Australian Government
Bureau of Meteorology

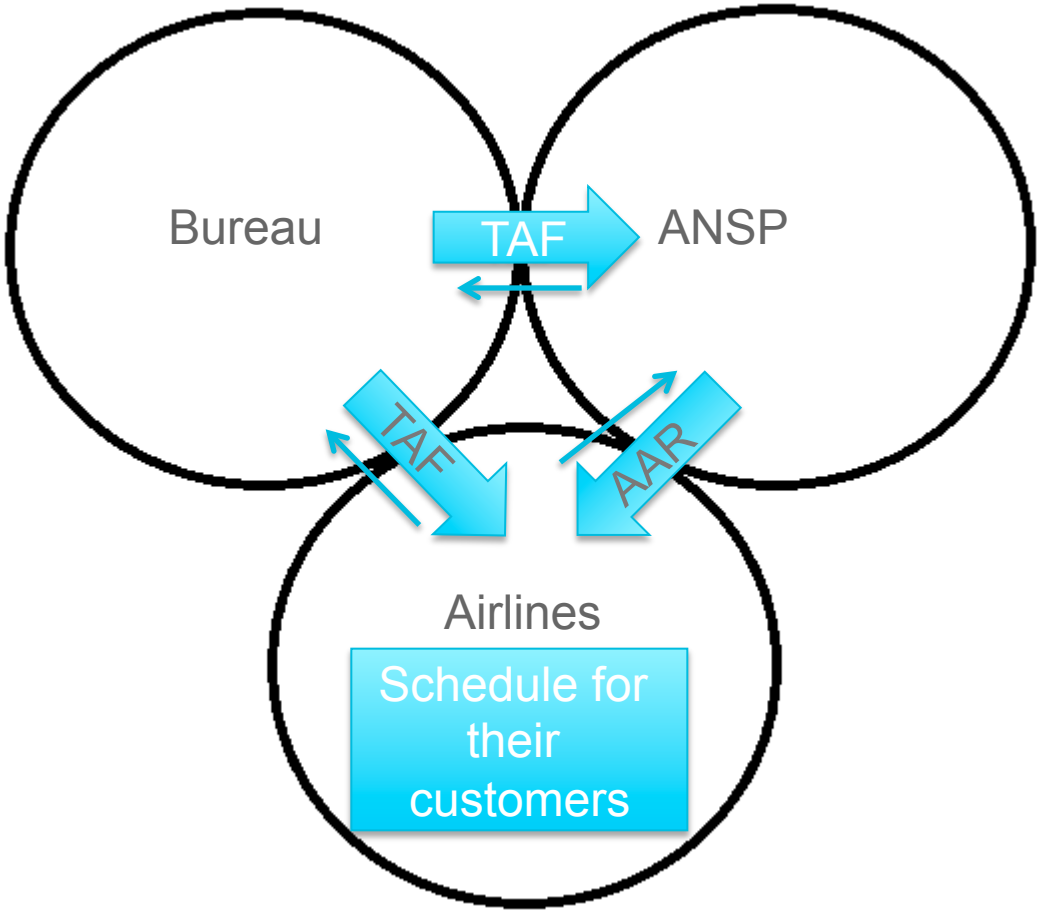
Collaborative Decision Making
MET-CDM

Australian Government
Bureau of Meteorology

How information flowed between areas of expertise (Pre-METCDM)

TAF not suitable for ATFM.

