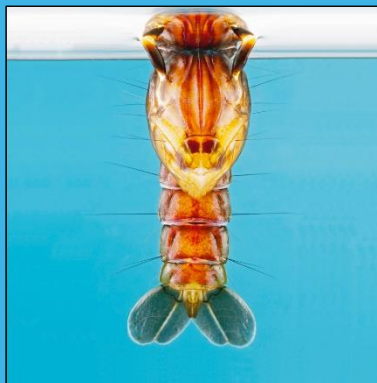


NSW Arbovirus Surveillance & Mosquito Monitoring Program, 2018-2019

Weekly Update: 11 January 2019



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All reports for the season are available at:

<https://www.health.nsw.gov.au/environment/pests/vector/Pages/nswasp-weekly-report-2018-19.aspx>

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This report was prepared by Stephen Doggett, Manager, Department of Medical Entomology, NSW Health Pathology (ICPMR). Testing and scientific services were provided by the Arbovirus Emerging Diseases Unit, NSW Health Pathology (ICPMR) for the sentinel chicken surveillance and the Department of Medical Entomology, NSW Health Pathology (ICPMR) for the mosquito surveillance. Please note that these results remain the property of the NSW Ministry of Health and may not be used or disseminated to unauthorised persons or organisations without permission.

Summary

- **Climate:** over the last week, the region of Sydney to the north coast and nearby ranges, experienced moderate levels of rainfall, while other areas had little precipitation. For December, rainfall was below average for the state north and mostly average elsewhere. Maximum and minimum temperatures for December were 2-3 degrees above average for the state.
- **Three Month Forecast:** for January 2019 to March 2019, rainfall is predicted to be below average for NSW. Maximum and minimum temperatures are predicted to exceed the average. According to the Bureau of Meteorology (BOM) as of 18 December 2018, the El Niño Alert continues.
- **Tides:** the small series of high tides that occurred over 5-8 January 2019 failed to reach levels that would trigger larval hatching of *Aedes vigilax*. The next larger series are due over 21-25 January 2019, when heights of almost 2.1m are predicted. These are forecast to be the highest tides for the summer.
- **Murray Valley Encephalitis virus (MVEV) Models:** the data relevant to both the Forbes' and Nichol's hypotheses have been updated to December 2018. Neither model is suggestive of an MVEV epidemic.
- **Mosquito Numbers Inland:** mosquito collections continue to be well below average and were 'low' (<50 mosquitoes/trap) at all but Griffith, where 'high' numbers (100-1,000 mosquitoes/trap) were yielded. However, even at this site, numbers are well below normal.
- **Mosquito Numbers Coast:** *Aedes vigilax* continue to be 'low' at all sites, with Ballina, Coffs Harbour, and Kempsey, yielding 'high' mosquito numbers, comprising mainly freshwater breeding species.
- **Mosquito Numbers Sydney:** the decline in the mosquito numbers from the saline habitats (Georges River and Parramatta Rivers) continue in line with tidal patterns, but numbers still remain well above average. 'Very high' collections (1,000-10,000/trap) continue along the Georges River sites, with almost 6,000 mosquitoes trapped at Picnic Point and around 3,000 from Alford's Point. For the Parramatta River, over 1,000 mosquitoes were trapped each at Duck River and Eric Primrose Reserve. The collections continue to be dominated by *Aedes vigilax*, although larger yields of freshwater breeding mosquitoes were trapped this week. The non-saline locations mostly produced 'low' numbers, although Muru Mittiger (Penrith) yielded 'high' numbers, with a collection of over 900 mosquitoes.
- **Arboviral Isolates:** there was one detection of Kokobera virus from Picnic Point on the Georges River from a mosquito collection made on 9 January 2018.
- **Chicken Sentinel Flocks:** all chickens were negative to MVEV and Kunjin virus (KUNV).
- **Human Notifications:** for the current fiscal year, there have been 209 Ross River virus (RRV) and 27 Barmah Forest virus (BFV) notifications, which is well below the previous four season average (315RRV and 38BFV).

Comment: the mosquito numbers from the inland have been well below average. Normally, collections from the Riverina would be in the thousands, but only a few hundred were trapped at Griffith, and all other sites produced 'low' numbers. For the coast, *Aedes vigilax* yields remain 'low' in spite of some 'high' mosquito numbers from the mid and north coast.

