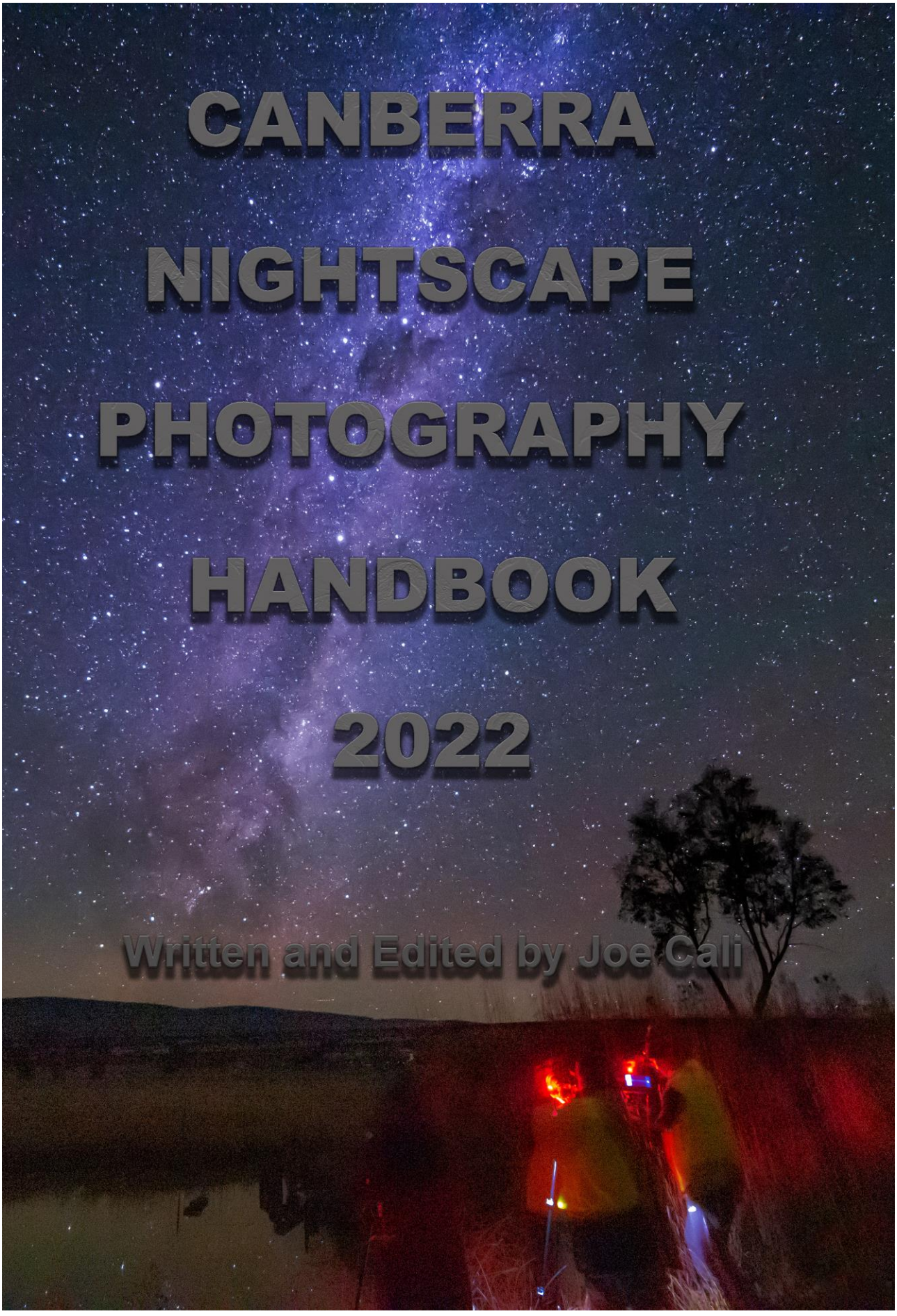

CANBERRA
NIGHTSCAPE
PHOTOGRAPHY
HANDBOOK
2022
Written and Edited by Joe Cali

Above: Comet Leonard C/2021-A1 with intruding meteor
Comet Leonard on December 28 was at what was probably at its brightest and in this photo, sporting a magnificent 15 degree tail Pentax K1 Rokinon 135mm ED f2 Single exposure raw processed in Adobe Lightroom and Adobe Photoshop.
Front cover: *Paul Carpenter and Luminita Lunita shooting the Milky Way during the April 2020, Nightscapes and Star Trails Workshop*

Shoot Planning Data for Astrophotography and Astronomical Nightscapes in the Canberra Region 2022

[149ºE, 35ºS]

