half hour).

During the evening, arrivals were suspended for a 15 minute period (0825-0840z), however there were no missed approaches or runway changes as the storm moved through. Figure 9 show the 75th percentile airborne arrival delay from 05z to 11z. Airborne arrival delays were most severe in the 0700z hour, with 75% of arrivals experiencing up to 10 minutes airborne arrival delay between 0600z and 1100z.

A Level 3 GDP Revision was initiated by the SYTM at 1017z following an assessment of actual weather conditions, traffic disposition, current MAESTRO rate, actual airborne delay, and traffic projection in Harmony, as a control to prevent not-yet departed aircraft from attempting to arrive after curfew.

In total 34 flights were cancelled through the event. The majority of these cancellations were related to the Level 2 Revision as a result of more-severe-than-forecast thunderstorm activity within 20nm.

As a result of the later Level 3 Revision, Tiger Airways cancelled a Brisbane to Sydney service at the gate with doors closed and 100% load factor. All customers were stranded. As result of aircraft being out of base, a Sydney to Brisbane service the following morning was cancelled with 30% of customers recovered over 36 hours and no recovery option for the remaining customers.

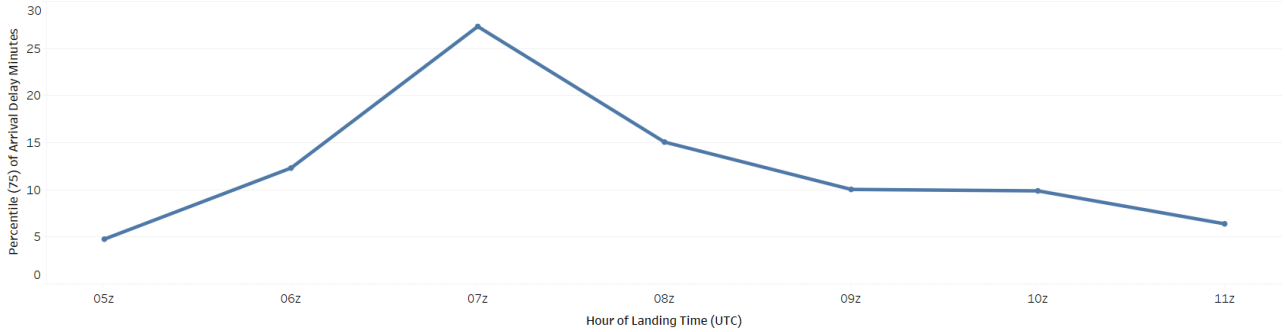

Figure 9 – Shows the 75th percentile of arrival delay by hour from 05z to 11z at Sydney (source: ODAS)

Analysis

0400z-0620z

Thunderstorms were building over the ranges south west of Sydney as forecasted, and were slowly expanding in north-easterly direction. A tactical MAESTRO rate of 44 was maintained until approximately 0500z, from which a rate of 34 was the achievable arrival rate due thunderstorms within the TMA. Thunderstorms entered Sydney TMA sometime after 0500z and expanded to the west of the airport by 0600z (see Figure 10).

SAMU and NCCMET did not have a shared situational awareness of the thunderstorm activity and associated impact assessment for the remainder of the day. Leading up to the event, NCCMET and SAMU were not sharing information and had different opinions of the impact of the event and prognosis for the rest of the evening. Due to thunderstorms entering TMA, actual MAESTRO rates achieved in the 0500z hour was 29, 5 down from the 34 MET-CDM rate; NCC was unaware at the time.

At 0605z, the duty Traffic Manager requested MET-CDM as SAMU had advised thunderstorms are likely going to get within 20nm. MET-CDM subsequently advised to maintain rates at 34 for the remainder of the program. The Traffic Manager revised the rate down to 26, which was the rate being achieved in MAESTRO, and the rate that was expected to be achievable for the remainder of the night taking into consideration SAMU advice of potential for sudden and unexpected wind changes and the possibility of required runway changes. The revised rate of 26 was applied for the remainder of the program. Traffic Manager requested a Level 2 Revision to affect the revised rates.

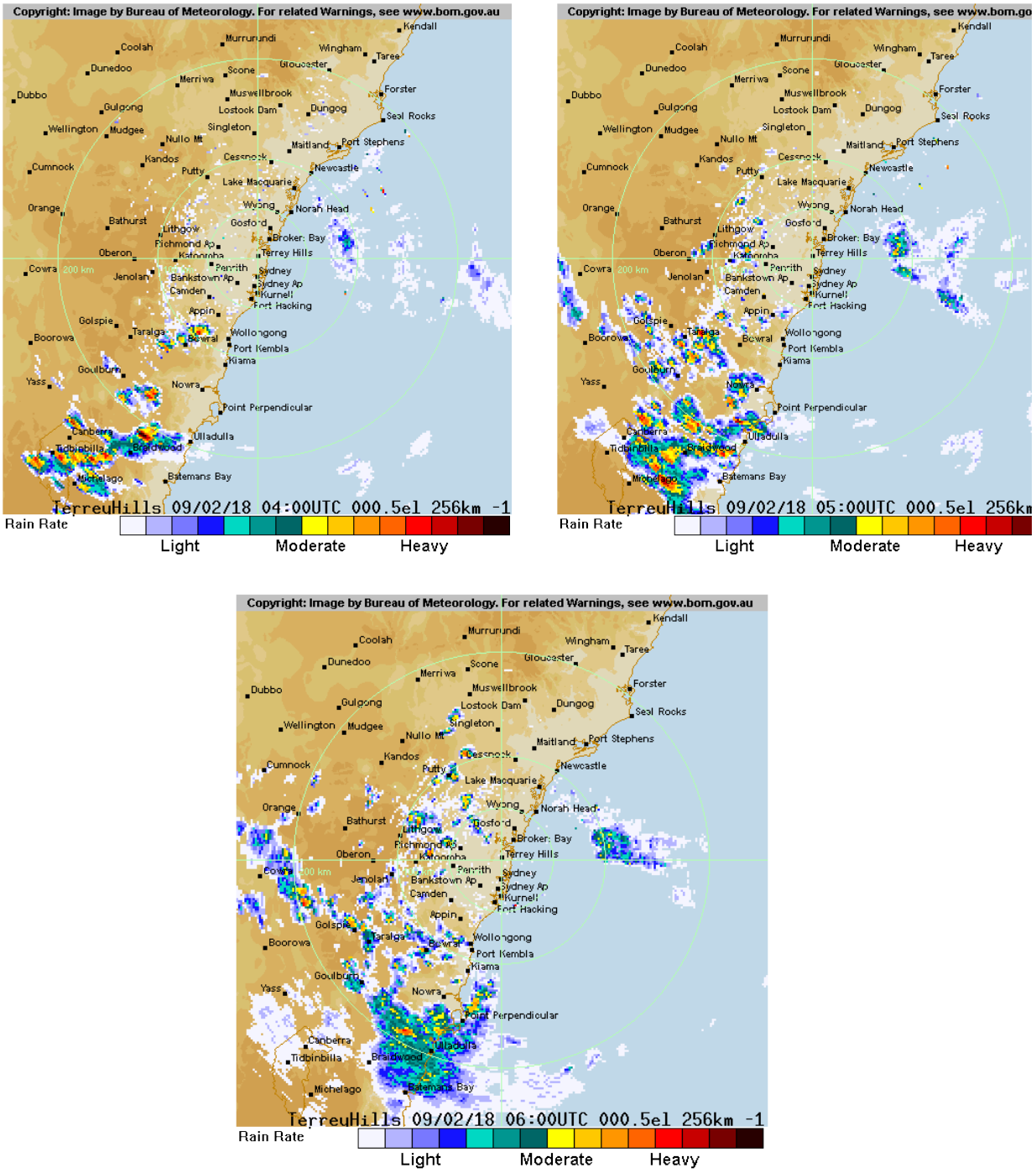

Figure 10 – Bureau of Meteorlogy rain radar images for Terry Hills for 0400z, 0500z and 0600z (historical images for Sydney airport were not available).

Figure 11 and Figure 12 show the demand in Harmony just before and just after the Level 2 Revision. There is some over-subscription with respect to the original ATFM rate of 34, which could be partly the result of demand shifting late (see Appendix A), as well as a MAESTRO rate of 29 in the 0500z hour.

Prior to the Level 2 Revision, there were no communications from the NCC to external stakeholders (e.g. airlines) about increased risk of thunderstorms impacting operations at Sydney.

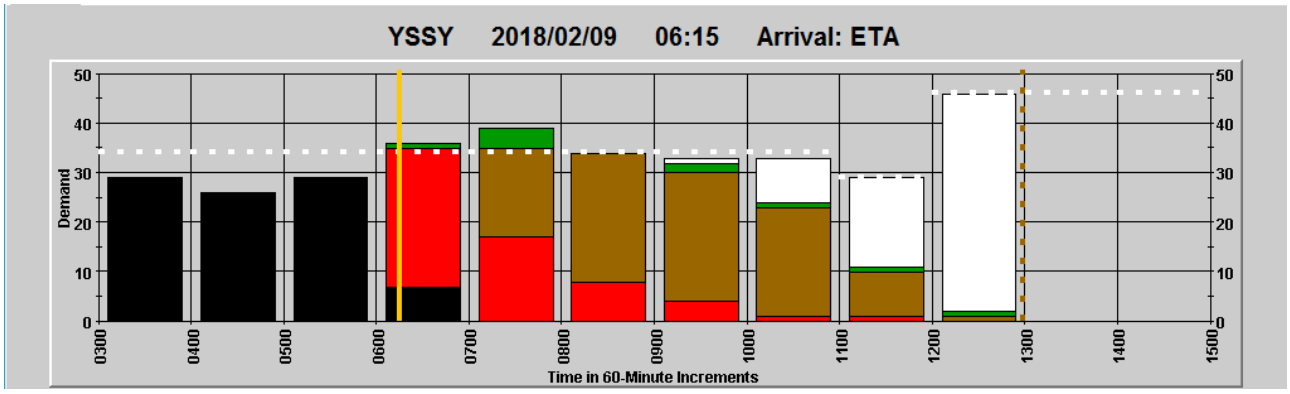

Figure 11 – Demand in Harmony at 0615z, just prior to the level 2 revision.

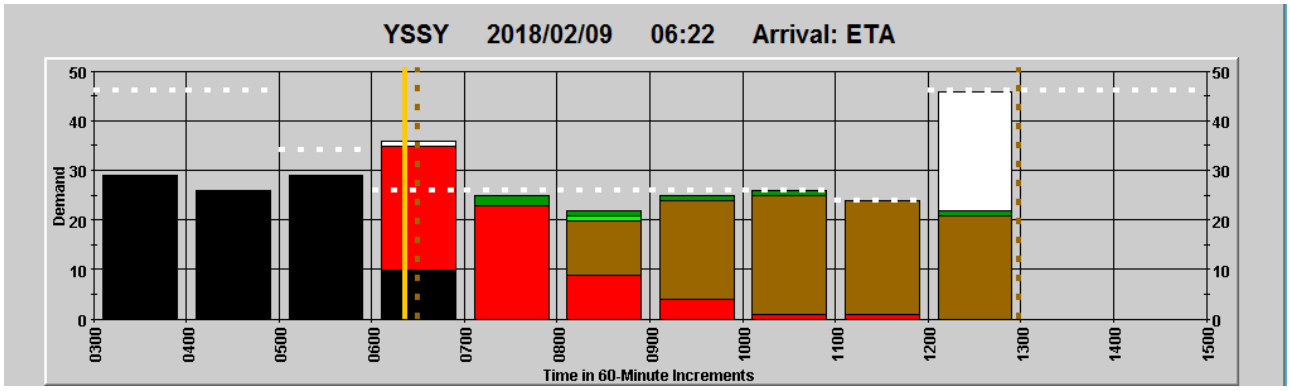

Figure 12 – Demand in Harmony at 0622z, just after to the level 2 revision.

0620z-0900z

Despite actual landing rates being achieved at a higher rate than anticipated in the GDP (30 and 31 landings in the 0600z and 0700z hours respectively against a GDP rate of 26, see Figure 13), actual airborne holding increased to a maximum of 44 minutes in the 0700z hour (RXA674, see Figure 14). Advice of large airborne delays were communicated by Whispir at 0638z.

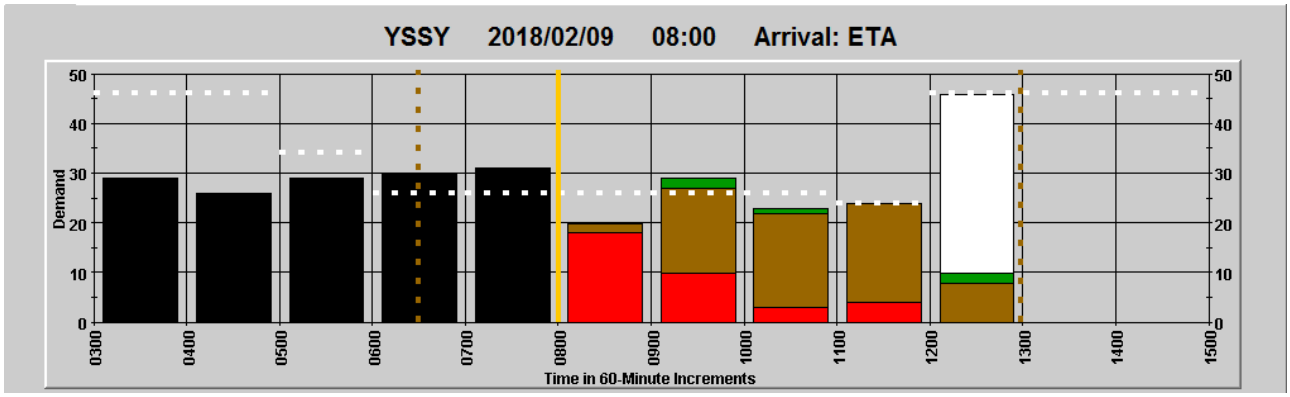

Figure 13 – Demand in Harmony at 0800z.

The increasing airborne delay, while achieving higher rates than planned, is mostly the result of demand coming predominantly from the southwest and being nominated Runway 16R as can be seen in Figure 14. The Traffic Manager reported only a single inbound stream being achievable from the southwest due to thunderstorms in the TMA, with no opportunity for aircraft to overfly the field for a left-hand circuit onto Runway 16L.

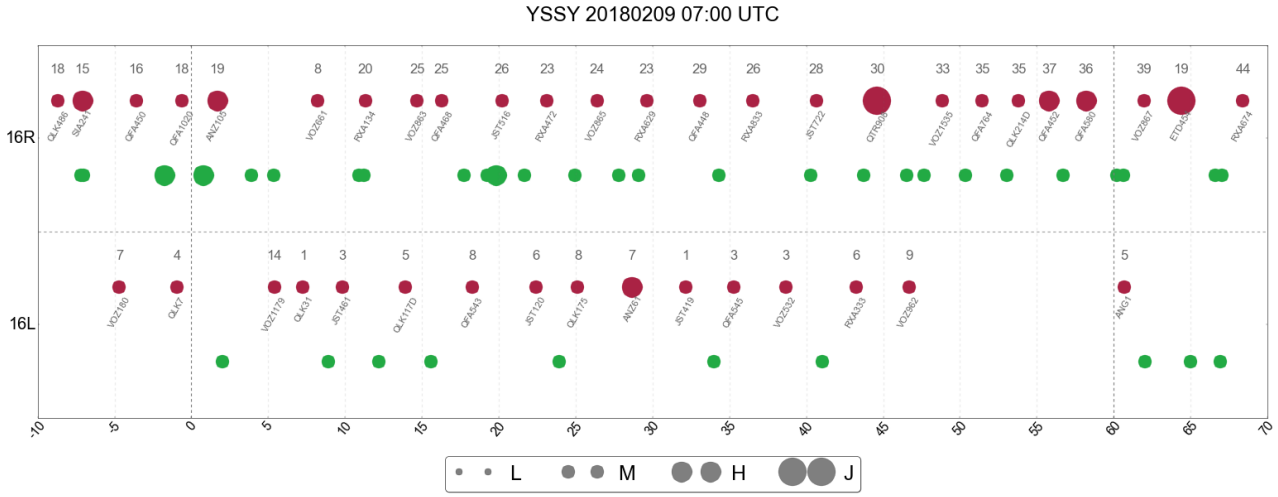

Figure 14- Arrivals (red) and departures (green) during the 0700 UTC hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated above the arrival dots are the arrival delay (in minutes), and below the arrival dots are the callsigns of the aircraft. (source: ODAS)

From Figure 15 it can be seen that by 0730z, thunderstorms were enclosing the airport from the west and south, making an approach from the southwest (e.g. RIVET) to Runway 16L via a left-hand circuit very difficult. Prior to this time, approaches from RIVET to Runway 16L may have been possible, but delays for Runway 16R were still relatively low and there was sufficient demand for Runway 16L from other points of the compass prior to 0730z (see Figure 14). After 0730z, there was less demand from the north, and therefore less airborne delay for arrivals onto Runway 16L and some unutilised slots at the end of the 0700z hour.