The main mosquito breeding activity continues to be centered on the salt marsh locations from around Sydney, with several sites along the Georges and Parramatta River continuing to produce 'very high' mosquito collections. With this number of mosquitoes collected over recent weeks, it is no real surprise to see some virus activity and the two isolates identified (see below) could well be the start of further detections to come.

Interestingly, one of the virus isolates was the first ever detection of Kokobera virus (KOKV) from the NSW coastal region. To date, there have only been 30 KOKV detections in the history of the NSW Arbovirus Surveillance Program and 21 of these were from Griffith and Leeton, and the remainder from other inland localities.

KOKV belongs to the flavivirus group of arboviruses. It was first isolated in 1971 from *Culex annulirostris* trapped in North Queensland. Three cases of illness attributed to this virus have been reported, one each from Griffith and Ivanhoe in NSW, and one from Bairnsdale in Victoria. Very few laboratories test for KOKV in humans and very few general practitioners would request pathology for this in patients (or even know of the existence of the virus). Thus how many human cases of disease have occurred with this virus is not known.

The risk that KOKV poses is unknown. Symptoms reported are typical for an arbovirus: febrile illness, aches and pains in joints, headache, and lethargy. The clinical reports are very sporadic, but very little testing occurs, as noted above. As this is the first time that the virus has been detected on the coast, the population may have little immunity and likely to be susceptible to infection. NSW Health will continue to closely monitor the situation and earlier precautionary warnings to avoid mosquito bites remain relevant (see www.seslhd.health.nsw.gov.au/sites/default/files/groups/Media_and_Communications/docs/2018/181218mb%20Mosquito%20warning%20for%20Georges%20River%20area.pdf).

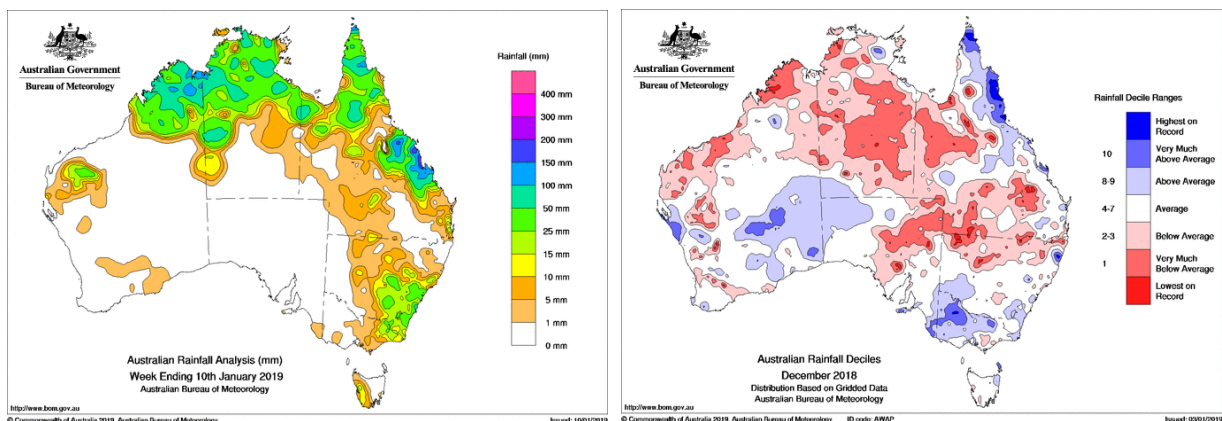
The other virus isolate was Edge Hill virus. This virus has previously been isolated on a number of occasions from trap sites along the Georges River. Like KOKV, human cases are very rare, with similar symptoms, and there is also little clinical testing for this virus.

There was a detection of the exotic *Aedes aegypti* mosquito from a Commonwealth biosecurity approved facility outside of the airport precinct, the third such detection this season. A comprehensive response has been implemented to contain the mosquito risk and examine the likely source of origin.

Environmental Conditions

Rainfall

Rainfall across Australia for the week ending 10 January 2019 is depicted on the left and monthly rainfall deciles for December 2018 are on the right. Over the last week, much of the state experienced moderate levels of rainfall, but conditions were dry in the north and the west of the state. For December, rainfall was below average for the state north and mostly average elsewhere. Maximum and minimum temperatures for December were 2-3 degrees above average for the state.