Compiled & Edited by Joe Cali
http://joe-cali.com/nightscape

Comet Leonard

Above: *Photograph Comet Leonard on December 31st. This is an HDR image produced by combining different exposures for the head and tail with an 8" telescope.*

TABLE OF CONTENTS

Table Of Contents	4
Introduction	5
ACT Public Holidays & Daylight Savings Switchovers	6
Calendar 2022 With New Moons	7-8
Moon Phase Dates& Distance	9-10
Workshops 2022	11-13
Winter Milky Way Rise And Set Times - Canberra Region?	14-15
Avoiding Trailed Star Images	16-18
Rise And Set Times	
- Sunrise & Sunset	20-21
- Astronomical Twilight	22-23
- Moonrise	25-26
Lunar Distance And Size, Super Moons And Micro Moons	27
Eclipses Of 2022	28-30
Meteor Shower Calendar	31-33

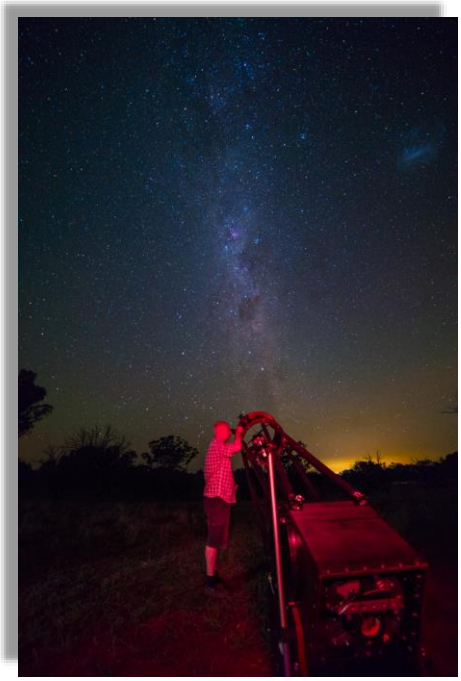
Introduction

Why this handbook?

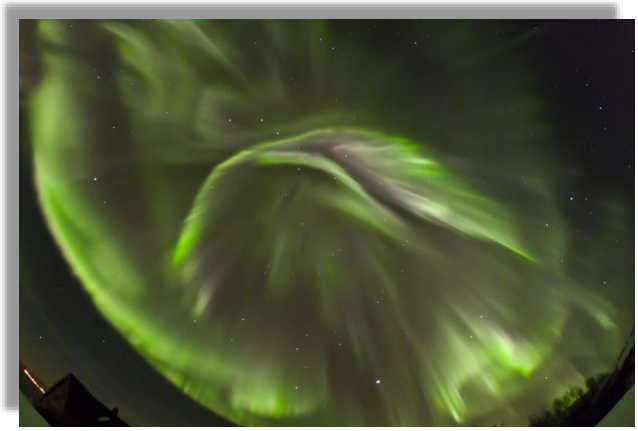
Although many smartphone apps can give you rise and set and other information for a specific day, usually the day on the app calendar, I find it useful to farm online resources to produce an annual almanac of rise/set and other useful planning information that I use for forward planning of nightscape and astronomical observing activities in the local region. I teach this approach in my nightscape photography themed workshops and events. I have produced a collection of such information each year for many years but only shared with a few close friends. In recent years, I have put in extra time, it turned out to be a **lot** of extra time, producing a pdf book for wider distribution. I want to thank and acknowledge Phil Jones for proof reading and assistance in production.

About me

I have been an avid observer of all things astronomical and a keen photographer since the 1970's. I built my first telescope when I was 15, and my last scope ….well, I guess I haven't built or even planned it yet. I really enjoy the meditative solitude of spending a whole night alone under the stars watching the Earth revolving. However, I equally love sharing it with close



friends or introducing new people to the joys of the night sky. I have observed 14 total solar eclipses, many of them with my late friend, Bengt Alfredsson of Sweden. Until his sad and untimely passing in April 2019, Bengt [seen at the telescope in the photo] and I travelled all over the world chasing total eclipses, annular eclipses, aurorae, wildlife and spectacular landscapes in the Arctic, the Libyan Sahara, Zambia, Australia, China, and the Americas. I love sharing my knowledge of the night skies and do this through forums and also through residential retreat astrophotography workshops at my new dark sky home in Central West New South Wales. Hope to see you there! Joe.



***Photos. Above left**, Bengt observing Omega Centauri through my 18" reflector.*

***Above right,** In March 2015, we observed a total solar eclipse from Svalbard, only 800km from the north pole at a chilly 22^{o}C below zero.*

Left: A sky filling aurora lit the entire sky, and snow-covered ground beneath us on Kvaløya, Norway just one week before the 2015 total solar eclipse on Svalbard.