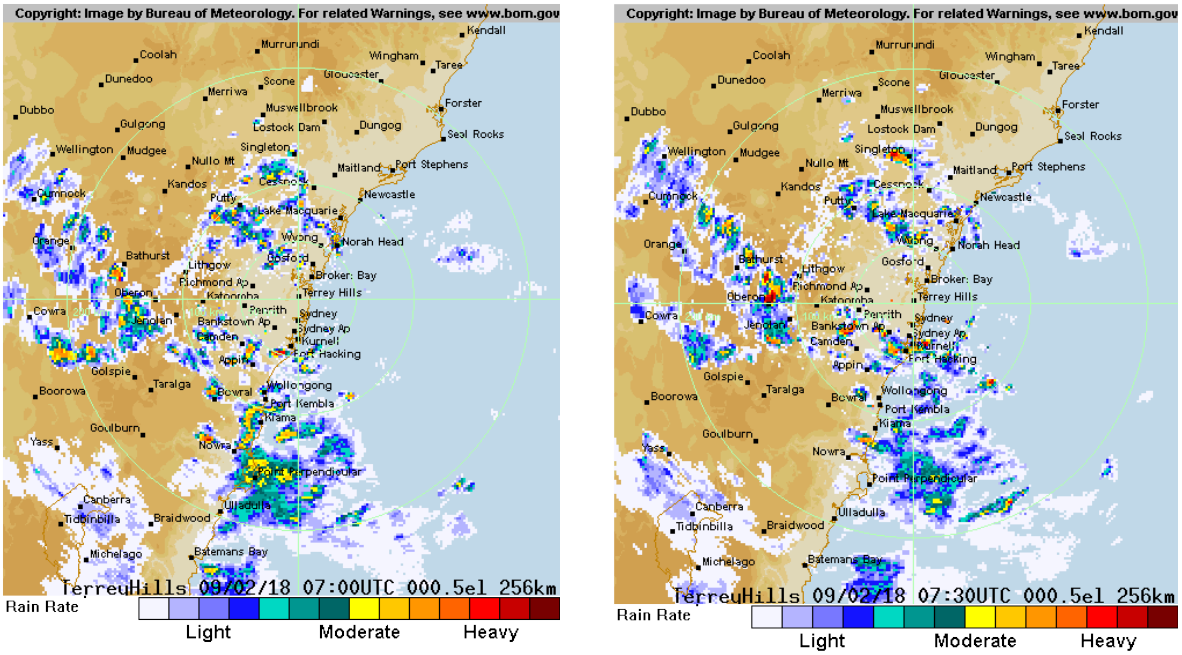

Figure 15 – Bureau of Meteorlogy rain radar images for Terry Hills for 0700z and 0730z (historical images for Sydney airport were not available).

By 0810z, individual airborne delay figures on both runways had dropped indicate that there was low pressure within the network system (Figure 16). By this time, thunderstorms had fully enclosed the field from the south (Figure 17).

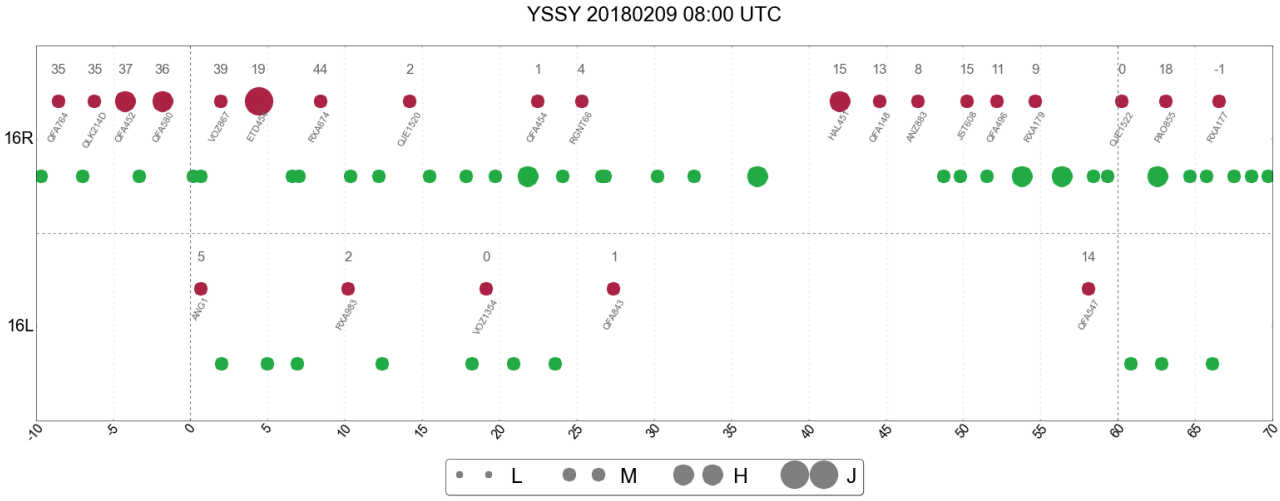

Figure 16- Arrivals (red) and departures (green) during the 0800 UTC hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated above the arrival dots are the arrival delay (in minutes), and below the arrival dots are the callsigns of the aircraft. (source: ODAS)

Thunderstorms continued moving north, and from 0825z there was a 15 minute period when there were no attempted approaches or aircraft that landed. Figure 17 shows the radar images for 0800z, 0830z and 0900z.

Once approaches to final recommenced, HAL151 was the first to land with approximately 15 minutes airborne delay (Figure 16). This airborne delay approximately equals the period at which approaches were suspended, and may provide an indication of little pressure around the time the thunderstorms impacted operations.

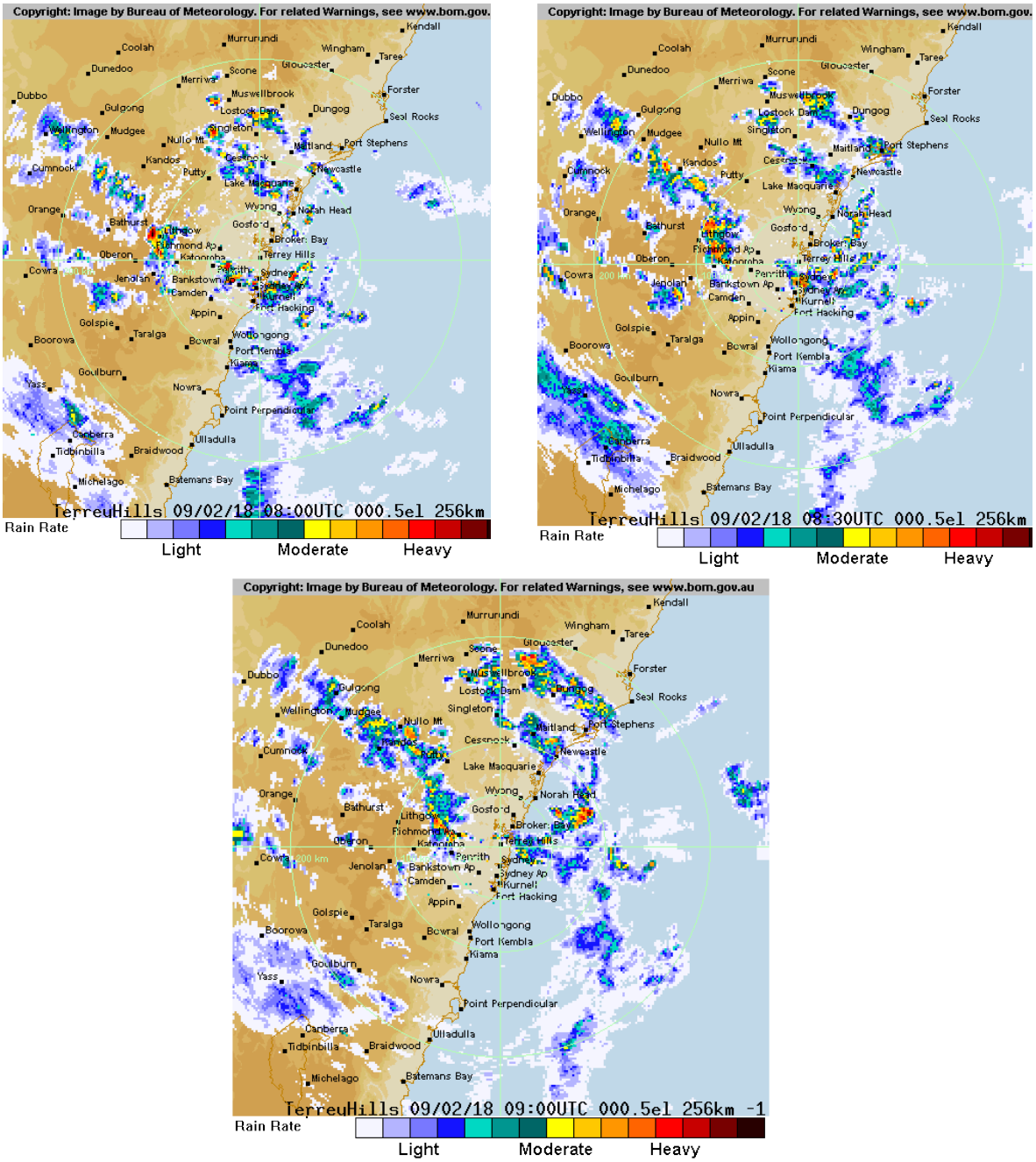

Figure 17 – Bureau of Meteorlogy rain radar images for Terry Hills for 0800z, 0830z and 0900z (historical images for Sydney airport were not available).

0900z-1000z

From 0900z, thunderstorm were predominantly to the north of the field, with some local cells to the west within 20nm (see Figure 18 and ATIS messages listed below).

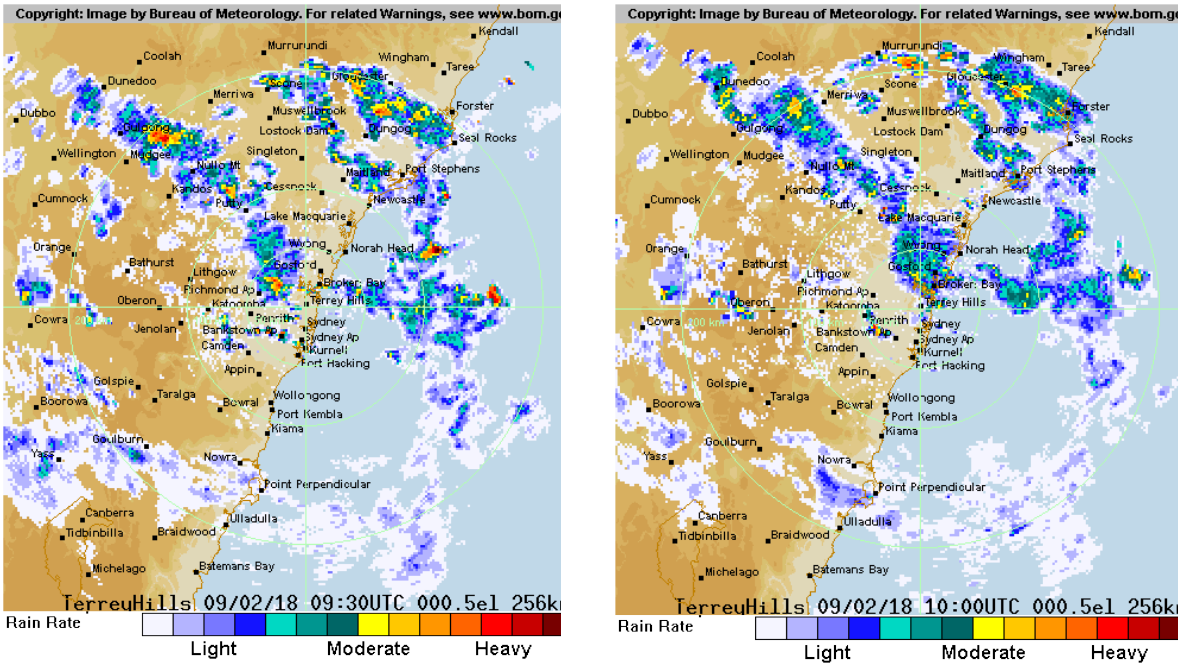

Figure 18 – Bureau of Meteorlogy rain radar images for Terry Hills for 0930z and 1000z (historical images for Sydney airport were not available).

0910z: INFO X. EXP GLS OR ILS APCH THEN INDEP VIS APCH WHEN VIS. CL. DAMP. WX: CB TO NORTH EAST. RWY 16L&R FOR ARRS & DEPS. PARL RWY OPS IN PROGRESS. INDEP DEPS IN PROGRESS. SIGWX: EXP MODERATE TURB ON FINAL. TMP: 23. VIS: 10 KM, REDUCED TO 6 KM IN PASSING SH. CLD: FEW008 SCT018. INFO X. WIND: VRB, 8 KTS. TAILWIND MAX 3 KTS. QNH: 1013.

0935z: INFO Y. TMP: 24. WIND: 220/10 KTS. QNH: 1015. EXP GLS OR ILS APCH THEN INDEP VIS APCH WHEN VIS. CL. RWY 16L&R FOR ARRS & DEPS. PARL RWY OPS IN PROGRESS. INDEP DEPS IN PROGRESS. SIGWX: EXP MODERATE TURB ON FINAL. DAMP. WX: CB TO NORTH EAST. CLD: FEW008 SCT018.INFO Y. VIS: 10 KM, REDUCED TO 6 KM IN PASSING SH.

0945z: INFO A. WET. EXP GLS OR ILS APCH THEN INDEP VIS APCH WHEN VIS. CL. RWY 16L&R FOR ARRS & DEPS. PARL RWY OPS IN PROGRESS. INDEP DEPS IN PROGRESS. SIGWX: EXP MODERATE TURB ON FINAL. WX: CB TO NORTH EAST. TMP: 24. VIS: 10 KM, REDUCED TO 6 KM IN PASSING SH. WIND: 220/10 KTS.INFO A. CLD: FEW008 SCT018. QNH: 1015.

1005z: INFO B. WX: CB TO NORTH & EAST. CLD: FEW008 SCT015. EXP GLS OR ILS APCH THEN INDEP VIS APCH WHEN VIS. CL. RWY 16L&R FOR ARRS & DEPS. PARL RWY OPS IN PROGRESS. INDEP DEPS IN PROGRESS. WET. TMP: 24. VIS: 10 KM, REDUCED TO 6 KM IN PASSING SH. WIND: 220/10 KTS. QNH: 1015.

As a result of an ATFM rate of 26 with demand better balanced from different compass directions, individual airborne delays figures appear to be lower in the 0900z hour (Figure 19), compared to what was experienced in the 0700z hour with a predominant southwest demand. This continued into the 1000z hour (Figure 20).

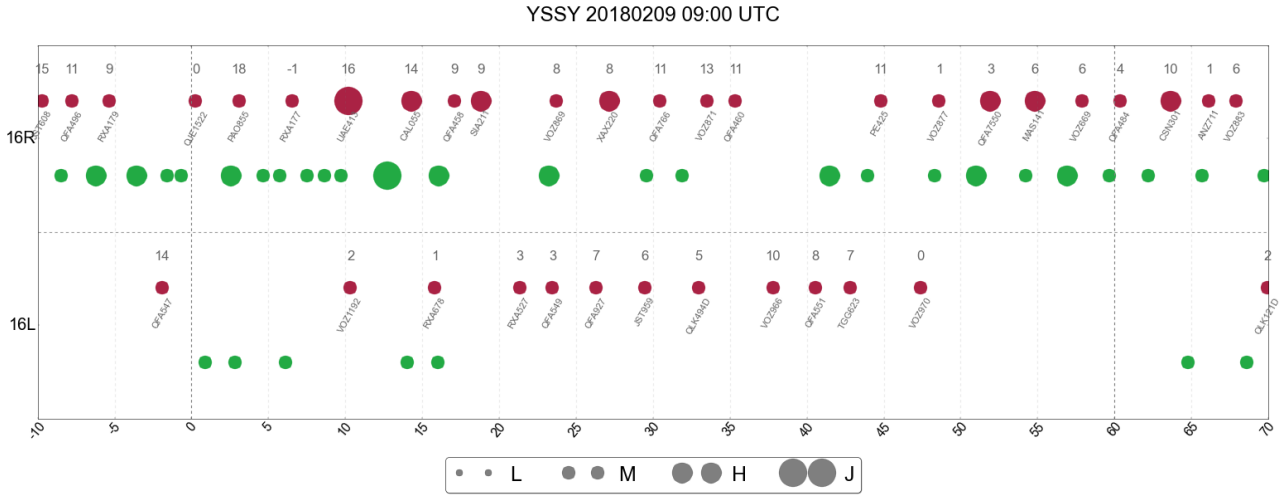

Figure 19- Arrivals (red) and departures (green) during the 0900 UTC hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated above the arrival dots are the arrival delay (in minutes), and below the arrival dots are the callsigns of the aircraft. (source: ODAS)

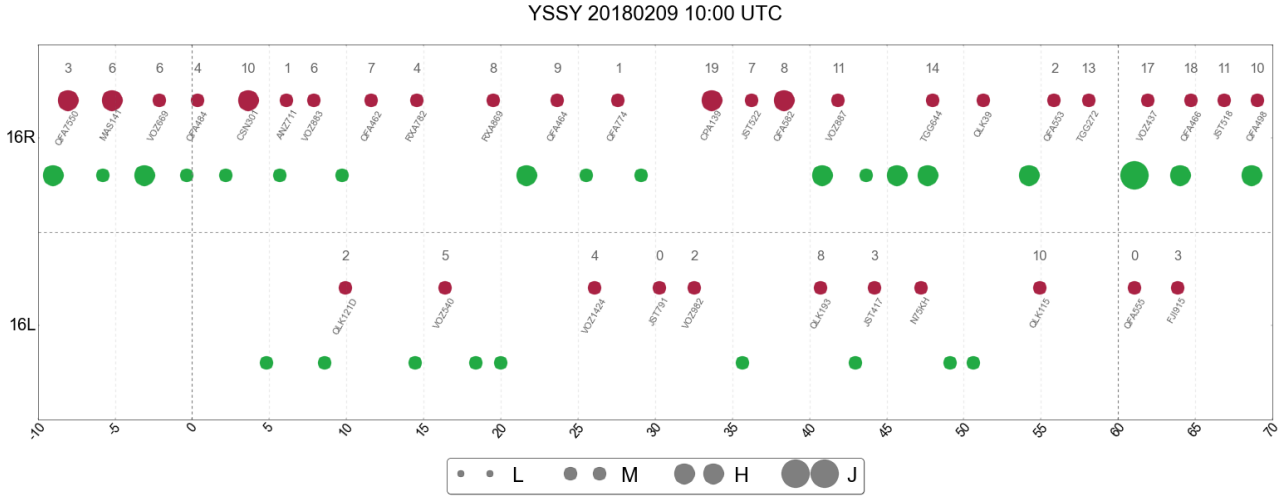

Figure 20- Arrivals (red) and departures (green) during the 1000 UTC hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated above the arrival dots are the arrival delay (in minutes), and below the arrival dots are the callsigns of the aircraft. (source: ODAS)

1000z-1200z

At 1010z, the Traffic Manager advised the NCC that there were continuing issues including thunderstorms between 15-20nm on the approach paths and diversions away from the runways. The Traffic Manager highlighted that there may be a requirement for further traffic management initiatives, based on their assessment of actual weather conditions, actual and anticipated airborne delay, and traffic projection in Harmony pre and post curfew. This was the first communication between the Traffic Manager and NCC after communications in relation to the Level 2 revision.