Three Month Rainfall & Temperature Forecast

For January 2019 to March 2019, rainfall is predicted to be below average for NSW. Maximum and minimum temperatures are both predicted to exceed the average. The following webpages contain graphics of the seasonal outlook:

www.bom.gov.au/climate/outlooks/#/rainfall/median (Rainfall outlook).

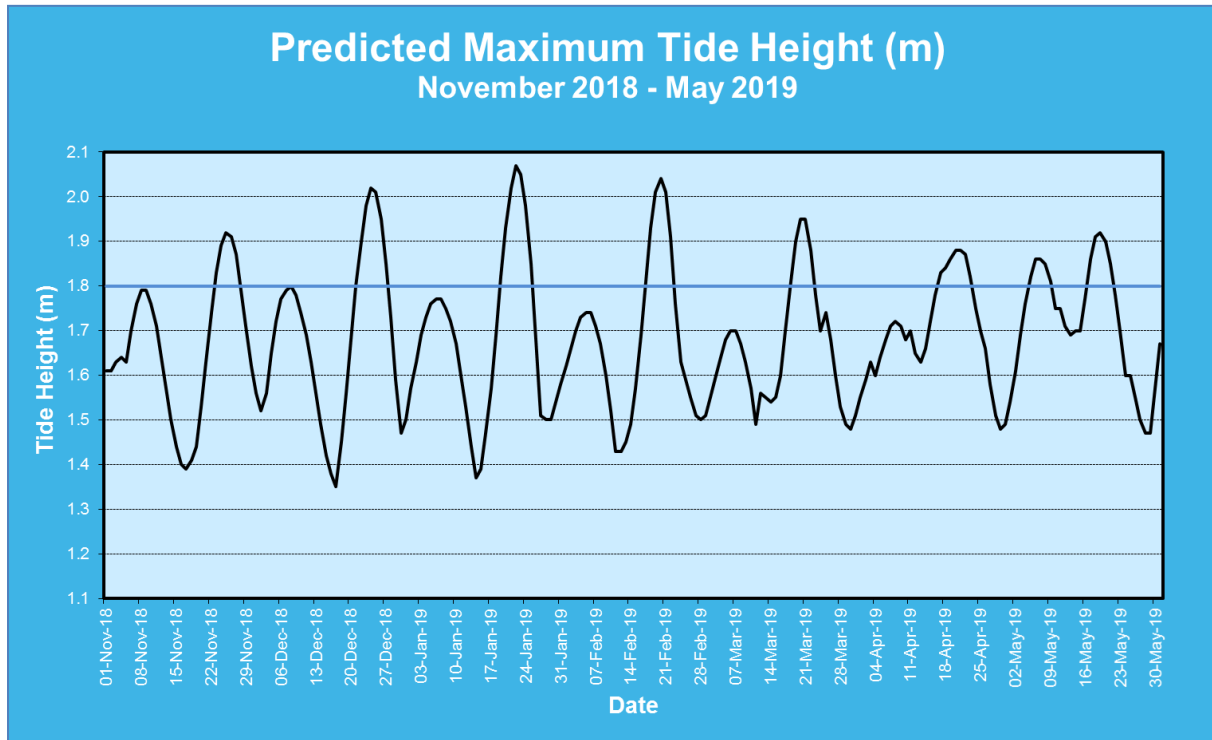
www.bom.gov.au/climate/outlooks/#/temperature/summary (Max & min temperature outlook).

According to the BOM as of 8 January 2019, the El Niño Alert continues (although some contributing factors to the El Niño have become neutral). A positive Indian Ocean Dipole (IOD) is now underway, however it has now weakened (positive IODs are associated with dry conditions across Australia, although has little influence on the nation's climate over December to April).

For more information: www.bom.gov.au/climate/enso/ and, www.bom.gov.au/climate/iod/

Tides

Tidal information is relevant for the prediction of the activity of the salt marsh mosquito, *Aedes vigilax*. Typically for NSW, tides of over 1.8m, as measured at Sydney, can induce hatching of *Aedes vigilax* larvae and the graph below of predicted tide heights can provide some indication of when this is likely to occur. Note this trigger height varies between regions, thus at Batemans Bay, a tide height over 0.8m can initiate egg hatching.