Forecaster priority problem for ATFM

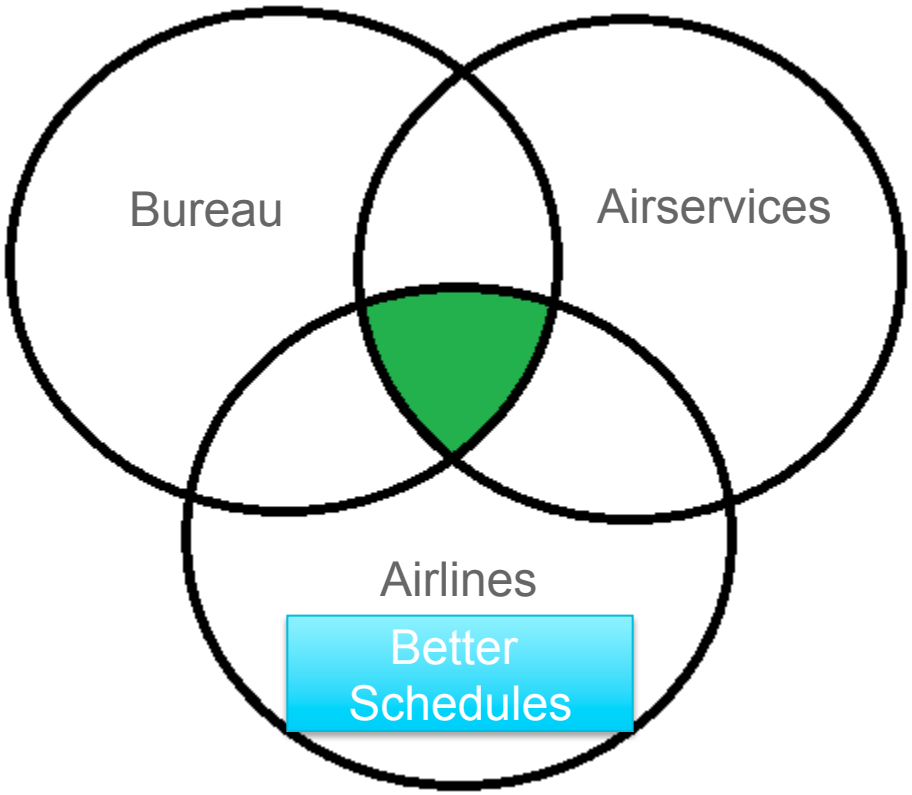


Australian Government
Bureau of Meteorology

MET CDM
Understanding each others business

NCC MET dedicated to ATFM

Flexible and adapting products to solve the problem



Fully transparent process

TM has final endorsement

Airline MET units collaborate

Provides transparency and better certainty

Australian Government
Bureau of Meteorology

MET CDM

- Collaborative approach between Airservices, Bureau of Meteorology, Qantas (Met) and Virgin Australia (Met).
- Process requires people with combined expertise in meteorology and ATFM.
- Ground delay program.
- Forecast delay related to:
  - forecast weather ATFM impacts and;
  - forecast demand on capacity.
  - Highly complex problem.
- Prior to Met CDM acceptance rates calculations were based on TAF.
- Refined acceptance rates through MET CDM.

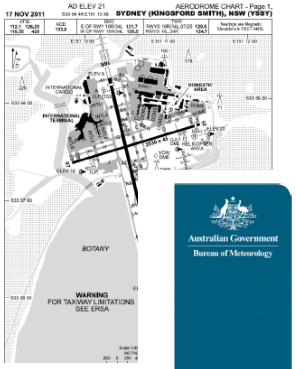
Australian Government
Bureau of Meteorology

Reference Cards

- Process requires people with combined expertise in meteorology and ATFM.
- Reference cards developed to date reflect the known parameters that affect traffic flows at the airports.
- They are a reflection of documentation and discussions with Airservices traffic management.
- Reference cards managed jointly.

YSSY Air Traffic Operations

Sydney is the busiest international airport in Australia consisting of twin moderately spaced parallel runways in the direction 16/34 magnetic, and a single cross runway of 07/25 magnetic.

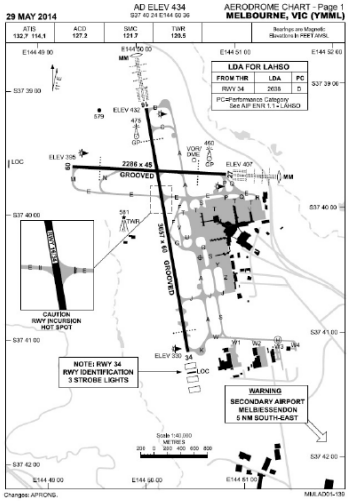


Curfew
Curfew regulates aircraft taking o
landing between the hours of 11p
6am. A limited number of schedu
approved take-offs and landings
permitted respectively in the "sho
periods" of 11pm to midnight and
8am, by Section 12 of the *Sydne*
Curfew Act 1995.

Aircraft Arrival Rates (AAR)
Sydney Airport has a legislated c
80 aircraft movements per hour w
cannot be exceeded. For arrivals
Sydney Airport has the capacity t
rate of 46 or 50 on the parallel ru
and 24 on the cross runway.

YMML Air Traffic Operations

Melbourne is the second busiest international airport in Australia consisting of two intersecting runways in the direction 16/34 magnetic and 09/27 magnetic.