At 1017z, the Traffic Manager confirmed the requirement for a Level 3 Revision. Indicative airborne delay figures were on the rise (Figure 20). A rate of 20 was set for the 1100z hour which was deemed highest achievable by the Traffic Manager, essentially meaning that only flights that were airborne at 1015z, would be able to get in pre-curfew.

Figure 21 provides a view of the demand in Harmony just prior to the revision. Demand for the 1000z was 26 (as per plan), and 28 for the 1100z hour. The demand for the post-curfew 1200z hour is shown in Figure 22. It includes two RFDS flights (curfew exempt), 3 cancelled X-flights, and one tactical release (slot 'parked' post curfew as per Business Rules). Therefore, there was no actual demand post-curfew. After the Level 2 Revisions, airlines had managed their flights to ensure there was no post-curfew demand. However, based on the demand presented in Figure 21, it is quite likely that the Traffic Manager may have perceived the 6 post-curfew flights as actual pre-curfew demand.

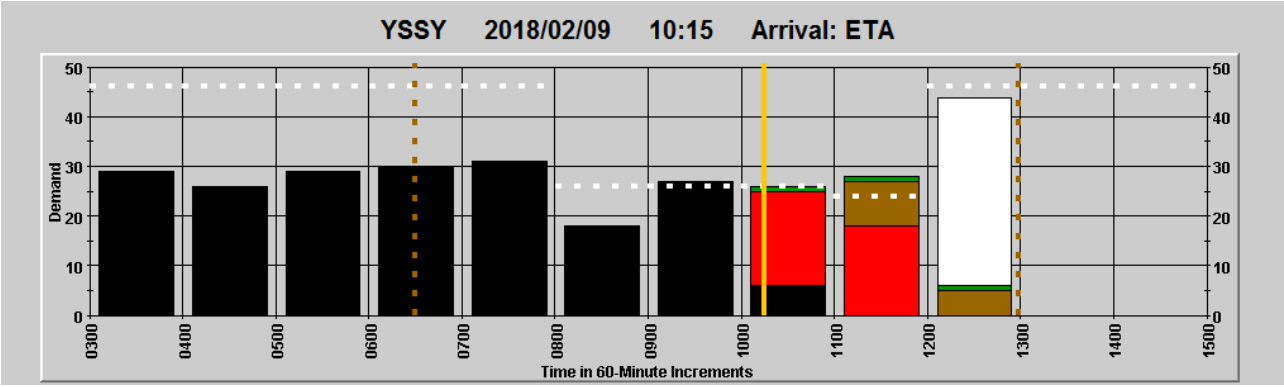

Figure 21 – Demand in Harmony at 1015z, just prior to the level 3 revision.

The 3 cancelled X-flights (QFA490X, TGG264X and VOZ875X) were in violation of the Business Rules as (1) IOBTs were all 0900z or prior, and (2) cancelled flights are only to be re-introduced when a revision is upcoming (which wasn't announced yet at 1015z).

Current Info

Data: Arrivals

Filter(s): Ground Stopped OR Dep (Past ETD) OR Dep (No CTOT) OR Dep (CTOT Issued) OR Dep (CTOT Other Element) OR Flight Active OR Arrived AND ETA between 09/1200 and 09/1258

	ACID	MAJOR	AC_REG	CNX	ADEP	IOBT	ELOBT	LOBT	SOBT	COBT
1	AM201	RFDS	VHAMS	☐	YORG	09/0930	09/0930	-	-	09/1118
2	QFA490X	QFA	VHVXP	☐	YMML	09/0900	09/0923	09/0923	-	09/1056
3	AM203	RFDS	VHNAO	☐	YPMQ	09/1120	09/1120	-	-	09/1120
4	TGG264X	VOZ	VHVUD	☐	YMML	09/0725	10/0740	10/0740	-	09/1139
5	VOZ875X	VOZ	VHVOM	☐	YMML	09/0700	10/0700	10/0700	-	09/1142
6	QLK39T	QFA	VHSCE	☐	YSDU	09/0200	09/0920	09/0920	-	09/1155

Figure 22 – Demand for 1200z hour, as at 1015z.

With thunderstorm threat now passed, it appears that all airborne demand was accommodated without too much airborne delay (Figure 20 and Figure 23). From the airborne delay figures in Figure 23 it appears that after 1105z, essentially there was no pressure on the runways and under-utilised slots in the arrival sequence for both runways appeared towards the end of the 1100z hour. This situation is likely the result of low ATFM rate, while weather conditions had significantly improved. Final view of Harmony is provided in Figure 24.

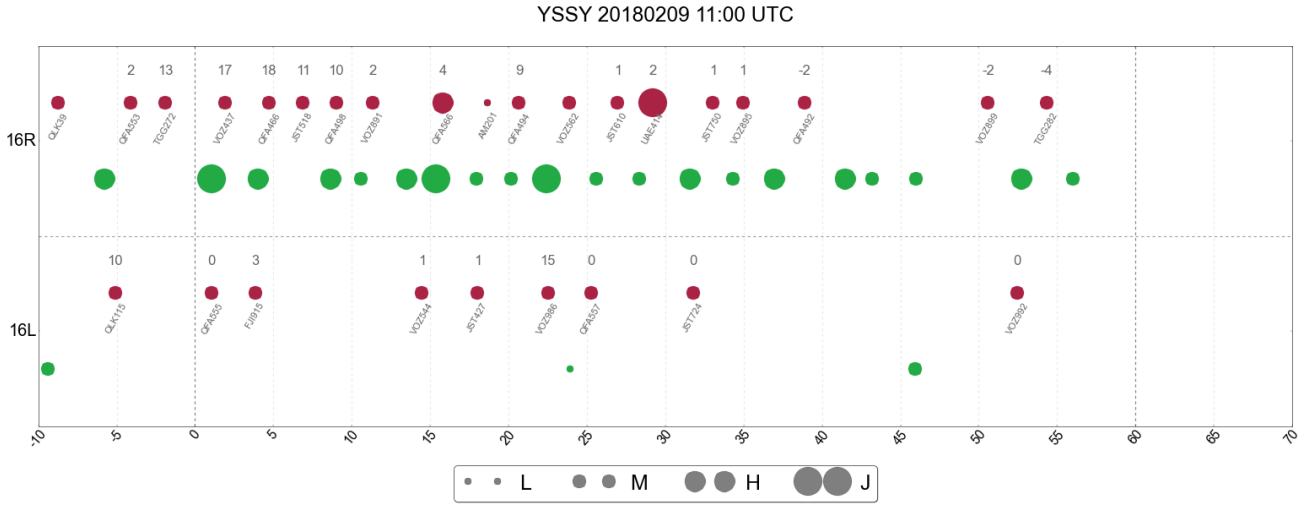

Figure 23- Arrivals (red) and departures (green) during the 1100 UTC hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated above the arrival dots are the arrival delay (in minutes), and below the arrival dots are the callsigns of the aircraft. (source: ODAS)

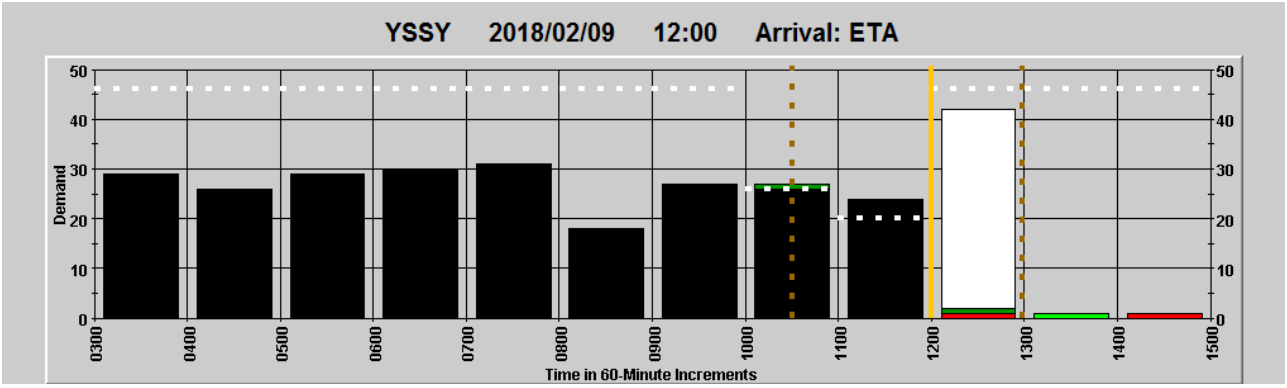

Figure 24 – Demand in Harmony at 1200z, curfew.

Summary

This review focused on a delay event from late afternoon/early evening until curfew at Sydney, where weather conditions forced a Level 2 and Level 3 Revision at 0615 and 1017 UTC, respectively.

In essence, ineffective communication and teamwork between various network players directly resulted in three cancelled flights (aircraft positioning issues may have led to further cancellations the following day) which may have been avoided.

Based on the analysis presented, the following can be concluded:

- A Level 3 Revision to protect the curfew was not an appropriate traffic management initiative available and was perhaps influenced by misunderstanding of 'phantom' demand post curfew (e.g. X-flights and 'parked' tactical releases). Three flights were cancelled as result of this decision. Airlines are responsible to manage their schedules to meet requirements of the Sydney Curfew Act. In future similar situations, Airservices and airlines should apply a collaborative approach to minimise impact on the travelling public, while ensuring safe and orderly flow of air traffic.

- NCCMET and SAMU and did not have a shared situational awareness of increased thunderstorm risk within 20nm. This potentially led to significant variance between the advice delivered by SAMU and NCCMET/MET-CDM.
- It is recommended Letters of Agreement be established between the NCC and each of the GDP TCUs to ensure clear communication procedures and requirements are formalised, to ensure consistent outcomes.
- Communication to external stakeholders during the event did not meet expectations set under the Communications Plan. The importance of timely and accurate communication from the NCC to external stakeholders has been reaffirmed.
- The NCC needs to act more proactive to identify and act on violations of business rules, especially during significant events. At times when there is risk of curfew violation, post-curfew demand should be assessed in more detail to verify if the demand is real, with this information communicated to the duty Traffic Manager.
- Airlines should better manage the practise of X-flights, and only introduce these upon the notification of a revision, in accordance with the business rules.

For further information please contact Network Performance and Analysis @ OPS_ANALYSIS_ADMIN@AirservicesAustralia.com

Appendix : Compliance

Compliance to CTOT may have been a contributing factor to the elevated arrival delay. From 0400-0900 UTC 70 aircraft were identified as either non-compliant, exempt or compliant with a difference between ATOT and CTOT of 10 or more minutes. Table 2 shows the flights where ATOT compliance to CTOT may have caused an issue for sequencing of arrivals into Sydney, for 0400-0900 UTC hour blocks.

Table 2- Flights in the 1900 hour block, which are either: exempt, early/late non-compliant, or compliant with at least a 10 minute difference between CTOT and ATOT.

ACID	ADEP	ALDT	ATYP	CTOT-ATOT	CTOT Compliance
QLK23	YARM	9/02/2018 4:00	DH8C	12	Compliant
JST4	PHNL	9/02/2018 4:12	B788	10	Exempt
QFA144	NZAA	9/02/2018 4:19	B738	10	Exempt
CES777	ZPPP	9/02/2018 4:21	A332	35	Exempt
QFA438	YMML	9/02/2018 4:24	B738	14	Compliant
CCA173	ZBAA	9/02/2018 4:26	B77W	19	Exempt
ANZ885	NZCH	9/02/2018 4:33	A320	7	Exempt
VOZ651	YSCB	9/02/2018 4:43	AT76	19	Late Non Compliant
QFA64	FAOR	9/02/2018 4:47	B744	21	Exempt
TGG397	YBPN	9/02/2018 4:52	A320	17	Late Non Compliant
VOZ853	YMML	9/02/2018 5:11	B738	15	Compliant
QFA642	YPPH	9/02/2018 5:15	A332	14	Compliant
ANZ763	YSNF	9/02/2018 5:17	A320		null
QFA122	NZQN	9/02/2018 5:23	B738	-4	Exempt
RXA774	YMAY	9/02/2018 5:38	SF34	-6	Early Non Compliant
QFA537	YBBN	9/02/2018 5:40	B738	17	Late Non Compliant
QFA482	YMML	9/02/2018 5:41	B738	15	Compliant
QLK710D	YSCB	9/02/2018 5:45	DH8D	10	Compliant
UPS34	PHNL	9/02/2018 5:54	B744	17	Exempt
ANZ849	NZWN	9/02/2018 5:56	A320	9	Exempt
JST514	YMML	9/02/2018 6:08	A321	13	Compliant
QFA470	YMML	9/02/2018 6:14	B738	16	Late Non Compliant
VOZ657	YSCB	9/02/2018 6:17	B737	24	Late Non Compliant
QFA164	NZWN	9/02/2018 6:23	B738	5	Exempt
VOZ859	YMML	9/02/2018 6:24	B738	17	Late Non Compliant
QLK420D	YSCB	9/02/2018 6:28	DH8D	16	Late Non Compliant
VOZ163	NZQN	9/02/2018 6:30	B738	7	Exempt
QFA541	YBBN	9/02/2018 6:34	B738	11	Compliant
QFA446	YMML	9/02/2018 6:35	B738	21	Late Non Compliant
VOZ427	YPAD	9/02/2018 6:44	B738	10	Compliant
QFA146	NZAA	9/02/2018 6:49	A332	2	Exempt
SIA241	WSSS	9/02/2018 6:53	B77W	13	Exempt
VOZ180	NFFN	9/02/2018 6:55	B738	-3	Exempt
ANZ105	NZAA	9/02/2018 7:01	A343	14	Exempt
VOZ1179	YMAY	9/02/2018 7:05	AT76	12	Compliant
VOZ863	YMML	9/02/2018 7:14	B738	20	Late Non Compliant

QFA468	YMML	9/02/2018 7:16	B738	20	Late Non Compliant
QFA543	YBBN	9/02/2018 7:18	B738	17	Late Non Compliant
JST516	YMML	9/02/2018 7:20	A321	12	Compliant
JST120	NFFN	9/02/2018 7:22	A320	13	Exempt
ANZ61	NCRG	9/02/2018 7:28	B772	-3	Exempt
RXA629	YBTH	9/02/2018 7:29	SF34	-30	Early Non Compliant
JST419	YBCG	9/02/2018 7:32	A320	-48	Early Non Compliant
VOZ532	YBCG	9/02/2018 7:38	B738	-66	Early Non Compliant
RXA333	YGFN	9/02/2018 7:43	SF34	-64	Early Non Compliant
QTR908	OTHH	9/02/2018 7:44	A388	-12	Exempt
VOZ962	YBBN	9/02/2018 7:46	B738	-83	Early Non Compliant
QLK214D	YMAY	9/02/2018 7:53	DH8D	-38	Early Non Compliant
ANG1	AYPY	9/02/2018 8:00	B737	20	Exempt
VOZ867	YMML	9/02/2018 8:02	B738	16	Late Non Compliant
ETD454	OMAA	9/02/2018 8:04	A388	-43	Exempt
RXA674	YSWG	9/02/2018 8:08	SF34	-43	Early Non Compliant
RXA983	YARM	9/02/2018 8:12	SF34	12	Compliant
QJE1520	YSCB	9/02/2018 8:14	B712	10	Compliant
HAL451	PHNL	9/02/2018 8:42	A332	0	Exempt
QFA148	NZAA	9/02/2018 8:45	B738	-12	Exempt
ANZ883	NZCH	9/02/2018 8:47	A320	4	Exempt
PAO855	NSFA	9/02/2018 8:55	B738		Exempt
QJE1522	YSCB	9/02/2018 9:00	B712	10	Compliant
RXA177	YORG	9/02/2018 9:06	SF34	-166	Early Non Compliant
UAE413	NZCH	9/02/2018 9:10	A388	11	Exempt
CAL055	RCTP	9/02/2018 9:14	A359	16	Exempt
QFA458	YMML	9/02/2018 9:17	B738	14	Compliant
SIA211	WSSS	9/02/2018 9:18	B77W	9	Exempt
QFA927	YBCS	9/02/2018 9:26	B738	-59	Early Non Compliant
XAX220	WMKK	9/02/2018 9:27	A333	-3	Exempt
JST959	YBCS	9/02/2018 9:29	A320	-78	Early Non Compliant
QFA7550	PHNL	9/02/2018 9:52	B744	4	Exempt
MAS141	WMKK	9/02/2018 9:54	A333	27	Exempt
VOZ669	YSCB	9/02/2018 9:57	B737	16	Late Non Compliant

Figure 25 below shows the difference between the calculated landing hour (CLDT) and the actual landing hour (ALDT). This figure illustrates whether the pre-tactical plan was achieved and what the delivery accuracy of that plan was (in terms of meeting the allocated landing slot). In the case of increasing delays this graphic will generally show a cascading effect of late aircraft shown in red, as aircraft arrive later than planned due to airborne delays. During the period 1800-2200 local (0700-1100 UTC) we can see several 'early' and 'late' aircraft.