The recent series of high tides that occurred over 5-8 January 2019 peaked at the forecast level and were not overly high, as recorded at Sydney. Thus the tides did not reach the necessary height to trigger *Aedes vigilax* hatching.

The next larger series of tides are forecast for 21-25 January 2019, when heights of almost 2.1m are predicted. These are forecast to be the highest tides for the summer.

Actual tide heights can vary by 0.3m (or more in unusual circumstances) due to variations in atmospheric pressure, rainfall, wind and other climatic phenomena. Sea level rise with climate change may also result in increased tide heights. Thus predicted tide height should be used as a gauge only for potential *Aedes vigilax* activity. The larvae of the saltmarsh mosquito relies on an inundation/drying cycle for the mudflats in which it lives; continual wet weather prevents the drying cycles thereby reducing larval production.

MVEV Climatic Models

Three predictive environmental based models for MVEV activity have been developed; the Forbes (which relies on rainfall in the river catchment basins of Eastern Australia), Nichols (based on the Southern Oscillation), and the Bennett theory (based on the Indian Ocean Dipole). The latter theory has low reliability and is not considered below. Note that all the predictive models have been developed on a limited data set and do not always forecast activity. There can also be unusual environmental conditions that may lead to the introduction of the virus to southeastern Australia, such as the movement of low pressure cells from the north to the south of the country during 2008 and 2011. Vertical transmission of the virus (from adult to the egg in *Aedes* species) can result in restricted activity following localised heavy precipitation (as per 2003 at Menindee).

i. Forbes' Hypothesis

Rainfall was not above Decile 7 in all of the river catchment basins in eastern Australia for the last quarter of 2017, the first quarter of 2018, nor the last quarter of 2018 (Table 1). Thus Forbes' hypothesis for an MVEV outbreak has not been fulfilled.

Table 1. Rainfall indices for the main catchment basins of eastern Australia as per Forbes' hypothesis, relevant to the 2018-2019 season. Note that a value of 1 equals Decile 7 rainfall.

Catchment Basin	Oct-Dec 2017	Jan-Mar 2018	Oct-Dec 2018	Jan-Mar 2019
Darling River	0.93	0.52	0.84	0.71
Lachlan/Murrumbidgee/Murray Rivers	1.15	0.70	0.77	0.87
Northern Rivers	0.81	1.07	1.00	0.70
North Lake Eyre system	0.75	0.69	0.73	0.56

ii. Nichol's Hypothesis

Table 2. The seasonal atmospheric pressures (in mm) according to Nichol's hypothesis, relevant to the 2018-2019 season.

	Autumn 2018	Winter 2018	Spring 2018
2018 Value	1009.27	1011.8	1010.90
Pre past MVEV seasons	<1009.74	<1012.99	<1009.99

The Spring period pertaining to the Nichol's hypothesis is not in line with past MVEV active years.

Arboviral Isolates

LOCATION – Site	Date Trapped	Detection Method	Virus
GEORGES RIVER – Picnic Point	9/Jan/2019	Whole grind	Edge Hill
GEORGES RIVER – Picnic Point	9/Jan/2019	FTA card	Kokobera

Exotic Detections

There was a detection of *Aedes aegypti* on 2 January 2019, at a Commonwealth biosecurity approved arrangements facility outside of the airport precinct, the third such detection this season. The mosquitoes were collected by the Commonwealth Department of Agriculture and Water Resources (DAWR) as part of routine monitoring and the species identity confirmed by the Department of Medical Entomology, NSW Health Pathology.

The response was similar to the previous detections. This included an urgent insecticide application at the site (thermal fogging and residual treatment) and enhanced surveillance was initiated. Pathway analysis will be undertaken by reviewing cargo sources and the mosquitoes will be analysed via molecular assays to determine likely source of origin.

Human Notifications

Weekly notifications of human mosquito-borne disease infections are available from the NSW Ministry of Health, Communicable Disease Weekly Report and summarized in the Table below* (www.health.nsw.gov.au/Infectious/reports/Pages/CDWR.aspx).