Noise Abatement
There is no curfew at Melbourne airport. However, noise abatement procedures apply. These procedures include a preference to use runway 16 for noise abatement, particularly in the overnight

Terminal Area (TMA)
This term is used to describe the designated area of controlled airspace surrounding a major airport where there is a high volume of traffic. The Terminal Area (TMA) is a 30nm radial area

airservices

Airservices MET CDM Rate Calculator

Software Version 2.1.84

Autoload TAF

EMAIL COPY TO SUPPORT

LATEST TAF | RECALCULATE | CLEAR DATA

```
TAF AMD YBBN 0505122 0506/1012
01014KT 9999 FEW040
FM091200 30006KT CAVOK
FM092400 17008KT 9999 SCT030
FM100200 12015KT 9999 SCT025
FM101000 14007KT 9999 SCT020
INTER 1002/1008 6000 SHRA BKN020
PROB30 TEMPO 1003/1008 VRB30G45KT 1000 TSRA BKN010 BKN050CB
RMK
T 26 24 23 21 Q 1009 1010 1011 1010
```

YBBN — Tuesday, 10 Oct 2017 - Run 1 - Final

First Light: 1852
Last Light: 0815

BUSINESS RULES RATES FROM TAF (SHOW / HIDE CALCULATIONS)

DATE/TIME	092000	092100	092200	092300	100000	100100	100200	100300	100400	100500	100600	100700	100800	100900	101000	101100	101200
BUSINESS RULES SUMMARY																	
BR RWY	01/32	01/32	01/32	01/32	19	19	19	19	19	19	19	19	19	19	19	19	
Tailwind (Worst)	-0.3	-0.3	-0.3	-0.3	-6.4	-6.4	-0.8	45.0	45.0	45.0	45.0	45.0	-0.8	-0.8	-2.7	-2.7	
Crosswind (Worst)	6.0	6.0	6.0	6.0	4.8	4.8	15.0	45.0	45.0	45.0	45.0	45.0	15.0	15.0	6.4	6.4	
BR Approach Mode	CROPS	CROPS	CROPS	CROPS	IMC	IMC	IMC	LVO/FOG	LVO/FOG	LVO/FOG	LVO/FOG	LVO/FOG	IMC	IMC	IMC	IMC	
BR Rate	28	28	28	28	24	24	24	12	12	12	12	12	24	24	24	24	
RESET BELOW	MET CDM RATE (EXPAND/COMPACT MET CDM)																
Wind °True (LOAD WINDS)	240	230	210	190	090	080	080	100	120	120	120	120	140	140	140	150	150
Significant Wind Speed	5	5	5	5	7	10	14	15	16	18	18	16	15	14	12	10	10
Anticipated RWY	19	19	19	19	01	01	01	01	19	19	19	19	19	19	19	19	19
Tailwind (Main RWY)	-4.2	-4.6	-5.0	-4.6	-3.2	-8.0	-8.4	-4.4	-0.8	-0.9	-0.9	-0.8	-5.9	-5.5	-4.7	-5.4	-5.4
Crosswind (Main RWY)	2.7	2.0	0.3	1.5	6.2	8.0	11.2	14.3	16.0	18.0	18.0	16.0	13.8	12.9	11.0	8.4	8.4
Tailwind (Cross RWY)																	
Crosswind (Cross RWY)																	
Anticipated Approach	VMC	VMC	VMC	IMC	IMC	IMC	IMC	TS-21	TS-21	TS-21	TS-22	IMC	IMC	IMC	IMC	IMC	IMC
MET CDM Initial Rate	24	24	24	24	24	24	24	21	21	21	22	24	24	24	24	24	24
MET CDM Notes	1	1	1	1&2	2	2	3	3	3	3	3&4	4	4	5	5	5	5
MET CDM X-Factor (EXPORT PDF)							-1					-1		-1	-1	-1	-1
MET CDM Final Rate (NOTIFY SMTM)	24	24	24	24	24	24	23	21	21	21	22	23	24	23	23	23	23
SMTM Notes																	
SMTM X-Factor																	
Final Arrival Rates (NEXT)	24	24	24	24	24	24	23	21	21	21	22	23	24	23	23	23	23

Passengers

NON MET CDM NOTES (SHOW / HIDE CDM)

Non MET CDM Notes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
DATE/TIME	092000	092100	092200	092300	100000	100100	100200	100300	100400	100500	100600	100700	100800	100900	101000	101100	101200
Previous Arrival Rates																	
Programmed Rates (?) (ACCEPT RATES)																	