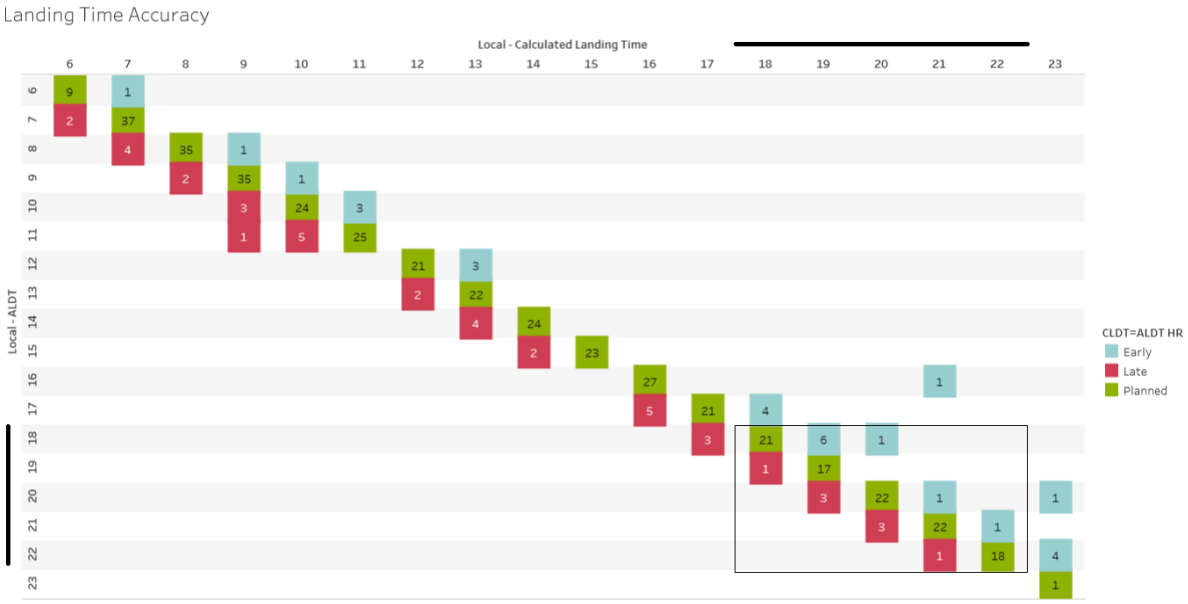

Figure 25 – Calculated landing hour vs actual landing hour

Post Operational Performance Review

Brisbane Airport – 16th February 2018

Event Description

A review was initiated for operations at Brisbane Airport on the 16th February 2018 for an observation regarding an elevated delay period during 0600-1000 UTC. Figure 26 shows the elevated delay period, with the number of arrivals below the planned arrival rate during 0600z and 0700z, then matching the rate during 0800z. During 0900z and 1000z the number of arrivals exceed the planned rate. Additionally, the CLDT vs. ALDT comparison shows the arrivals 'spilling over' into the next hour from their targeted slot (between 0600z and 1000z). For comparison, Figure 27 shows the 75th-percentile of airborne arrival delay from ODAS-sourced data. The curve is a smooth parabolic shape for the period 0600-1000z for. This contrasts with the more jagged shape for the EDW-sourced arrival delay. Overall, the ODAS data suggests higher amounts of airborne arrival delay during the period of interest, particularly during 1000z where the value is 20 minutes higher which is firmed by the operational commentary provided. EDW airborne arrival delays are calculated as ALDT minus the first MAESTRO ETA, while the ODAS airborne arrival delay is calculated as the actual flight time within 250NM of the destination minus the estimated (unimpeded) flight time within 250NM which is derived from the trajectory created by Dali using the flight plan message.

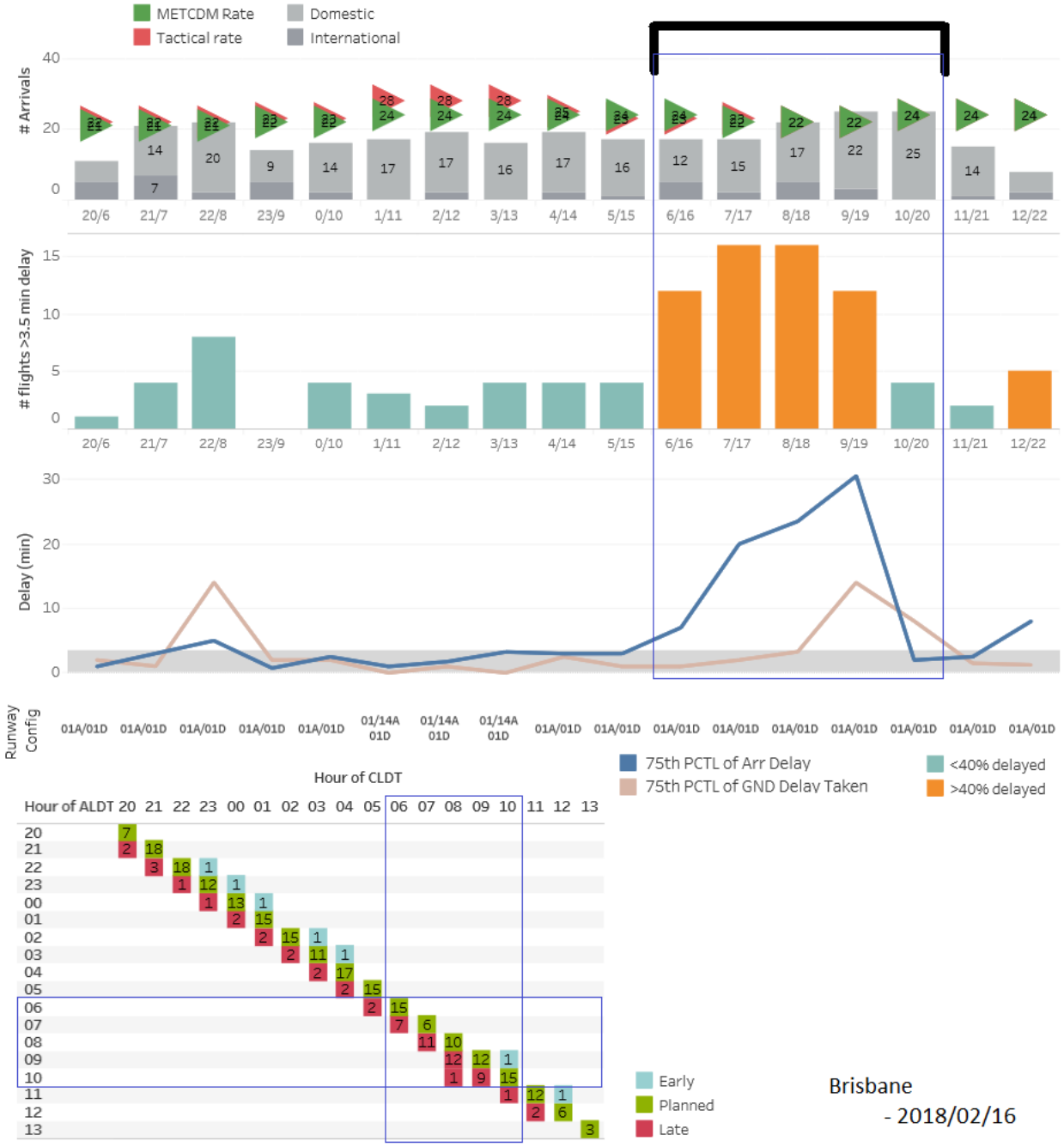

*Figure 26 – Starting from the top, and going down: 1. The actual arrival rate compared to the targeted arrival rate. 2. Counts of the number of arrivals exceeding 3.5 minutes of airborne arrival delay *****. 3. The 75th-percentile of airborne arrival delay and ground delay *****. 4. The difference between the calculated and actual landing hour. This illustrates whether the pre-tactical plan was achieved and what the delivery accuracy of that plan was (in terms of meeting the allocated landing slot). In the case of increasing delays this graphic will generally show a cascading effect of late aircraft shown in red, as aircraft arrive later than planned due to airborne delays. The black bar (with blue rectangle extending down over the first 3 charts) at the top of the image shows the period of elevated delay, and the blue rectangles on the fourth chart show the same period on the CLDT vs ALDT graph. ***** The amount of airborne arrival delay during 1000 UTC appears to have been underestimated in the EDW data. ODAS data is used to show this higher level of delay later in the report (current graph shows 2 minutes for 75th-percentile @10z, ODAS data indicates 21 minutes for the 75th-percentile).*

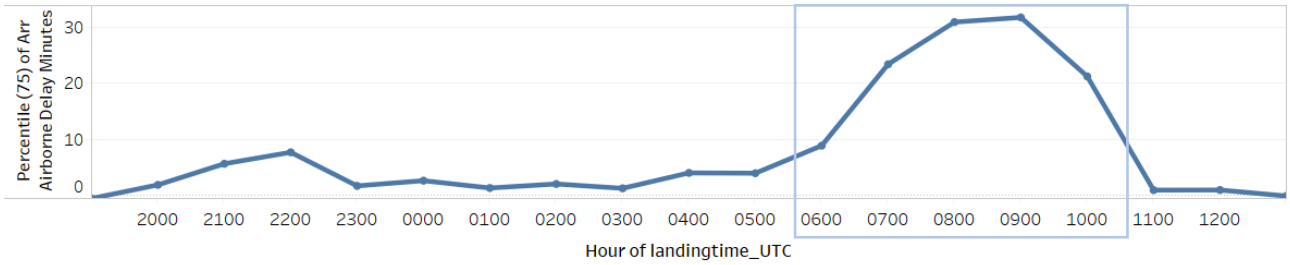

Figure 27 – Airborne arrival delay calculated using ODAS data. When compared to the EDW sourced arrival delay, in the hour blocks 0600z, 0700z and 0800z the ODAS values are about 5 minutes higher, in the 0900z hour block the values are similar, and in the 1000z hour block the ODAS value is about 20 minutes higher. The blue rectangle shows the elevated delay period.

Analysis

Analysis concentrates on a period of elevated airborne arrival delay during a significant weather event heading in a northerly direction passing overhead the airport. The MET CDM process predicted a thunderstorm beginning about 0700z and lasting for three hours – weather radar images from the Bureau of Meteorology and ATIS information support the accuracy of this prediction (see below).

Compliance of ATOT to CTOT may also have been a contributing factor to elevated arrival delay. During the period 0600-1000z 16 flights were deemed late non-compliant, 4 early non-compliant, 33 compliant with a difference of 10 or more minutes between ATOT and CTOT, and 15 flights were exempt (see Table *2* for a flight list). Additionally, an ETA was calculated using the time an aircraft gets within 250NM of Brisbane, and adding to it the flying time within 250NM obtained by the Dali prediction tool. The obtained estimated landing time is compared to the CLDT to understand the accuracy of the CLDT. This comparison revealed that 6 flights had an ETA at least 10 minutes before the CLDT, and 34 flights had an ETA at least 10 minutes after the CLDT (see Table 4 for a list of these flights).

When the delay begins to elevate (0600z), see Figure 28, the weather has intensified and has begun to move closer to Brisbane Airport. However, conditions are not deteriorating in the TMA area yet, although some low-level cloud is present. The ATIS message at 0611 indicated wind 360/15, visibility greater than 10KM, distant CB in area to the west, cloud FEW at 2500ft. Then, at 0710z the weather system is encroaching the TMA, but ATIS conditions fairly stable with wind unchanged, visibility unchanged, CB to the south and cloud scattered at 1500ft.

During 0600z (see Figure 29):

- four aircraft have airborne delay of 10 or more minutes. Earlier in the hour there are gaps in the sequence (including two of at least five minutes), and by the end of the hour there is a full sequence

During 0700z (see Figure 30):

- more gaps in the arrival sequence have occurred (including three of at least five minutes), and 10 aircraft have an arrival delay of 10 or more minutes
- at the end of this hour three flights had a departure delay of 20 or more minutes.

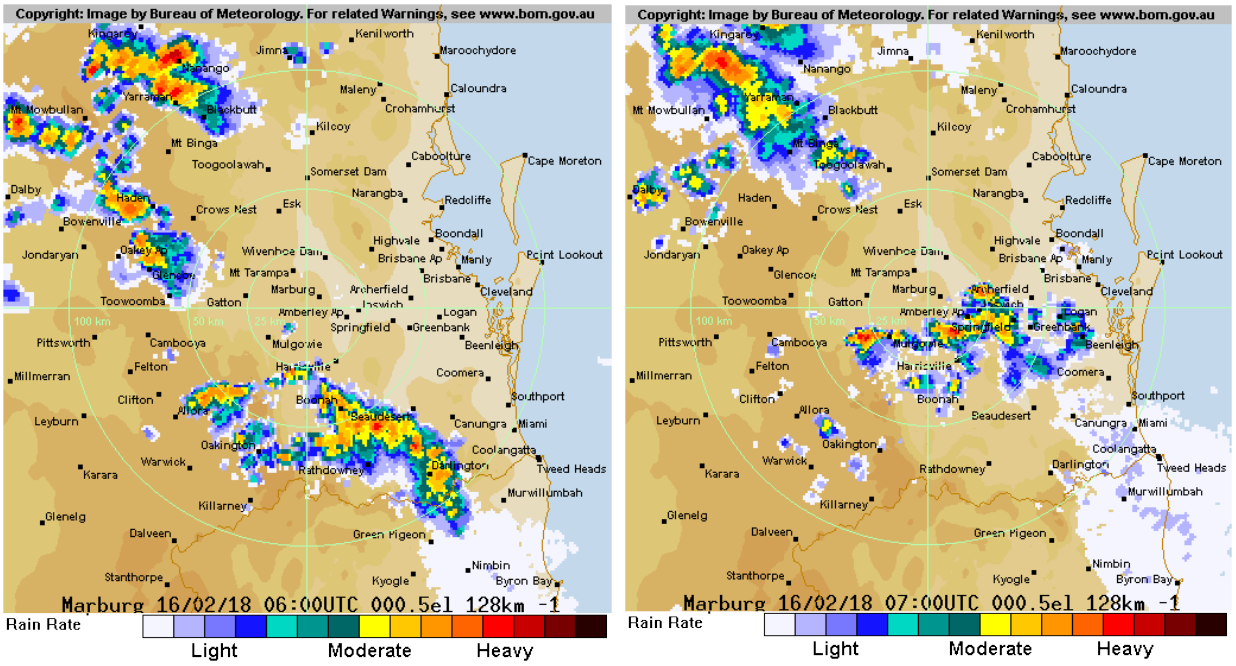

Figure 28- Left: weather further intensifying around Brisbane at 0600 UTC. Right: weather moving within about 30km of Brisbane Airport at 0700 UTC. NOTE: Brisbane Airport is approx. 60km NE of image centre (top right quadrant).

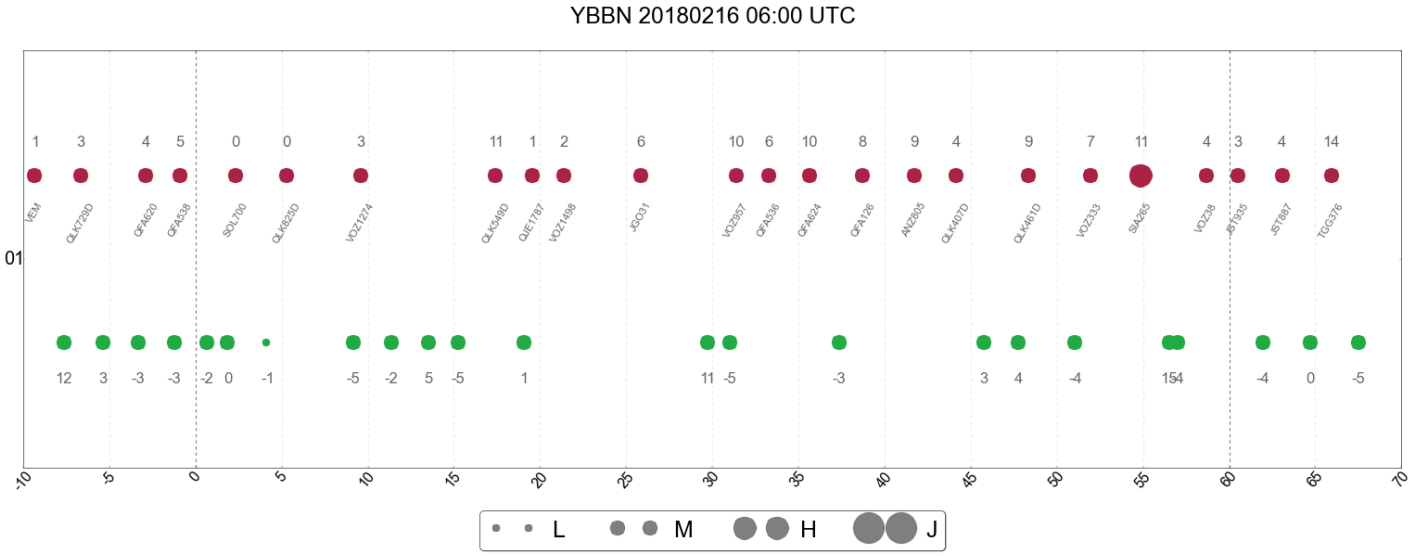

Figure 29- Arrivals (red) and departures (green) during the 0600z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals is airborne arrival delay (in minutes).

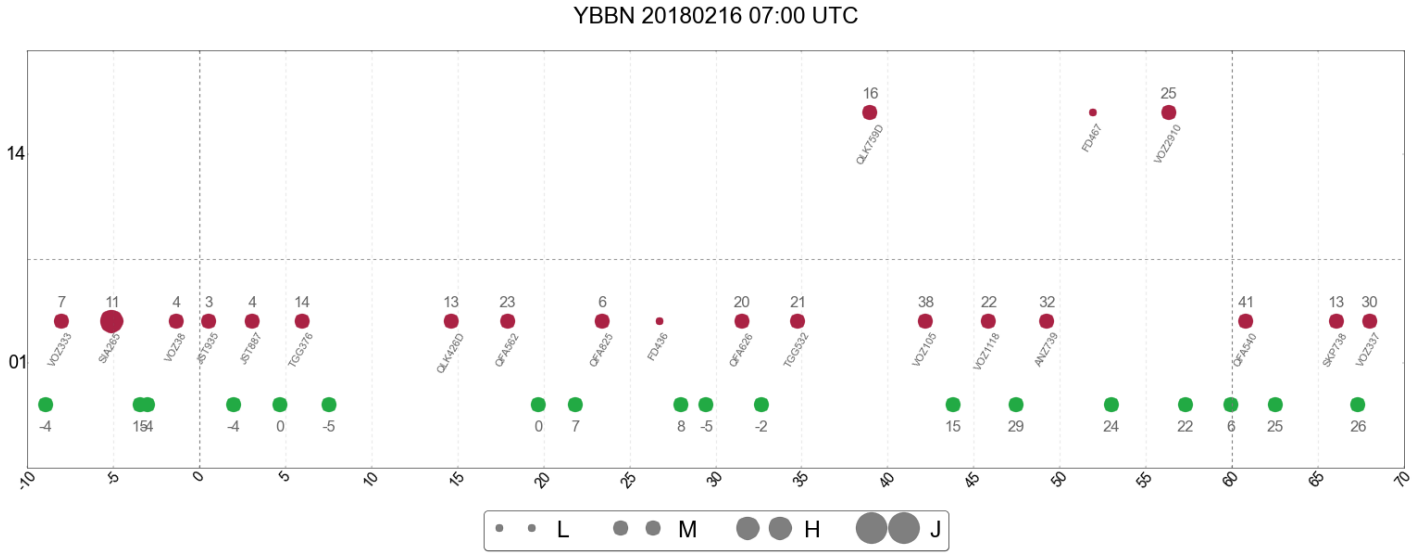

Figure 30- Arrivals (red) and departures (green) during the 0700z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals is airborne arrival delay (in minutes).