Table 4. Notifications of mosquito-borne disease in NSW, 2018-2019*

Week Ending	RRV	BFV	DENV [†]	Malaria [†]	CHIKV [†]	ZIKV [†]	Total
7-Jul-18	12	1	10	1	0	0	24
14-Jul-18	9	1	2	3	0	0	15
21-Jul-18	5	2	3	2	0	0	12
28-Jul-18	8	1	6	3	0	0	18
4-Aug-18	4	0	8	3	0	0	15
11-Aug-18	8	3	6	1	0	0	18
18-Aug-18	12	0	3	1	0	0	16
25-Aug-18	8	1	2	1	0	0	12
1-Sep-18	8	0	0	0	0	0	8
8-Sep-18	5	1	2	2	0	0	10
15-Sep-18	13	4	1	5	0	0	23
22-Sep-18	5	0	5	1	0	0	11
29-Sep-18	7	2	5	2	0	0	16
6-Oct-18	10	0	2	1	0	0	13
13-Oct-18	9	0	2	4	0	0	15
20-Oct-18	7	0	5	2	1	0	15
27-Oct-18	11	0	8	1	0	0	20
3-Nov-18	10	0	5	0	1	0	16
10-Nov-18	7	3	6	0	3	0	19
17-Nov-18	5	3	9	2	0	0	19
24-Nov-18	4	1	8	0	0	0	13
1-Dec-18	11	1	14	1	1	0	28
8-Dec-18	11	1	5	0	2	0	19
15-Dec-18	1	1	3	0	0	0	5
22-Dec-18	9	0	0	7	0	0	16
29-Dec-18	2	0	0	1	0	0	3

RRV = Ross River virus; BFV = Barmah Forest virus; DENV = Dengue virus; CHIKV = Chikungunya virus; ZIKV = Zika virus. [†]All of these viruses are acquired overseas, although some DENV cases may be from North Queensland. *The data in this table is updated once available from the NSW Ministry of Health.

Comment: It should also be noted that notifications are for NSW residents and that the infection may have been acquired elsewhere. Winter notifications of RRV and BFV are unlikely to be recent infections or may be false positives.

Table 4 cont. Notifications of mosquito-borne disease in NSW, 2018-2019*

Week Ending	RRV	BFV	DENV [†]	Malaria [†]	CHIKV [†]	ZIKV [†]	Total
5-Jan-19	9	0	2	1	0	0	12
12-Jan-19							
19-Jan-19							
26-Jan-19							
2-Feb-19							
9-Feb-19							
16-Feb-19							
23-Feb-19							
2-Mar-19							
9-Mar-19							
16-Mar-19							
23-Mar-19							
30-Mar-19							
6-Apr-19							
13-Apr-19							
20-Apr-19							
27-Apr-19							
4-May-19							
11-May-19							
18-May-19							
25-May-19							
1-June-19							
8-June-19							
15-June-19							
22-June-19							
29-June-19							
Total	210	26	122	45	8	0	411

RRV = Ross River virus; BFV = Barmah Forest virus; DENV = Dengue virus; CHIKV = Chikungunya virus; ZIKV = Zika virus.

[†]All of these viruses are acquired overseas, although some DENV cases may be from North Queensland.

*The data in this table is updated once available from the NSW Ministry of Health.

Table 5. Ross River virus infection notifications in NSW residents, by month of disease onset per fiscal year, July 2013 to Jun 2019*.

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
2014-2015	38	50	46	67	59	90	117	305	431	264	102	50	1,619
2015-2016	54	61	53	61	70	54	42	60	78	79	52	16	680
2016-2017	12	11	20	17	38	216	429	274	200	142	174	89	1,622
2017-2018	29	37	52	56	37	31	30	39	51	74	96	70	602
2018 - 2019	32	41	30	45	32	25	4						209
Ave [†]	33	40	43	50	51	98	155	170	190	140	106	56	1,132

*updated 4 January 2019 (this table is updated at different times to Table 4 above, hence there maybe differences in the numbers).

[†]Average for 2014-15 to 2017-18.

Table modified from: <http://www1.health.nsw.gov.au/IDD/#/ROSS>

Table 6. Barmah Forest virus infection notifications in NSW residents, by month of disease onset per fiscal year, July 2014 to Jun 2019*.