MET CDM Notes

1. A pre-frontal trough moves through with a weak SW change, so have opted for RWY 19.
2. A stronger low level SE change develops along the coast to the south, with local winds turning E'ly ahead of that to favour RWY 01 by around 00Z. There is the possibility of showers developing on the leading edge of this change as it spreads northwards.
3. The main low level SE wind change begins to move through from around 02 or 03Z, with winds turning through ESE to SE and increasing to 15 to 20 knots aloft below about 2000ft during the early afternoon. There is the risk of low level wind shear as the change develops due to its initial shallowness. As the change spreads north and inland, this provides a trigger for more significant showers and thunderstorms. Given that the change initially is shallow as it spreads inland, and steering level winds are WSW 20 to 25 knots, there is enough of a risk that these will affect approaches onto RWY 01 and also occur near the airport once the low level capping inversion is broken.
4. As the SE change spreads further north and inland and deepens, the main instability zone shifts further west and north with areas directly upstream of the airport less likely to see showers and thunderstorms with a reduced risk at the airport. Low level SE winds now 20 to 25 knots below 2000ft, but only 10 to 15 knots above that to 3000ft. Expect a greater concentration of thunderstorms over the far west and north of the TMA.
6. The cool, shallow but still humid airmass behind the change provides a somewhat conducive enviroment for lower cloud as the inversion height appears to be around 2500ft. As a result, there is a risk of cloud ceiling near 1500ft and possibly as low as 1200ft (ILS), so have indicated this as an adjustement in the suggested MET CDM rate.
8.
7.

SMTM NOTES

1.
2.

NON MET CDM NOTES

1. RWY 14/32 NOT AVBL DUE WIP. Refer to NOTAM C663/17.
2.
3.

airservices

Airservices MET CDM Rate Calculator

Software Version 2.1.84

Autoload TAF

EMAIL COPY TO SUPPORT

LATEST TAF | RECALCULATE | CLEAR DATA

```
TAF AMD YBBN 092307Z 1000/1106
10008KT 9999 SCT030
FM100200 12015KT 9999 SCT025
FM101000 14007KT 9999 SCT015
FM102200 10008KT 9999 SCT025 SCT035
FM110400 05013KT 9999 SCT035
INTER 1010/1012 6000 SHRA BKN015
TEMPO 1012/1022 9999 BKN012
PROB30 TEMPO 1003/1010 VRB30G45KT 1000 TSRA BKN010 BKN050CB
RMK
T 29 28 25 23 Q 1013 1012 1012 1015
```

YBBN — Tuesday, 10 Oct 2017 - Run 2 - Final

First Light: 1852
Last Light: 0815

BUSINESS RULES RATES FROM TAF

SHOW / HIDE CALCULATIONS

DATE/TIME	092000	092100	092200	092300	100000	100100	100200	100300	100400	100500	100600	100700	100800	100900	101000	101100	101200
BUSINESS RULES SUMMARY																	
BR RWY						01/14	19	19	19	19	19	19	19	19	19	19	19
Tailwind (Worst)						-2.3	-0.8	46.0	46.0	46.0	46.0	46.0	46.0	46.0	-2.7	-2.7	-2.7
Crosswind (Worst)						7.7	15.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	6.4	6.4	6.4
BR Approach Mode						CROPS	IMC	LVO/FOG	LVO/FOG	LVO/FOG	LVO/FOG	LVO/FOG	LVO/FOG	LVO/FOG	IMC	IMC	ILS
BR Rate						28	24	12	12	12	12	12	12	12	24	24	21

RESET BELOW

MET CDM RATE

EXPAND/COMPACT MET CDM

Wind °True (LOAD WINDS)						090	100	120	120	120	120	120	140	140	140	150	150
Significant Wind Speed						10	14	15	16	18	18	16	15	14	12	10	10
Anticipated RWY						01	01	19	19	19	19	19	19	19	19	19	19
Tailwind (Main RWY)						-4.5	-4.1	-0.8	-0.8	-0.8	-0.8	-0.8	-5.5	-5.5	-4.7	-5.4	-5.4
Crosswind (Main RWY)						8.9	13.4	15.0	18.0	18.0	18.0	18.0	13.8	12.9	11.0	8.4	8.4
Tailwind (Cross RWY)																	
Crosswind (Cross RWY)																	
Anticipated Approach						IMC	IMC	TS-21	TS-21	TS-21	IMC	IMC	IMC	ILS	ILS	ILS	ILS
MET CDM Initial Rate						24	24	21	21	21	24	24	24	21	21	21	21
MET CDM Notes							1	1	1	1	1	1	2	2	2	2	2
MET CDM X-Factor (EXPORT PDF)							-1				-1	-1	-2				
MET CDM Final Rate (NOTIFY SM/TM)						24	23	21	21	21	23	23	22	21	21	21	21