During 0800z (see Figure 31):

- 19 flights had an arrival delay of 10 or more minutes, there were two gaps of at least five minutes in the arrival sequence
- four flights had a departure delay of 20 or more minutes.

During 0900z (see Figure 32):

- 19 flights had an arrival delay of 10 or more minutes (all flights for which the delay could be calculated)
- nine flights had a departure delay of 20 or more minutes.

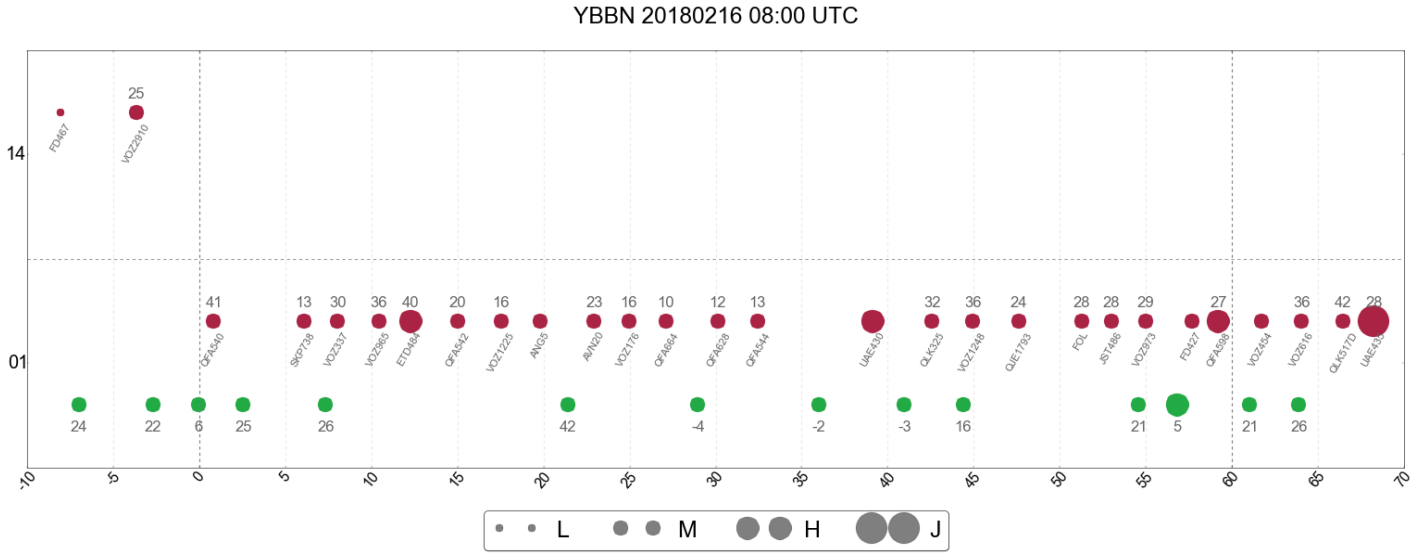

Figure 31- Arrivals (red) and departures (green) during the 0800z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the

estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals is airborne arrival delay (in minutes).

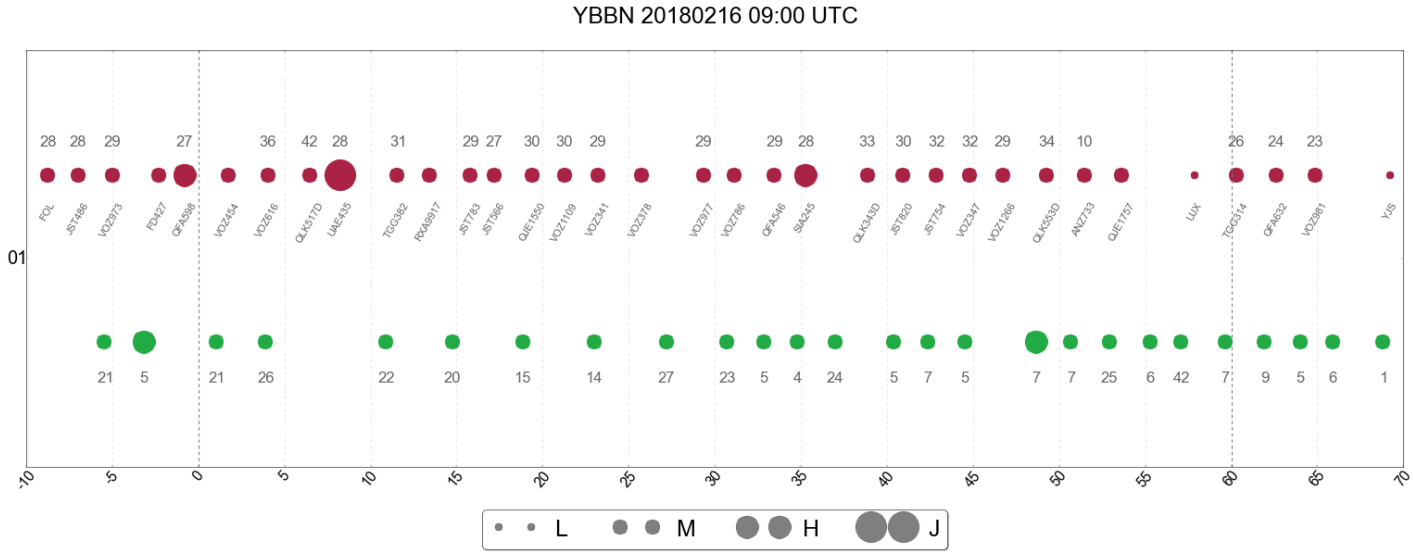

Figure 32- Arrivals (red) and departures (green) during the 0900z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals is airborne arrival delay (in minutes).

Weather radar and ATIS data shows the worst of the conditions have left the airport by 1000z, and by 1100z conditions have improved again with showers now dissipated.

During 1000z (see Figure 33):

- 13 flights had an arrival delay of 10 or more minutes, with one gap of about five minutes in the arrival sequence. Flights with less than 10 minutes delay land towards the end of the hour
- four flights had a departure delay of 20 or more minutes.

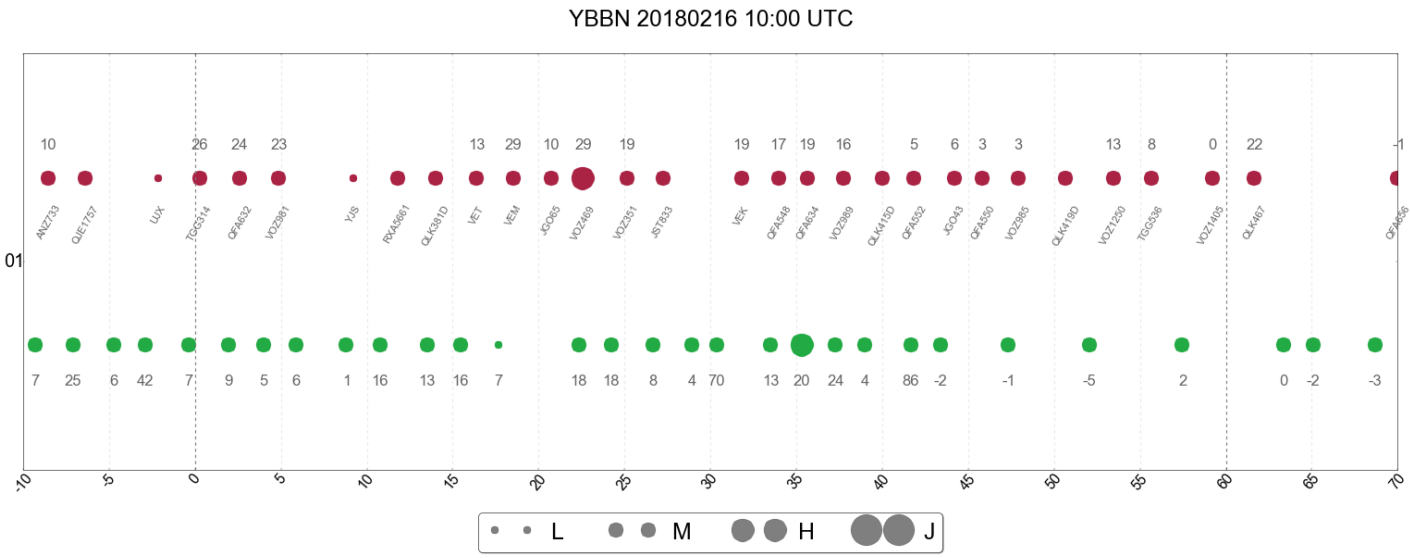

Figure 33- Arrivals (red) and departures (green) during the 1000z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals is airborne arrival delay (in minutes).

Summary

This review focused on a delay event (delays exceeding 10 minutes) occurring in between 06z-10z at Brisbane airport, as a thunderstorm (predicted and planned for) moved across the region. As the thunderstorm was building and moving towards the airport, when the arrival demand was below the programmed arrival rate, several aircraft either departed late or had a large difference between ETA and CLDT, leading to oversubscription. During the period 0600-1000z 16 flights were deemed late non-compliant, 4 early non-compliant, 33 compliant with a difference of 10 or more minutes, and 15 flights were exempt. Several of the exempt flights had up to 90 minute variance on their calculated landing time in part due to delay. This increased demand during the period when the thunderstorm hit the airport caused a long period of over subscription combined with poor weather conditions. Departures and arrivals did not seem to stop for a sustained period, however, there were noticeable gaps in the sequences, including 5 periods of 10 or more minutes with no departing aircraft between 0600 and 0900 UTC. Across the five hours of elevated arrival delay (0600-1000z) there were eight gaps of at least five minutes in the arrival sequence (with maybe a few more smaller gaps). This suggests a reluctance for aircraft to land under the adverse weather conditions as confirmed by the operational commentary.

The key learnings from this review include:

- The impact of late, early and exempt flights on fully subscribed programs.

For further information please contact Network Performance and Analysis @ OPS_ANALYSIS_ADMIN@AirservicesAustralia.com

Appendix: Compliance

Table 3- Flights in the hour blocks from 0600-1000z, are either: exempt, early/late non-compliant, or compliant with at least a 10 minute difference between CTOT and ATOT.

ACID	ADEP	ATYP	CTOT-ATOT	CTOT Compliance
QFA542	Sydney Departures	B738	17	Late Non Compliant
VOZ337	Melbourne Departures	B738	14	Compliant
VOZ333	Melbourne Departures	B738	23	Late Non Compliant
VOZ1248	YBRK	F100	12	Compliant
UJX	YTWB	AC50	31	Late Non Compliant
VOZ351	Melbourne Departures	B738	11	Compliant
QFA664	YPAD	B738	25	Late Non Compliant
SIA265	WSSS	B772	19	Exempt
VOZ1118	YBPN	B738	8	Compliant
QFA628	Melbourne Departures	B738	17	Late Non Compliant
JST566	Melbourne Departures	A321	18	Late Non Compliant
VEK	YARM	SW4	6	Compliant
VOZ341	Melbourne Departures	B738	-109	Early Non Compliant
QFA598	YPPH	A332	12	Compliant
YJS	YMYB	AC50	14	Compliant
UAE435	NZAA	A388	-1	Exempt
ANZ739	NZAA	A320	56	Exempt
ETD484	OMAA	B789	33	Exempt
FD436	YBWW	BE20	-193	Early Non Compliant

TGG532	Melbourne Departures	A320	14	Compliant
FOL	YSBK	FA50	52	Late Non Compliant
QFA126	NZAA	B738	23	Exempt
SIA245	WSSS	A359	-6	Exempt
FD427	YBSU	B350	-118	Early Non Compliant
SOL700	AGGH	A320	12	Exempt
VOZ957	Sydney Departures	B738	9	Compliant
QFA825	YPDN	B738	12	Compliant
VOZ469	YPPH	A332	20	Late Non Compliant
VOZ965	Sydney Departures	B738	7	Compliant
QFA546	Sydney Departures	B738	8	Compliant
QLK517D	YBMK	DH8D	10	Compliant
ANZ733	NZAA	A320	4	Exempt
QFA626	Melbourne Departures	B738	12	Compliant
VOZ1225	YSCB	B738	17	Late Non Compliant
QJE1787	YBTL	B712	17	Late Non Compliant
VEM	YSTW	SF34	12	Compliant
QLK325	YBUD	DH8C	10	Compliant
VOZ1274	YBMA	F100	12	Compliant
VOZ1498	YBHM	B738	13	Compliant
QFA632	Melbourne Departures	B738	13	Compliant
QFA634	Melbourne Departures	B738	8	Compliant

TGG536	Melbourne Departures	A320	14	Compliant
VOZ38	AYPY	B738	10	Exempt
QFA624	Melbourne Departures	B738	7	Compliant
ANZ805	NZCH	A320	13	Exempt
QLK553D	YROM	DH8D	-6	Early Non Compliant
VOZ989	Sydney Departures	B738	6	Compliant
JGO65	YSTW	E145	24	Late Non Compliant
ANG5	AYPY	B737	8	Exempt
VOZ105	NZWN	B738	16	Exempt
VOZ347	Melbourne Departures	B738	6	Compliant
QFA550	Sydney Departures	B738	15	Compliant
JGO31	YMAY	E145	11	Compliant
QFA552	Sydney Departures	B738	9	Compliant
VOZ985	Sydney Departures	B738	12	Compliant
JST820	Sydney Departures	A320	6	Compliant
AVN20	NVVV	B738	14	Exempt
VOZ176	NFFN	B738	44	Exempt
QLK415D	YEML	DH8D	23	Late Non Compliant
QLK381D	YHBA	DH8D	60	Late Non Compliant
FD467	YBRK	BE20	14	Compliant
VOZ981	Sydney Departures	B738	11	Compliant
VOZ454	YPDN	B738	13	Compliant

VOZ1250	YBRK	F100	16	Late Non Compliant
VOZ1109	YWLM	B738	22	Late Non Compliant
RXA5661	YBWW	SF34	31	Late Non Compliant
VOZ1266	YEML	F70	7	Compliant
UAE430	OMDB	B77L	-111	Exempt

Table 4- Flights in the hour blocks from 0600-1000z, have at least a 10 minute difference between Dali ETA and CLDT.

ACID	ADEP	ATYP	ETA-CLDT
QFA542	Sydney Departures	B738	13
VOZ337	Melbourne Departures	B738	20
VOZ333	Melbourne Departures	B738	28
UJX	YTWB	AC50	35
VOZ351	Melbourne Departures	B738	18
QFA664	YPAD	B738	32
QFA628	Melbourne Departures	B738	21
JST566	Melbourne Departures	A321	23
VOZ341	Melbourne Departures	B738	-27
QFA598	YPPH	A332	22
YJS	YMYB	AC50	16
UAE435	NZAA	A388	10
ANZ739	NZAA	A320	58
FD436	YBWW	BE20	-193
TGG532	Melbourne Departures	A320	17
FOL	YSBK	FA50	72
QFA126	NZAA	B738	29

SIA245	WSSS	A359	-30
FD427	YBSU	B350	-121
QFA825	YPDN	B738	10
ANZ733	NZAA	A320	12
QFA626	Melbourne Departures	B738	16
JST935	YBCS	A320	11
VOZ1225	YSCB	B738	14
VEM	YSTW	SF34	10
VOZ1274	YBMA	F100	21
QFA632	Melbourne Departures	B738	20
VOZ38	AYPY	B738	10
JGO65	YSTW	E145	20
VOZ105	NZWN	B738	24
QFA550	Sydney Departures	B738	12
VOZ176	NFFN	B738	18
JST486	YWLM	A320	20
QLK381D	YHBA	DH8D	52
QLK759D	YMRB	DH8D	13
VOZ1250	YBRK	F100	13
VOZ1109	YWLM	B738	39
RXA5661	YBWW	SF34	44
VOZ1266	YEML	F70	-27
UAE430	OMDB	B77L	-17

Post Operational Performance Review

Brisbane Airport – 26th February 2018

Event Description

A review was initiated for operations at Brisbane Airport on the 26th of February 2018, for an observed elevated delay period during 08-12z[1]. Figure 26 and Figure 35 (next page) show the elevated delay period, from the Enterprise Data Warehouse (EDW) data. The following sequence of events can be inferred:

- Arrival throughput is under the tactical arrival rate for the period 22–07z, prior to the elevation in arrival delay (showing spare capacity for additional arrivals during this period), and then exceeds the rate during the 08z block.
- The following hour (09z), the arrival throughput drops below the tactical rate once again (13 aircraft landed in this period, with a tactical rate of 16).
- Subsequently, in the 10z block, there are only 3 arrivals. All of them occur at the end of the hour, after no arrivals for a period of 55 minutes.
- During 11z, the period with the highest arrival delay observed, the number of arrivals matched the MET CDM rate of 21 (one less than the tactical rate).
- Finally, during 12z, the arrivals drop below the tactical rate (arrival demand is below the tactical rate). The elevated arrival delay in this hour is caused by flights in the first 15 minutes, which were all part of the full sequence during the previous hour.

The CLDT (calculated landing time) vs. ALDT (actual landing time) comparison (Figure 35) shows the arrivals 'spilling over' into the next hour from their targeted arrival time. This behaviour is accentuated from 0800z[2] onwards, at the beginning of the high-delay period. Figure 27 shows the 75th-percentile of airborne arrival sourced from ODAS data, for comparison with the values obtained from EDW data (bottom panel of Figure 26). The ODAS data looks similar to the EDW-sourced values during the elevated delay period. The amount of delay from both sources is the same during 08z, but ODAS delays are larger by ~ three minutes across the 09-12z period. Note that this difference is relatively small in comparison to the 20+ minutes of delay, and results from different calculation methods applied to the two datasets: EDW airborne arrival delays are calculated as ALDT minus the first MAESTRO ETA, while the ODAS airborne arrival delay is calculated as the actual flight time within 250NM of the destination airport (ADES) minus the estimated (unimpeded) flight time within 250NM, derived from the trajectory created by Dali using the flight plan message.