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
2014-2015	10	3	11	11	8	4	12	17	43	43	16	11	189
2015-2016	6	9	7	9	6	3	4	5	2	3	10	2	66
2016-2017	4	3	0	0	1	9	9	5	8	6	24	24	93
2017-2018	8	10	6	8	8	6	5	12	8	10	8	7	96
2018 - 2019	4	6	5	2	6	4	0						27
Ave [†]	7	6	6	7	6	6	8	10	15	16	15	11	113

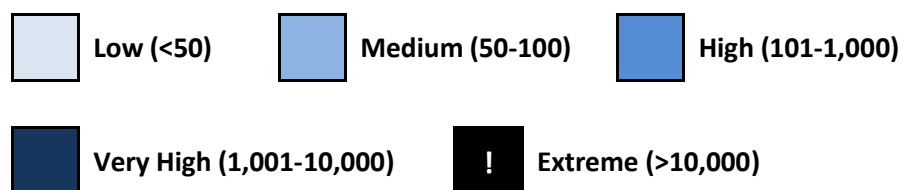
*updated 4 January 2019 (this table is updated at different times to Table 4 above, hence there maybe differences in the numbers).

[†]Average for 2014-15 to 2017-18.

Table modified from: <http://www1.health.nsw.gov.au/IDD/#/BF>

Mosquito Results

Mosquito abundance is best described in relative terms, and in keeping with the terminology from previous NSW Arbovirus Surveillance and Mosquito Monitoring Program Annual Reports, mosquito numbers are depicted in the tables below as:



Each location represents the average for all trapping sites at that location.

Inland

Location	Mosquito	Oct-18				Nov				Dec					Jan-19				Feb				Mar						
		7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	3	10	17	24	31		
Albury	<i>Cx. annul</i>																												
	Total Mosq.																												
Bourke	<i>Cx. annul</i>																												
	Total Mosq.																												
Forbes	<i>Cx. annul</i>																												
	Total Mosq.																												
Griffith	<i>Cx. annul</i>																												
	Total Mosq.																												
Leeton	<i>Cx. annul</i>																												
	Total Mosq.																												
Macquarie Marshes	<i>Cx. annul</i>																												
	Total Mosq.																												
Wagga	<i>Cx. annul</i>																												
	Total Mosq.																												

Coastal

Location	Mosquito	Nov-18				Dec					Jan-19				Feb				Mar					Apr			
		4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	3	10	17	24	31	7	14	21	28
Ballina	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Coffs Harbour	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Gosford	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Kempsey	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Lake Macquarie	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Port Macquarie	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Tweed	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Wyong	<i>Ae. vigilax</i>																										
	Total Mosq.																										

Sydney

Location	Mosquito	Nov-18				Dec					Jan-19				Feb				Mar					Apr			
		4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	3	10	17	24	31	7	14	21	28
Banks-town	<i>Ae. vigilax</i>					■	■	■		■	■																
	Total Mosq.					■	■	■		■	■																
Blacktown	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Georges River	<i>Ae. vigilax</i>			■		■	■	■	■	■																	
	Total Mosq.			■		■	■	■	■	■																	
Hawkes-bury	<i>Cx. annul</i>																										
	Total Mosq.																										
Hills Shire	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Parramatta	<i>Ae. vigilax</i>							■	■	■	■																
	Total Mosq.							■	■	■	■																
Penrith	<i>Ae. vigilax</i>																										
	Total Mosq.																										
Sydney Olympic Park	<i>Ae. vigilax</i>					■	■	■	■	■																	
	Total Mosq.					■	■	■	■	■																	

Sentinel Chicken Flocks – MVEV and Kunjin Virus Antibody Test Results

Location	Oct	Nov				Dec					Jan-19				Feb				Mar				Apr			
	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	3	10	17	24	7	14	21	28
Deniliquin			15N	15N	15N	15N	15N	15N																		
Dubbo								15N																		
Forbes			12N	12N	12N	14N	15N	15N																		
Griffith		15N	15N	15N	15N	15N	15N	15N																		
Hay		15N	15N	15N	15N	15N	15N	15N	15N																	
Leeton	15N	15N	15N	15N	15N	15N	15N																			
Macquarie Marshes		15N		15N	15N	15N	15N	15N	15N																	
Menindee		15N		15N	15N	15N	15N																			
Moree				15N	15N	15N	15N	15N	15N																	

The number represents the number of chickens by test result (N = Negative, M = Positive for MVEV, K = Positive for Kunjin virus). Results are shown by week of sample collection. **Positive results will be in bold.**

Antibody test results in the sentinel chicken flocks were provided by the Arbovirus Emerging Diseases Unit, NSW Health Pathology (ICPMR).

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