ACT Government

ACT PUBLIC HOLIDAYS 2022

The following public holidays will be observed in the Australian Capital Territory during 2022.

Public holiday	Date to be observed
New Year's Day	Saturday, 1 January 2022 and Monday, 3 January 2022*
Australia Day	Wednesday, 26 January 2022
Canberra Day	Monday, 14 March 2022
Good Friday	Friday, 15 April 2022
Easter Saturday	Saturday, 16 April 2022
Easter Sunday	Sunday, 17 April 2022
Easter Monday	Monday, 18 April 2022
ANZAC Day	Monday, 25 April 2022
Reconciliation Day	Monday, 30 May 2022
Queen's Birthday	Monday, 13 June 2022
Labour Day	Monday, 3 October 2022
Christmas Day	Sunday, 25 December 2022 and Tuesday, 27 December 2022**
Boxing Day	Monday, 26 December 2022

Note: All public holiday dates are accurate at the time of publication.

*As 1 January 2022 falls on a Saturday in 2022, the following Monday is observed as an additional public holiday.

**As 25 December (Christmas Day) falls on a Sunday in 2022, there is an additional public holiday on the Tuesday.

Information is sourced from the *Holidays Act 1958* (ACT)

(Information correct as of 6 December 2019)

Workplace Safety and Industrial Relations Group

Chief Minister, Treasury and Economic Development Directorate

Email: wsir@act.gov.au

Chief Minister, Treasury and Economic Development

GPO Box 158 Canberra ACT 2601 | phone: 132281 | www.act.gov.au

Source : https://act.gov.au

Daylight Savings Switchovers

End DST: Sunday, 3 April 2022, 3 am turn 1 hour backward
Start DST: Sunday, 2 October 2022, 2 am turn 1 hour forward
Source : https://act.gov.au

CALENDAR 2022

JANUARY

Mo	Tu	We	Th	Fr	Sa	Su
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

FEBRUARY

Mo	Tu	We	Th	Fr	Sa	Su
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

MARCH

Mo	Tu	We	Th	Fr	Sa	Su
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

APRIL

Mo	Tu	We	Th	Fr	Sa	Su
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

MAY

Mo	Tu	We	Th	Fr	Sa	Su
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

JUNE

Mo	Tu	We	Th	Fr	Sa	Su
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

JULY

Mo	Tu	We	Th	Fr	Sa	Su
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

AUGUST

Mo	Tu	We	Th	Fr	Sa	Su
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

SEPTEMBER

Mo	Tu	We	Th	Fr	Sa	Su
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

OCTOBER

Mo	Tu	We	Th	Fr	Sa	Su
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

NOVEMBER

Mo	Tu	We	Th	Fr	Sa	Su
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

DECEMBER

Mo	Tu	We	Th	Fr	Sa	Su
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

25 NEW MOON

18 NATIONAL & ACT PUBLIC HOLIDAYS

8 LUNAR ECLIPSE

2022 Moon Phase Dates and Moon-Earth Distances

PHASE	DATE	Earth-Moon Distance [km]
New moon	January 3	368441
First quarter	January 10	397839
Full moon	**January 18**	404677
Last quarter	January 25	372665
New moon	February 1	373804
First quarter	February 8	405602
Full moon	**February 17**	396596
Last quarter	February 24	367913
New moon	March 3	382041
First quarter	March 10	409292
Full moon	**March 18**	386921
Last quarter	March 25	366951
New moon	April 1	391645
First quarter	April 9	408088
Full moon	**April 17**	377835
Last quarter	April 23	369710
New moon	May 1	400644
First quarter	May 9	402561
Full moon	**May 16**	370999
Last quarter	May 23	375674
New moon	May 30	407038
First quarter	June 8	394204
Full moon	June 14	367348
Last quarter	June 21	383965
New moon	June 29	409445

First quarter	July 7	384880
Full moon	July 14	367205
Last quarter	July 21	393279
New moon	July 29	407428
First quarter	August 5	376379
Full moon	**August 12**	370515
Last quarter	August 19	401850
New moon	August 27	401447
First quarter	September 4	370130
Full moon	**September 10**	376961
Last quarter	September 18	407729
New moon	September 26	392724
First quarter	October 3	367058
Full moon	**October 10**	385803
Last quarter	October 18	409394
New moon	October 25	383082
First quarter	November 1	367630
Full moon	**November 8**	395548
Last quarter	November 16	406258
New moon	November 24	374559
First quarter	December 1	371915
Full moon	**December 8**	403962
Last quarter	December 16	398934
New moon	December 23	368830
First quarter	December 30	379486

N.B. See page 28 for dates of **micromoons** and **supermoons**

WORKSHOPS - 2022

Joe Cali - Mirador de la Crucetita, Argentina, 2019 Photo: Terry Cuttle.