The MET CDM process predicted a thunderstorm affecting the aerodrome, beginning at about 0800z and lasting for about three hours (08-10z), with lingering wet conditions beyond midnight local time. However, operational commentary suggested high levels of uncertainty around both the time the thunderstorm would hit, and the time a runway change would be forced. It appears that the time of each of these events was predicted roughly an hour earlier than experienced.

[1] Two digits followed by 'z', e.g. 01z, refers to the entire hour from 0100-0159 UTC

[2] Four digits followed by 'z', e.g. 0115z, refers to the exact time of 0115 UTC

A pre-tactical (MET CDM) rate of 16 was set during 08z, down from 21 the previous hour. However, the tactical rate was revised up to 18, and 22 flights were landed that hour. The runway mode was predicted to change during 09z, from runway 01 to runway 19, with a MET CDM and tactical rate of 16 and arrival throughput of 13. Runway 01 was used until almost 0945z, followed by a gap of 15 minutes before the first landing on runway 19, just before the end of the hour. However, two flights were able to depart from 01 in the first couple of minutes of 10z. The end-time of the thunderstorm activity (1100z) was accurately predicted, with conditions clearing enough to land 21 aircraft that hour, as was the lingering wet conditions that persisted for several more hours. Lead-in and lead-out rates were built into the planned rates, which accommodated the uncertainty surrounding the forecast.

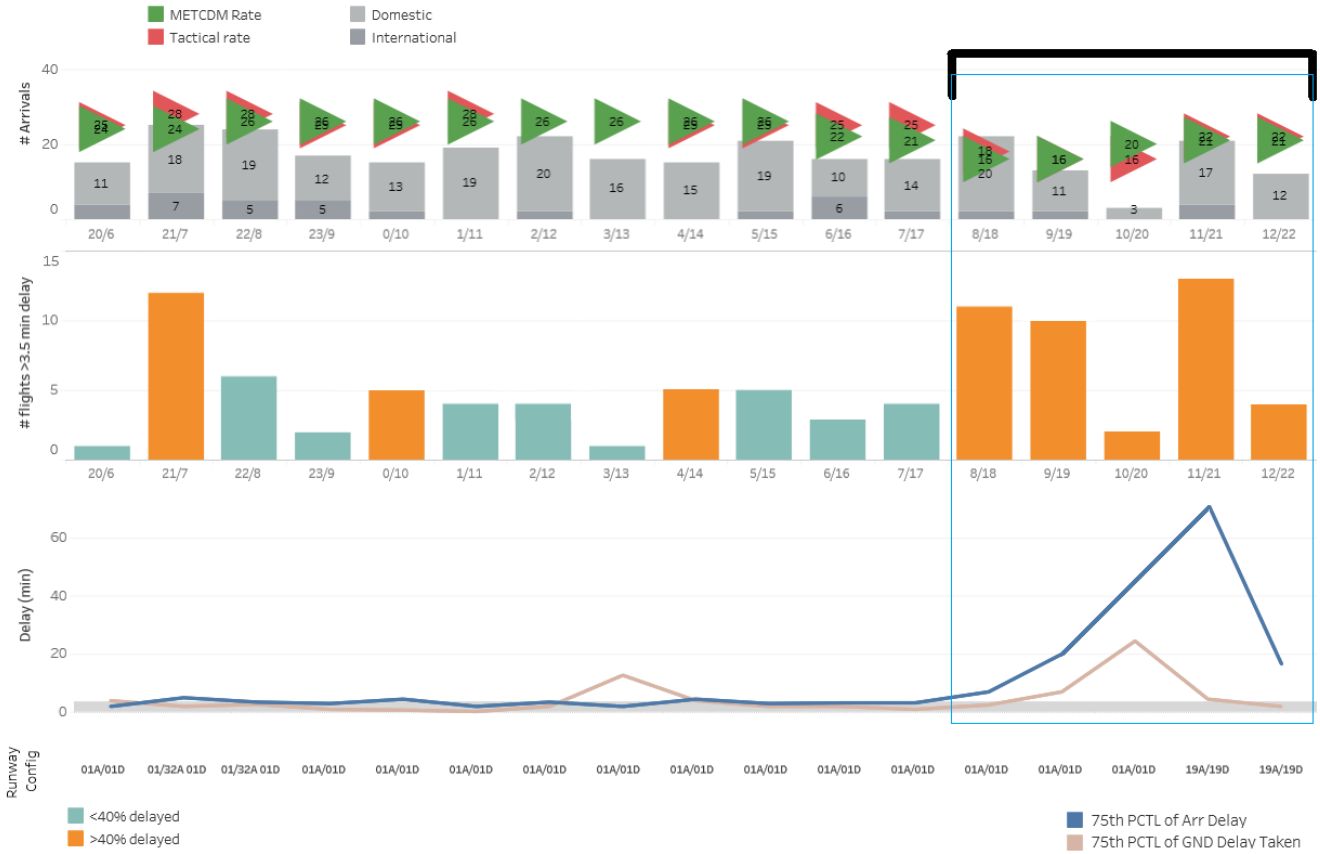

Figure 34 – Starting from the top panel, and going down: 1. Actual international and domestic arrival rates (grey bars) compared to the targeted tactical and METCDM arrival rates (in red and green, respectively). 2. Counts of the number of arrivals experiencing more than 3.5 minutes of airborne arrival delay, shown in orange if more than 40% of flights are delayed, in cyan otherwise. 3. 75th-percentile of airborne arrival delay (blue) and ground delay (brown). The black bar at the top of the image, with blue rectangle extending down over all the charts, highlights the period of elevated delay.

Figure 35 – Difference between the calculated landing time (CLDT, horizontal axis) and actual landing time (ALDT, vertical axis), by hour (UTC). This illustrates what the pre-tactical plan was and to what extent it was achieved (in terms of flights meeting the allocated landing slot). When increasing delays are experienced, this graphic will generally show a cascading effect of aircraft arriving late (shown in red), as aircraft arrive later than planned, as a result of the airborne delays. The blue rectangles highlight the period of elevated delay for the current event.

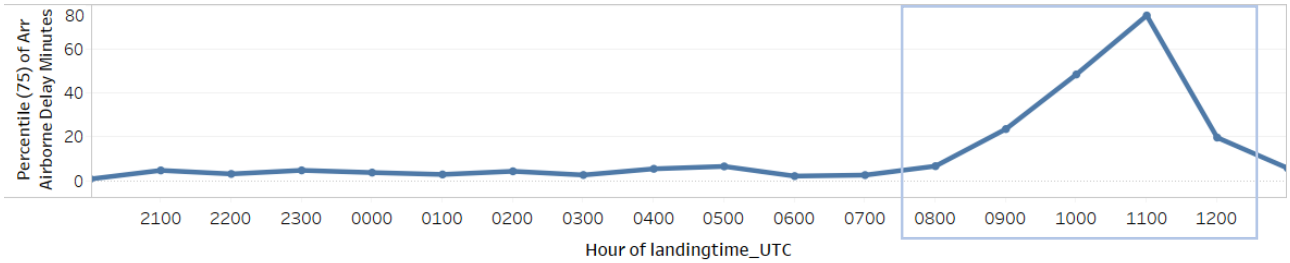

Figure 36 – Airborne arrival delay calculated using ODAS data. When compared to the EDW-sourced arrival delay, the values are similar for the hour block 0800z , then in the hour blocks 0900z to 1200z, the ODAS values are about 3 minutes higher. The blue rectangle shows the elevated delay period.

Analysis

Summary

The analysis concentrates on a period of elevated airborne arrival delay during 08z-12z. The MET CDM process predicted a thunderstorm beginning at about 0800z and lasting for three hours. However, weather radar images from the Bureau of Meteorology and ATIS information, and the fact that 22 flights landed during 0800z, suggest that the actual thunderstorm activity affecting the airport occurred during 09-10z, rather than the predicted 08-10z (as explored below).

The change from runway 01 to 19 was predicted during the 09z hour block, but operational commentary did indicate high uncertainty around the exact time the runway change would be forced. A single flight landed on runway 19 at 0958z (SIA245) as it was approaching the airport from the north and the storm was sitting south of the airport – two flights departed from 01 between 1000-1005z. Lingering wet and cloudy conditions were also predicted from 1100z onwards. There was a period of 55 minutes with no arrivals (1000-1055z) just prior to the runway change, with only three aircraft landing during 10z. Note

that the MET CDM process had increased the rate from 16 during 09z to 20 during 10z, indicating that weather conditions were expected to improve over the 10z hour block, while actual landings decreased to three in this block, from 13 the previous hour (09z). This indicates that the worst of the conditions were forecast to impact the airport earlier than when they actually eventuated.

Compliance of ATOT to CTOT may have been a contributing factor to the elevated arrival delay. During 08-12z 8 flights were deemed late non-compliant, 3 early non-compliant, 8 compliant with a difference of 10 or more minutes, and 8 flights were exempt (see Table 2 for a flight list). Additionally, in order to understand the accuracy of the CLDT an ETA was calculated using the time an aircraft gets within 250NM of Brisbane, and adding to it the flying time within 250NM obtained by the Dali prediction tool. The obtained estimated landing time is compared to the CLDT. This comparison revealed that 8 flights had an ETA at least 10 minutes before the CLDT, and 16 flights had an ETA at least 10 minutes after the CLDT (see Table 4 for a list of these flights).

Approximately 5 hours prior to the beginning of the elevated delay period (at 0300z), rain activity is observed in the Brisbane region. About three to four hours after this, the storms have intensified and are moving towards Brisbane Airport from the south. From 0811z FEW020 cloud is present in the ATIS message, at 0941z this changes to SCT010.

Just before 1000z (as the weather system was about to hit the airport from the south) arrivals switched from runway 01 to 19 (landing from the north instead of the south). One arrival landed on runway 19 (SIA245) before a period of about 55 minutes with no landings, before arrivals recommenced on runway 19. Five minutes after SIA245 landed, two flights departed from 01, likely due to the storm conditions being worse to the south of the airport.

When landings recommenced at 1055z, there was a period of about an hour and a half where every flight which landed had an airborne arrival delay exceeding 10 minutes. There were five gaps in the sequence of four minutes or longer. Six flights were diverted from Brisbane with landing times between 1015-1133z to either Gold Coast, Sunshine Coast or Rockhampton (see Table 5 for a list of these flights).

The maximum airborne arrival delay value provided in the Network Operations Report was 61 minutes (for flights not deprioritised due to non-compliance). However, seven flights (all in the 1100z hour block) exceeded this value (airborne delay figures taken from ODAS data). Of these flights,

- one flight, AVN20, was exempt (92 minutes of airborne arrival delay);
- two flights, VOZ351 and VOZ981, were deemed late non-compliant (64 and 114 minutes of airborne arrival delay, respectively); and
- four flights were compliant, QJE1554, QFA634, QLK419D and QLK369D (70, 79, 77 and 77 minutes of airborne arrival delay, respectively).

Two CIRRIS occurrences (ATS-0159451 and ATS-0159452) were recorded in the Brisbane region during the delay period, and they may indicate other compounding factors in this event. They indicate a radar failure (from 0757z for 24 hours) affecting Brisbane TCU and ADS-B site monitor failures affecting enroute traffic (from 1009z lasting for 23 minutes). However, the impact to ATS for both occurrences is indicated to be nil/minor.

*Table 5- Flights diverted from YBBN on 2018/02/26 between 1015-1200z. * all landing times on 2018/02/26 UTC day*

ACID	ADES	ALDT *
JST783	YBSU	1015z
QJE6202	YBCG	1037z
VOZ454	YBSU	1058z
TFX129	YBRK	1108z
QJE1757	YBCG	1122z
TFX103	YBSU	1133z

Timeline of Events

When the delay begins to increase (0800z), see Figure 28, the weather has intensified and begun to move closer to Brisbane Airport, and low cloud is reported in the ATIS message. At 0811z ATIS indicated wind 010/15, cloud FEW020, visibility 10km and some delay expected for southbound departures due to weather. At 0852z, ATIS information remains the same, with the addition of thunderstorm observations to the south, and to expect turbulence around 1000z. At 0941z there is a change in cloud to SCT010 and slight change in wind (010/12).

During 08z (see Figure 29):

- Three aircraft have airborne delay of 10 or more minutes (all in the last half hour)
- Three flights had a departure delay of 20 or more minutes (all in the last half hour)
- There are four gaps in the arrival sequence of about five minutes, and seven or eight gaps of five or minutes in the departure sequence
- Two flights, VOZ751 and JST442 (landing at 0834z and 0857z, respectively) are diverted flights originally scheduled to land at Gold Coast. Operational commentary suggested diversions from Gold Coast were potentially expected when the storm swept through Gold Coast Airport prior to it reaching Brisbane, these are the only two flights which were diverted to Brisbane Airport

During 09z (see Figure 30):

- Six flights have an airborne delay of 10 or more minutes
- More gaps in the arrival sequence have occurred (three of five or more minutes), and at the end of the hour there is a 15-minute gap before arrivals switch to the opposing runway (19 instead of 01) – one flight lands in this gap on the crossing runway 14
- Two flights had a departure delay of 20 or more minutes
- There is also a gap of 15 minutes in the departure sequence at the end of this hour (five gaps of five or more minutes prior to this), before two flights depart at the start of the next hour. These flights depart from runway 01 (with a flight, SIA245, landing on runway 19 five minutes earlier). At this time (approx. 1000z) the weather system is sitting just to the south of the airport, and SIA245 is approaching from the north, so it was allowed to land from the north, before two final flights were allowed to depart to the north just before the weather stopped all movements.

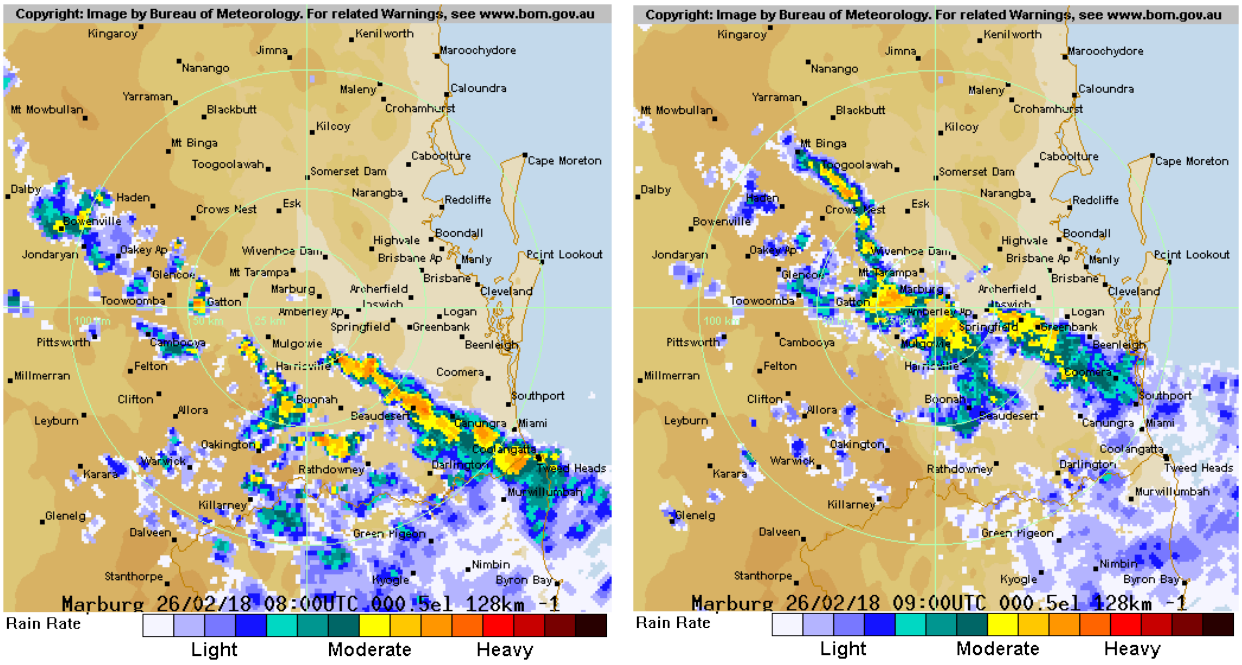

Figure 37- Left: weather further intensifying around Brisbane at 0800 UTC (moving closer to the airport). Right: weather moving within about 30km of Brisbane Airport at 0900 UTC. NOTE: Brisbane Airport is approx. 60km NE of image centre (top right quadrant).

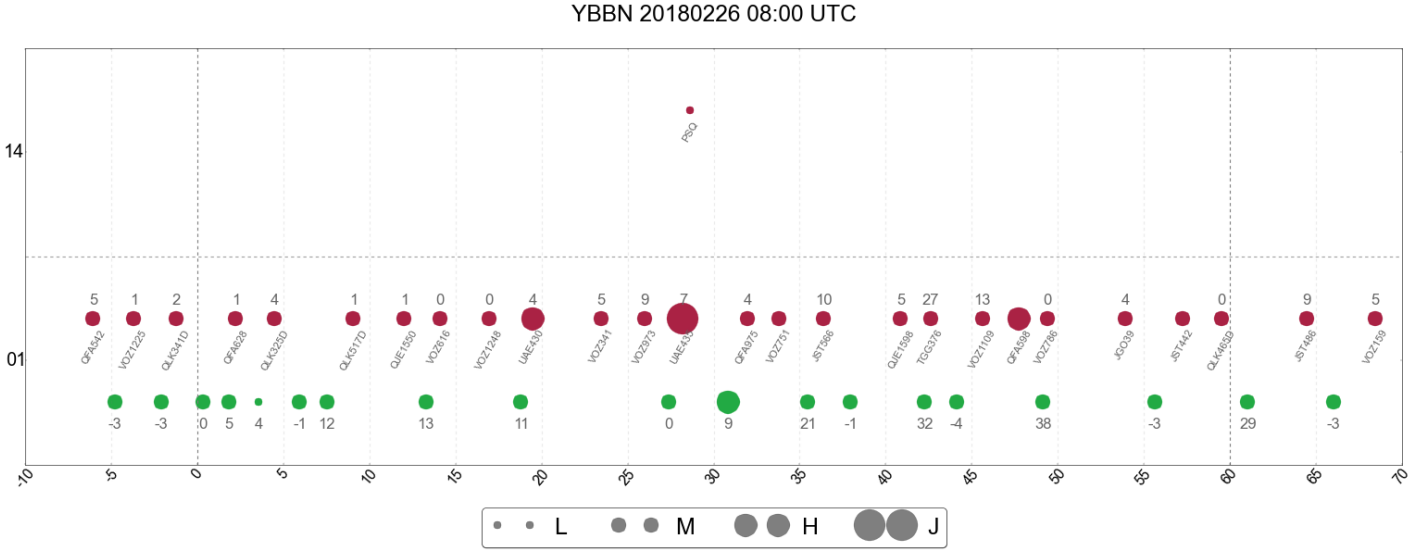

Figure 38- Arrivals (red) and departures (green) during the 0800z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals (bottom to top) is airborne arrival delay, ETA (ODAS/Dali sourced) minus CLDT and ATOT minus CTOT (all in minutes).