TCU SM/TM FINAL ADJUSTMENT

SM/TM Notes																	
SM/TM X-Factor																	
Final Arrival Rates (NEXT)						24	23	21	21	21	23	23	22	21	21	21	21

NON MET CDM NOTES

SHOW / HIDE CDM

Non MET CDM Notes						1	1	1	1	1	1	1	1	1	1	1	1
DATE/TIME	092000	092100	092200	092300	100000	100100	100200	100300	100400	100500	100600	100700	100800	100900	101000	101100	101200

Previous Arrival Rates	24	24	24	24	24	24	23	21	21	21	22	23	24	23	23	23	23
Programmed Rates (?) (ACCEPT RATES)																	

MET CDM Notes	1	Temperatures inland and along the hills/ranges are 30-32C, with dewpoints in the upper teens. The conditions are already there for convection within the TMA, we just need a trigger. Once a cell or two do develop, it may be like popcorn kernels popping, where individual cells will trigger other storms on the outflow from the storm. The random nature of popping kernels should be kept in mind, as there is a chance a storm could develop with little warning near/at the aerodrome, but the storms will most likely be first seen along the ranges. Steering winds are 25KT W-SW'ly, so they could take about 90 minutes to reach impact the aerodrome directly. The good news is that the environment will not support prolonged storm activity as the showers/storms will cool the lower levels, resulting in more stable conditions.
	2	The post storm environment will result in a low level temperature inversion that will trap the moisture below it. The combination of the precipitation from the showers/storms, and the persistent onshore breeze this afternoon is expected to result in cloud bases at or below 1500ft after last light.
	3	
	4	
SM/TM NOTES	1	
	2	
NON MET CDM NOTES	1	RWY 14/32 NOT AVBL DUE WIP. Refer to NOTAM C663/17.
	2	
	3	

airservices

Airservices MET CDM Rate Calculator

Software Version 2.1.83

Autoload TAF

EMAIL COPY TO SUPPORT

LATEST TAF | RECALCULATE | CLEAR DATA

```
TAF YMML 200533Z 2006/2112
36012KT CAVOK
BECMG 2014/2016 36018G32KT CAVOK
FM202100 36025G40KT 9999 -SHRA NSC
BECMG 2103/2105 33014KT 9999 -SHRA NSC
FM210900 19010KT 9999 FEW012 BKN025
INTER 2106/2112 5000 -SHRA BKN010
RMK FM201200 MOD TURB BLW 5000FT TILL 210600
FM201800 MOD/SEV TURB BLW 5000FT TILL 210400
T 18 14 13 13 Q 1015 1015 1015 1013
```

YMML — Thursday, 21 Sep 2017 - Run 1 - Final

First Light: 1944
Last Light: 0842

BUSINESS RULES RATES FROM TAF — SHOW / HIDE CALCULATIONS

DATE/TIME	202000	202100	202200	202300	210000	210100	210200	210300	210400	210500	210600	210700	210800	210900	211000	211100	211200	211300
BUSINESS RULES SUMMARY																		
BR RWY	34	34	34	34	34	34	34	34	34	27/34	27*	27*	27*	16/27*	16/27*	16/27*		
Tailwind (Worst)	-31.6	-39.5	-39.5	-39.5	-39.5	-39.5	-39.5	-13.1	-13.1	-7.8	-7.8	-7.8	-7.8	-1.0	-1.0	-1.0		
Crosswind (Worst)	5.0	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	11.6	11.6	11.6	11.6	9.9	9.9	9.9		
BR Approach Mode	VMC	VMC	VMC	VMC	VMC	VMC	VMC	VMC	VMC	LAHSO	VMC*	VMC*	VMC*	VMCB*	VMCB*	VMCB*		
BR Rate	24	24	24	24	24	24	24	24	24	40	22	22	22	22	22	22		
RESET BELOW	MET CDM RATE — EXPAND/COMPACT MET CDM																	
Wind °True (LOAD WINDS)	360	360	360	360	360	360	360	360	340	330	310	280	260	250	240	220	220	220
Significant Wind Speed	30	30	32	36	38	38	35	32	30	25	18	15	15	15	15	12	10	8
Anticipated RWY	34	34	34	34	34	34	34	34	34	34	27/34	27/34	16/27	16/27	16/27	16/27	16/27	16/27
Tailwind (Main RWY)	-29.6	-29.6	-31.6	-37.5	-37.5	-37.5	-34.6	-31.6	-29.4	-23.3	-14.6	-14.9	-8.3	-2.9	-5.4	-7.9	-6.6	-5.2
Crosswind (Main RWY)	4.7	4.7	5.0	5.9	5.9	5.9	5.5	5.0	5.7	9.0	10.6	1.6	15.0	14.7	14.0	9.1	7.5	6.0
Tailwind (Cross RWY)											-13.6	-4.9	-14.5	-13.7	-12.4	-7.1	-5.9	-4.7
Crosswind (Cross RWY)											11.8	14.2	3.6	5.1	8.4	9.7	8.1	6.5
Anticipated Approach	VMC	VMC	VMC	VMC	VMC	VMC	VMC	VMC	VMC	VMC	PRLAHSO	PRLAHSO	VMCA	VMCB	VMCB	ILSA	ILSA	ILSA
MET CDM Initial Rate	24	24	24	24	24	24	24	24	24	24	30	30	27	25	25	23	23	23
MET CDM Notes	1	1	1	1	1	1	1	1	1	2	2	2&3	3&4	3	3	5	5	5
MET CDM X-Factor (EXPORT PDF)																		
MET CDM Final Rate (NOTIFY SM/TM)	24	24	24	24	24	24	24	24	24	24	30	30	27	25	25	23	23	23
TCU SM/TM FINAL ADJUSTMENT																		
SM/TM Notes		1	1	1	1	1	1	1	1	1								
SM/TM X-Factor		-2	-2	-2	-2	-2	-2	-2	-2	-2								
Final Arrival Rate (NEXT)	24	22	22	22	22	22	22	22	22	22	30	30	27	25	25	23	23	23
NON MET CDM NOTES — SHOW / HIDE CDM																		
Non MET CDM Notes																		
DATE/TIME	202000	202100	202200	202300	210000	210100	210200	210300	210400	210500	210600	210700	210800	210900	211000	211100	211200	211300
Previous Arrival Rates																		
Programmed Rates (?) (ACCEPT RATES)																		

MET CDM Notes	1	Strong and gusty N winds ahead of an approaching cold front. Winds from surface to about 5000ft NW at 35 to 45 knots. Moderate to severe turbulence likely. TM to apply appropriate x-factor for turbulence.
	2	Winds easing slightly and turning further NW. Winds should be generally less than 20 knots after about 06Z so have elected PRLAHSO in the 06Z and 07Z hours. Winds aloft beginning to ease to about 20 knots and tend further NW. Possible high based showers during this period also though due to a deep dry lower atmosphere these showers should be very light.
	3	Wind direction may be quite variable during this period as a small scale pre-frontal trough moves over the aerodrome. Winds may shift between about 260 and 330 degrees at about 15 knots.
	4	Last light at 0842Z. VMCA elected for entire 08Z hour.
	5	Cold front and associated SW change now moving over region. Showers increasing with potential for cloud to about 1500ft after 11Z or 12Z so have elected ILSA rate.
	6	
	7	
SM/TM NOTES	1	Minus 2 due to strong winds.
	2	
	3	
NON MET CDM NOTES	1	
	2	

Australian Government
Bureau of Meteorology

Verification

1. Case studies.
2. Comparison between TAF rates and MET CDM rates.
3. Achieved rates vs. forecast rates.
4. Number of GDP revisions – low number – fleet predictability.
5. Airborne holding vs. previous years.
6. Diversions - MET CDM should reduce diversions.
7. Survey of customer satisfaction.

Australian Government
Bureau of Meteorology

Outcomes

1. Fewer aircraft airborne during times of high impact weather due to MET CDM.
2. Airborne holding generally lower.
3. The timing for the recovery refined in the subsequent MET CDM runs.
4. Rates tables and business rules regularly reviewed and refined.
5. Reference cards capturing knowledge.
6. MET CDM processes being triggered by participants in anticipation of forecast changes/ changed impacts.