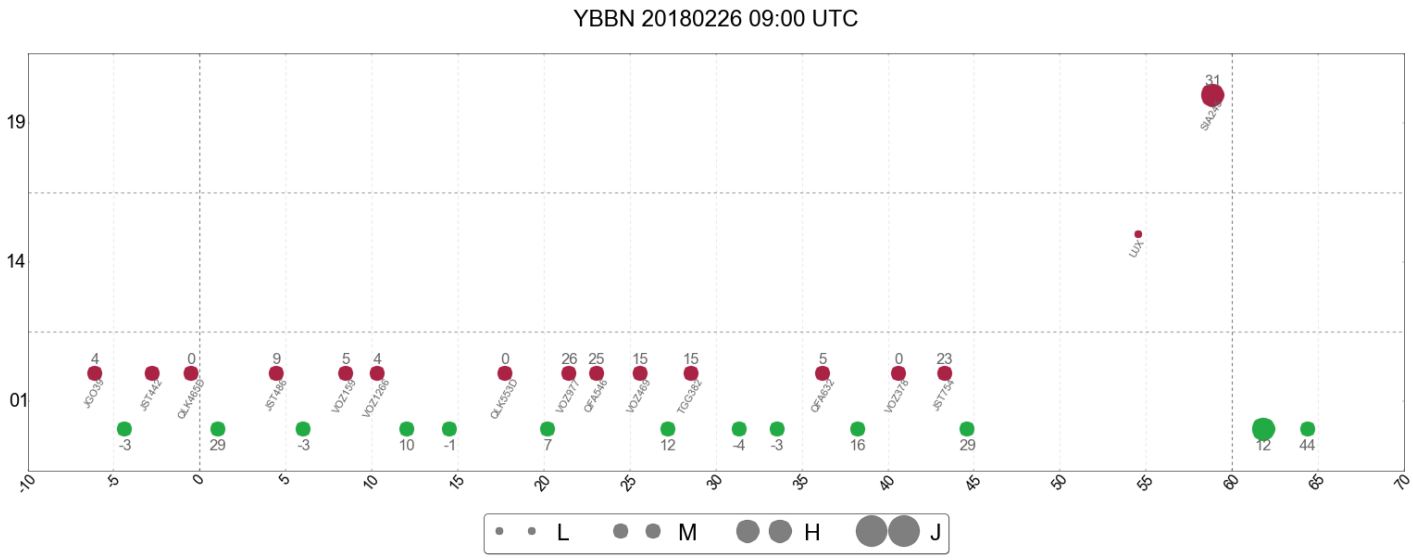

Figure 39- Arrivals (red) and departures (green) during the 0900z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals (bottom to top) is airborne arrival delay, ETA (ODAS/Dali sourced) minus CLDT and ATOT minus CTOT (all in minutes).

Figure 40 shows that the storm move through the TMA during 10z – at 1000z the worst of the weather is south of the airport, and by 1100z the worst of the weather is north of the airport.

At around 1000z the ATIS conditions have deteriorated with lightning, cloud and rain present. Around 1100z strong weather is still in the vicinity of the airport but now the majority of rain is falling north of the airport (instead of south – like an hour earlier), the ATIS conditions have not improved.

During 10z (see Figure 31):

- three flights arrived in the last seven minutes (none arrived before this), two of these had 10+ minutes of arrival delay (the other flight could not be measured).
- six flights (out of seven) had a departure delay of 20 or more minutes.

During 11z (see Figure 32):

- 18 flights (all where a valid calculation could be made) had 20+ minutes of arrival delay (maximum of 114 minutes, minimum of 36 minutes)
- there appear to have been a couple of gaps in the arrival sequence (one of about 10 minutes at the start of the hour)
- eight flights (out of nine) had a departure delay of 20 or more minutes.

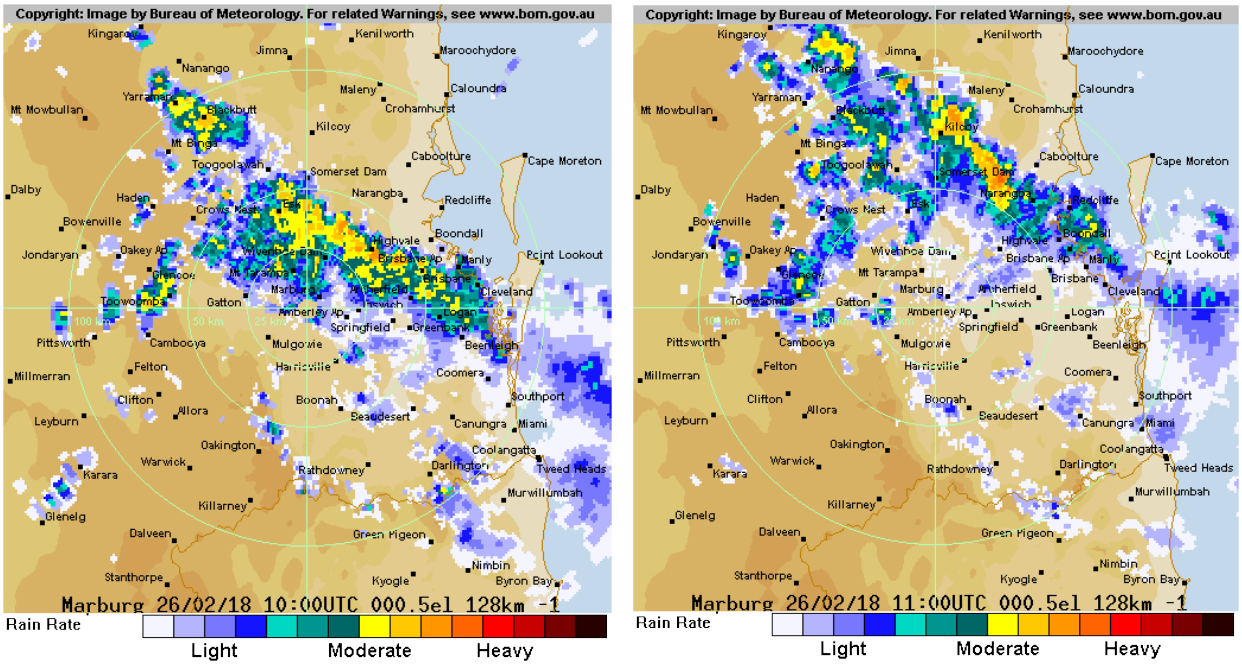

Figure 40- Left: weather in close proximity to Brisbane Airport at 1000 UTC. Right: weather moving away from Brisbane at 1100 UTC, however still intense weather to the north-west of the airport (some rain still lingering near the aerodrome). NOTE: Brisbane Airport is approx. 60km NE of image centre (top right quadrant).

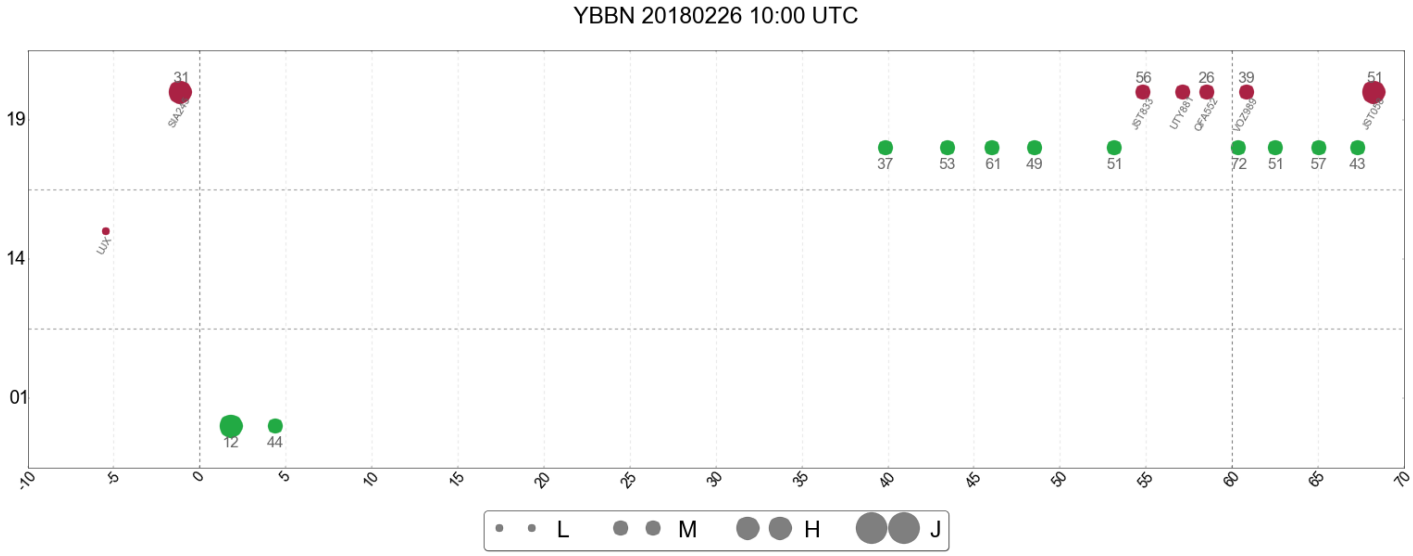

Figure 41- Arrivals (red) and departures (green) during the 1000z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals (bottom to top) is airborne arrival delay, ETA (ODAS/Dali sourced) minus CLDT and ATOT minus CTOT (all in minutes).

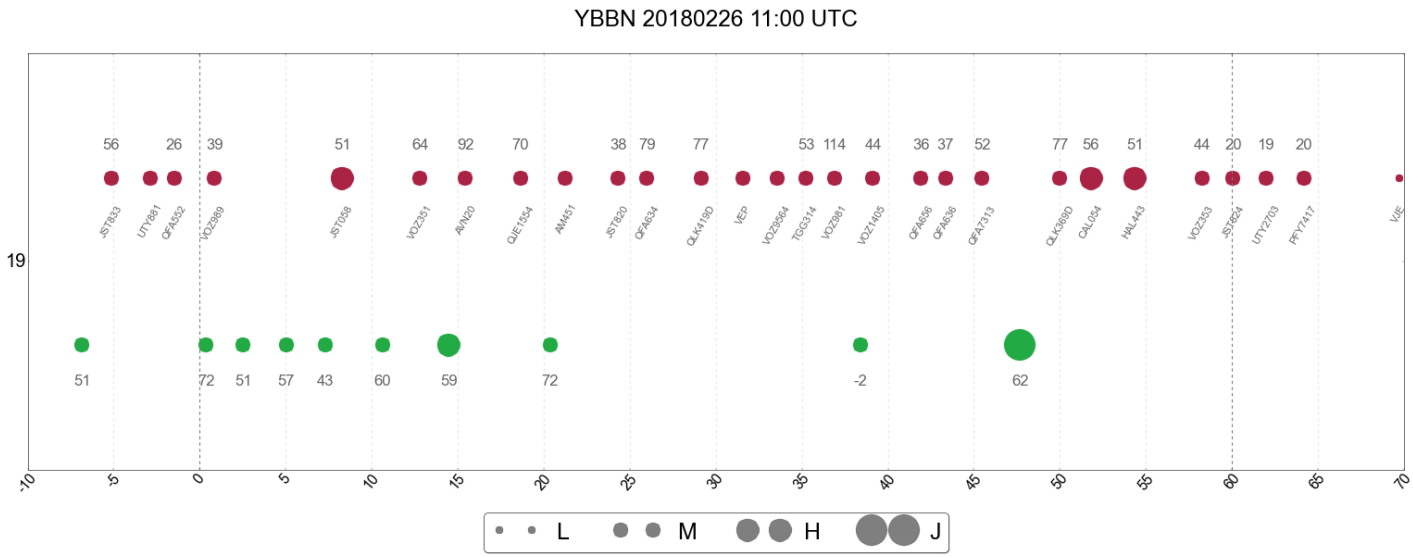

Figure 42- Arrivals (red) and departures (green) during the 1100z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals (bottom to top) is airborne arrival delay, ETA (ODAS/Dali sourced) minus CLDT and ATOT minus CTOT (all in minutes).

Figure 43 shows the worst of the storm leaving the airport region between 1200 and 1300 UTC.

Around 1200z the ATIS conditions have improved, although showers, turbulence and cloud still linger. The next ATIS release is about two and a half hours later (1436z), with very similar conditions to 1200z.

During 12z (see Figure 33):

- seven flights had 10+ minutes of arrival delay in the first 20 minutes of the hour. After this time, delay values drop, as this is the end of the full sequence arriving after the storms prevented landings for 55 minutes (between about 1000 and 1055 UTC)
- five flights had a departure delay of 20 or more minutes – two additional flights have 20+ minutes of arrival delay in the first 5 minutes of the 13z hour, with 35 minutes before the next departure.

Four gaps in the departure sequence of over 10 minutes appeared during 11-12z– with several flights departing soon after the gaps having 10 (or more) minutes of departure delay.

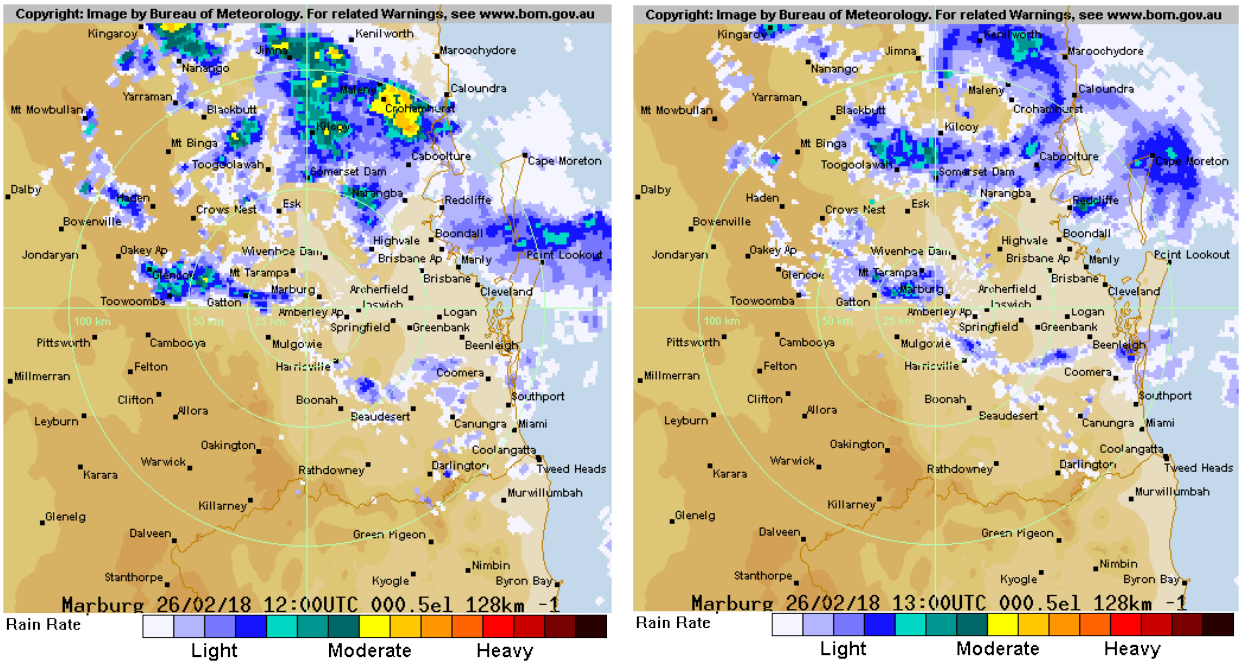

Figure 43- Left: weather dissipating near Brisbane at 1200 UTC. Right: weather further dissipating at 1300 UTC. NOTE: Brisbane Airport is approx. 60km NE of image centre (top right quadrant).

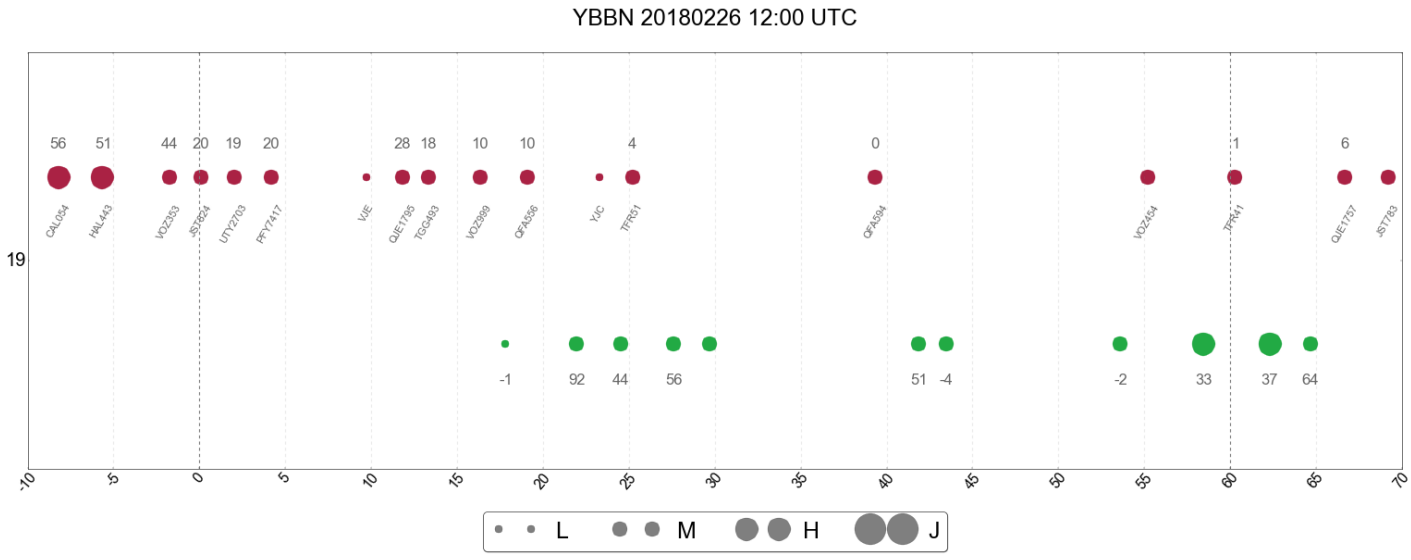

Figure 44- Arrivals (red) and departures (green) during the 1200z hour block. The dot sizes represent the wake-turbulence category of the aircraft - L (light), M (medium), H (heavy) and J (super-heavy). The y-axis shows the runway(s) in use, the x-axis shows the number of minutes past the hour. Annotated below departures is the estimated departure delay (ATOT minus CTOT, if flying to GDP airport, otherwise ATOT minus ETD). Annotated above arrivals (bottom to top) is airborne arrival delay, ETA (ODAS/Dali sourced) minus CLDT and ATOT minus CTOT (all in minutes).

Summary

This review focused on a delay event (sustained delays exceeding 10 minutes) occurring in the late afternoon/early evening time period at Brisbane resulting from a thunderstorm moving across the region. Departures stopped from 1005-1040 UTC and arrivals stopped from 1000-1055UTC. After this gap, operations switched from runway 01 to 19. The thunderstorm impacted the airport one hour later than pre-tactically forecast, and for only two hours as opposed to three in the forecast. However, the

prediction did forecast the runway change which assists in managing the impact of a severe weather event.

Large departure and arrival delays were experienced by almost all aircraft for over an hour after operations recommenced. Seven flights in the hour after arrivals recommenced had arrival delay exceeding 60 minutes (maximum of 114 minutes). There were seven gaps of at least five minutes before arrivals stopped for 55 minutes, and three such gaps in the hour and a half after arrivals recommenced. This indicates that there were unfavourable conditions for aircraft to land. Six flights also diverted from Brisbane to nearby airports (Gold Coast, Sunshine Coast and Rockhampton), all landing between 1015-1133z. These flights were likely due to land at Brisbane during the thunderstorm, it is possible that some gaps in the sequence are where these aircraft would have otherwise landed. These diverted flights would have decreased the magnitude of delay experienced by the remaining flights.

The duration of the thunderstorm was significant and it is typically difficult to estimate how long a thunderstorm may impact on an airport. The amount of delay able to be absorbed by some of the arriving aircraft indicates most airline operators had planned appropriate fuel reserves to arrive after the storm had passed.

The key learnings from this review include:

- The impact of prolonged airport shutdowns and runway changes, on the level of arrival delay and diversions. Seven flights incurred more than 60 minutes of arrival delay, and six flights diverted to other aerodromes.

For further information please contact Network Performance and Analysis @ OPS_ANALYSIS_ADMIN@AirservicesAustralia.com

Table 6- Flights in the hour blocks from 0600-1000z, are either: exempt, early/late non-compliant, or compliant with at least a 10 minute difference between CTOT and ATOT.

ACID	ADEP	ATYP	CTOT-ATOT	CTOT Compliance
QFA546	Sydney Departures	B738	11	Compliant
QJE1795	YBTL	B712	13	Compliant
UAE435	NZAA	A388	0	Exempt
TGG314	YPAD	A320	15	Compliant
JST058	WADD	B788	3	Exempt
YJC	YTWB	AC50		null
QLK553D	YROM	DH8D	-11	Early Non Compliant
VJE	YBRK	D228	11	Compliant
HAL443	PHNL	A332		Exempt
VOZ1109	YWLM	B738	12	Compliant
TGG376	Sydney Departures	A320	46	Late Non Compliant
AVN20	NVSS	B738	35	Exempt
QLK325D	YBUD	DH8D	26	Late Non Compliant
UAE430	OMDB	B77L	14	Exempt
VOZ159	NZAA	B738	-2	Exempt
JST486	YWLM	A320	11	Compliant
VOZ341	Melbourne Departures	B738	26	Late Non Compliant
TGG382	Sydney Departures	A320	34	Late Non Compliant
VOZ378	YBTL	B738	25	Late Non Compliant
VEP	YSTW	SF34	-38	Early Non Compliant
CAL054	NZAA	A333	0	Exempt

VOZ351	Melbourne Departures	B738	18	Late Non Compliant
VOZ751	Melbourne Departures	B738		null
SIA245	WSSS	A359	1	Exempt
VOZ981	Sydney Departures	B738	18	Late Non Compliant
VOZ1248	YBRK	F100	19	Late Non Compliant
JGO39	YSWG	E135	-21	Early Non Compliant
QJE1598	YPAD	B712	10	Compliant
JST442	Melbourne Departures	A320		null
QJE1550	YSCB	B712	11	Compliant

Table 7- Flights in the hour blocks from 0600-1000z, have at least a 10 minute difference between Dali ETA and CLDT.

ACID	ADEP	ATYP	ETA-CLDT
VOZ973	Sydney Departures	B738	-13
QFA556	Sydney Departures	B738	-12
UTY881	YTEE	F100	16
TFR51	YPDN	B733	20
QJE1795	YBTL	B712	10
QLK553D	YROM	DH8D	-15
VJE	YBRK	D228	14
JST820	Sydney Departures	A320	-13
VOZ1109	YWLM	B738	22

TGG376	Sydney Departures	A320	43
QLK325D	YBUD	DH8D	19
UAE430	OMDB	B77L	13
JST486	YWLM	A320	22
VOZ341	Melbourne Departures	B738	30
TGG382	Sydney Departures	A320	26
VOZ378	YBTL	B738	26
VEP	YSTW	SF34	-33
VOZ351	Melbourne Departures	B738	16
SIA245	WSSS	A359	-17
VOZ981	Sydney Departures	B738	13
VOZ1248	YBRK	F100	20
UTY2703	YBMA	F100	22
JGO39	YSWG	E135	-36
VOZ454	YBSU	B738	-10

Post Operational Performance Review

Perth Airport - 7th February 2018

Event Description

Elevated arrival delay was observed in the morning during the two hours between 0200z and 0400z (1000-1200 local) at Perth on 7 February 2018 (see Figure 1). The airborne arrival delay (75th percentile) in this period peaked at 11 minutes.

Runways 21 and 24 were originally planned for 0030-0600z but as a result of low cloud base only runway 21 was operated from 0100z. As a result the tactical rate during 0100z-0600z was reduced from 26 (MetCDM plan) to 24. The actual arrival rate between 0200z and 0400z was 21 on average and thus remained below the tactical rate.

This report reviews the individual estimated and actual landing times of each flight to explore why, despite sufficient capacity, the delay spiked.

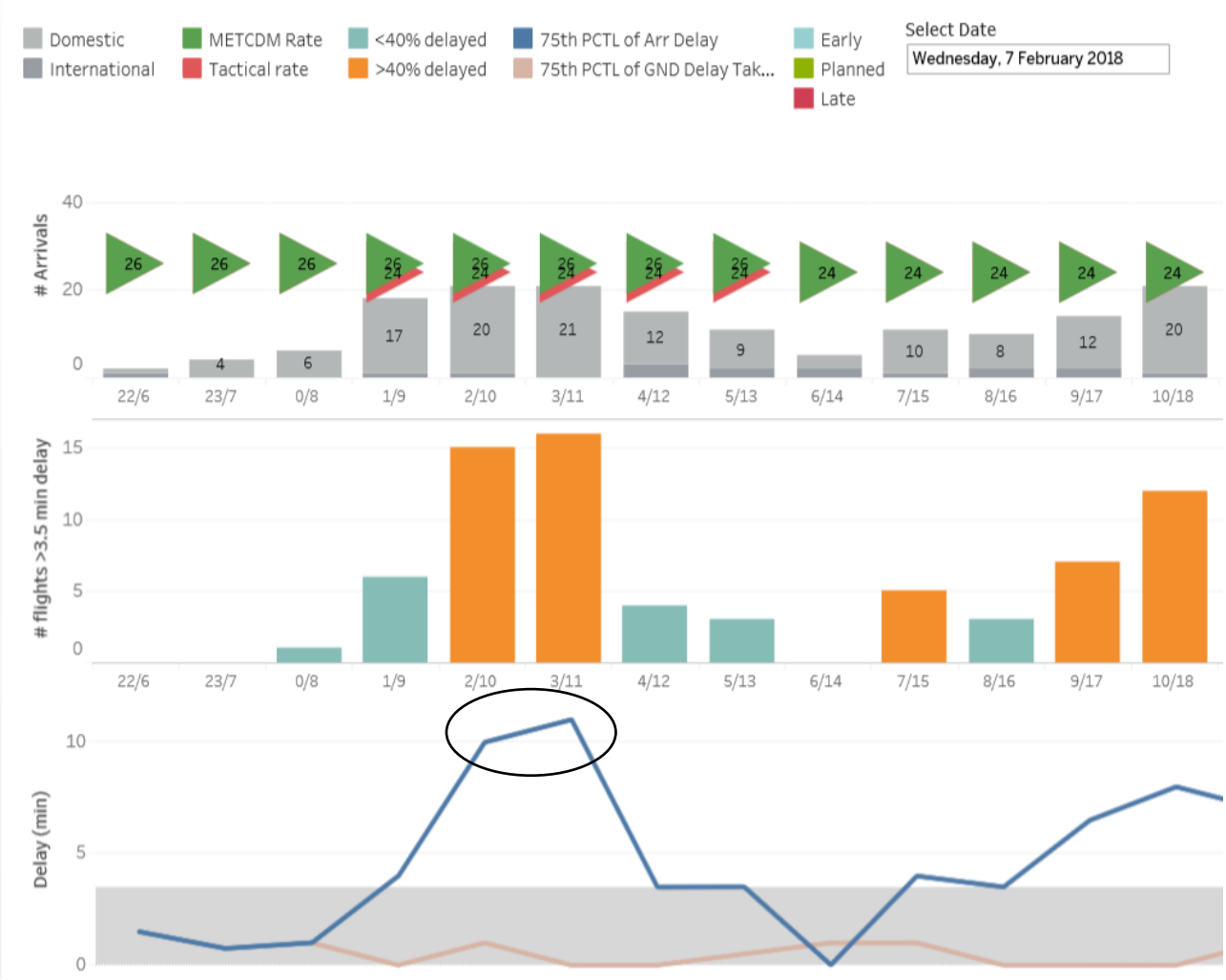

Figure 45: Hourly number of arrivals (top), proportion of delayed flights (centre) and 75th percentile delay (bottom)

Analysis

Table 1 and Figure 1 compare the calculated, estimated (demand) and actual arrivals during the period of elevated arrival delay between 0200 and 0400z. For reference, the tactical rate as the maximum number of landings possible, and the MetCDM is given. All flights were domestic arrivals, with one exception. The 0200-0215z window is characterised by low demand with only four arrivals (both estimated and actual). This is 2 arrivals below the tactical rate effectively resulting in spare capacity of 2 slots.

The estimated time of arrival (ETA) is sourced from the ODAS database. The ETA is calculated post operations, using the actual flight path until reaching 250NM to the airport and then the time of the predicated flight path by DALI (including the predicted STAR and approach). This represents the demand presenting at 250NM.

From 0215z onwards, the demand increased significantly, and there is a period of 90 minutes (0215-0345z) where the actual rate equalled the tactical rate of 6 arrivals per 15min. During the 0215-0230z interval a group of 10 arrivals presented at 250NM (left circle) which triggers cascading delay that affects all following flights, from 0330z there was spare capacity when demand dropped to 4 arrivals per 15min. Further delay follows as a second group of arrivals with ETA around 0320z (right circle) results in a second spike of delays that lasts until 0330z.

	Landing window (UTC)							
	2				3			
	0	15	30	45	0	15	30	45
tactical rate (Maestro)	6	6	6	6	6	6	6	6
MetCDM rate	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Calculated (based on CLDT)	4	**6**	**7**	5	**7**	6	5	0
estimated (based on ETA)	4	**10**	**7**	5	6	6	4	2
actual (based on ALDT)	4	6	6	6	6	6	6	3
demand > tactical	BELOW	ABOVE	ABOVE	EQUAL	EQUAL	EQUAL	BELOW	BELOW

Table 1: Arrival rate (tactical, METCDM, calculated, estimated and actual) in 15min-intervals for the 2-hour period. Estimated rates above the tactical rates are marked red.

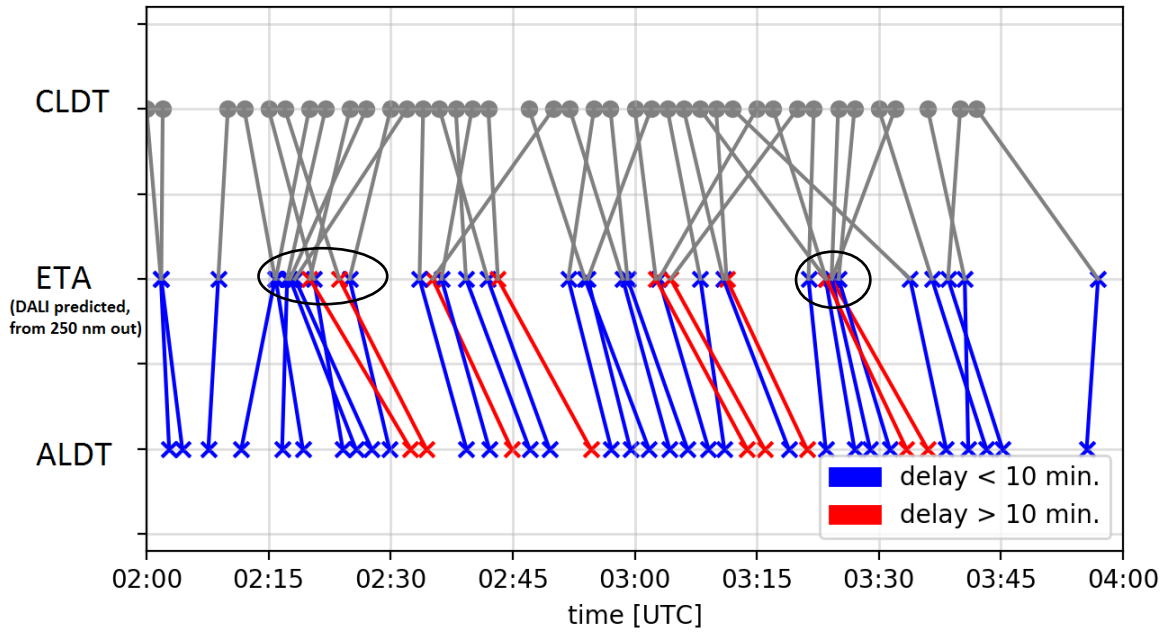

Figure 2: Deviation between calculated (CLDT, top), estimated (ETA (Dali predicted @ 250NM), centre) and actual landing time (ALDT, bottom). Blue lines represent flights arriving more less than 10 min after their ETA, red lines arriving more than 10 minutes past their ETA.

Summary

During the late morning hours (0200-0400z, 1000-1200 local), arrivals at Perth showed a spike in delay (> 10 minutes) despite the number of arrivals not reaching the maximum capacity as described by the tactical (maestro) rate.

The review found the cause of this delay was due to an imbalance in the hourly demand that presented to the TMA, with a group of 10 flights planning to arrive at the airport within a very short time window (about 10 minutes) around 0220z. In addition to causing delays to these ten flights, it also triggered a cascade that increased the average delay of all following flights and was not fully resolved until more than 90 minutes later.

For further information please contact Network Performance and Analysis @
OPS_ANALYSIS_ADMIN@AirservicesAustralia.com

Appendix B

Corporate Plan Key Performance Indicator Profile: Arrival airborne delay

Corporate Plan Description:

The median (and 75th percentile) excess time incurred during the arrival airborne phase of flight in reference to the estimated time of arrival for high-volume operations. (High volume operating environments defined as Brisbane, Melbourne, Perth and Sydney).

Corporate Plan Targets:

Year	17/18	18/19	19/20	20/21	21/22
75%	3.5	3.4	3.3	3.2	3.1
Median	0.6	0.6	0.6	0.6	0.6

What is it: Excess time incurred during the arrival phase of flight.

What is measured: It is measured by comparing the estimated flight time and actual flight time for the portion of the flight within 250 NM of the destination aerodrome.

Why 250NM: The 250NM threshold has been identified as the distance from the aerodrome at which arrival demand/capacity balancing measures and arrival flight paths start taking effect. It is a true reflection of the tactical arrival management of the flight, and is not skewed by other non-related issues such as congestion at the departure aerodrome.

Why measure Median rather than Average/Mean: In some cases, the actual flight time within 250NM of the destination aerodrome will be less than the estimated flight time (e.g.: ATC has provide track shortening). In the dataset, this translates into a 'negative' value for that particular flight.

The Median shows the mid-point of the data set and allows us to demonstrate our impact on all flights, not just the ones that were delayed. Additionally, over short timeframes and small datasets (such as a daily report), Median measurement is more resilient to data errors and small groups of outliers which may skew the average.

Why measure the 75th percentile: This supplements the Median and is valuable to demonstrate how effectively we have managed the arrival of most of the fleet.

The last 25th percentile can typically contain arrival data from flights that were impacted by non-routine events, such as Medical priority traffic or aircraft in an emergency or diversion.

How do we measure:

Uses the high-fidelity Dalí trajectory-based model. For Sydney, some assumptions are built in to calculations as the actual flight path is unique for each flight.