I retired from full-time work in 2020 and have purchased, "34 South," a holiday/hobby house midway between Young and Cowra and under very dark skies. I will be able to accommodate workshop groups of up to 8 participants in comfort in the house. My nightscape and astrophotography capture workshops will be based around 1-3 night stays at the house, using telescopes and trackers on-site or shoots around the area which offers stunning dark skies when the air is clear and free of smoke and dust. I will continue my 25-year association with the Photoaccess Art Centre and offer these workshops as part of their Workshop Program.

The following astro-photography theme workshops and field events will be offered during 2022 COVID permitting. When enrolments open, courses will appear on the Photoaccess Classes Page. Either keep an eye on the classes page or if you would like to be informed when the various astro workshops are released, you can subscribe to my email list. Send an email to:- mailto:joe_cali@hotmail.com?subject=subscribe astro workshops email list

Canola fields seem to glow under the southern Milky Way in this image taken during the September 2020 Nightscapes Course.

Nightscapes and Star Trails

Do you stand outside at night, look up at the stars and dream of capturing the awe-inspiring beauty of the Milky Way? If you're in possession of a DSLR camera, a tripod, warm clothes and a sense of adventure, then your dream can come true!

Join experienced astrophotographer and tutor Joe Cali for this hands-on workshop focusing on creating nightscapes. Together with fellow astro-enthusiasts, you'll consider how to compose after-dark landscapes and skyscapes, explore practical aspects of night shoots, such as forecasting clear skies and staying comfortable during long shoots, and experiment with capturing striking stills, star trails and panoramas. During long exposures, you'll no doubt also have lots of opportunity to discuss the wonder of the galaxy.

The workshop comprises four 1 hour zoom sessions and a Saturday night field trip (1 3/4 hour drive each way) staying over at Joe's dark sky property halfway between Young and Cowra. The field trip is scheduled for Saturday 2 April, but please note that it's always possible that the weather may spoil our plans and we may need to delay it or bring it forward to the Friday night. We'll only be able to give you 24-48 hours' notice if it's re-scheduled due to weather. Arrive before dark, have some dinner and then we head out for a shoot around the area. Sleep in as long as you need so you're not tired for the drive back. *34 South is Joe's private home, a 1 hour 45 min drive from Canberra. In addition to camera gear and warm clothes, you will need a sleeping bag and towel. Bedding, pillow and linen plus meals provided. Be prepared for hours outside at low temperatures. The climate in Young is more mild than Canberra, night-time 3°C to 8°C, daytime 13 °C to 212°C depending upon time of year. Be warned, spending substantial time outside at night **requires much much warmer clothing** than a quick dash from a house to the car. For this workshop, you must have basic to intermediate photography skills, including a good working knowledge of your camera controls and any associated equipment. If you're not sure about your skill level or whether your camera equipment is suitable, please contact us in advance of booking to discuss.

Course	Zoom classes 7pm-8pm	Field Trip overnight stay @ 34 South	Milky Way Core Rise/Set Time	Mean Minimum Overnight Temperature
2022 NS-1	Wed, Thurs March 17, 18, 24,25	Saturday/Sunday April 2/3	23:30 (RISE)	8°C ±4°C
2022 NS-2	Wed, Thurs June 15, 16, 22, 23	Saturday/Sunday June 25/26	19:00 (RISE)	3°C ±4°C
2022 NS-3	Wed, Thurs August 17, 18, 24, 25	Saturday/Sunday August 27/28	01:00 (SET)	3°C ±4°C
2022 NS-3	Wed, Thurs October 12,13, 19, 20	Saturday/Sunday October 23/24	22:00 (SET)	8°C ±4°C

Field Trip (Overnight stay) weather permitting. We will reschedule the field trip in the event of poor weather prospects.
COST: $285 (Includes Dinner, Bed, Breakfast for field night) Comprehensive notes.
Enrolments: https://www.photoaccess.org.au/learn/classes/nightscapes-and-startrails/

'EQUIDISTANT AND WITH A GHOST'

Venus, Jupiter Saturn and the Moon were all strung out equidistantly along the ecliptic on November 9th 2021. The ghostly apparition of Felicity Latchford is the figure in the foreground.

" Long Weekend @ 34 South"

May 28, 29, 30 (Fri, Sat, Sun nights)
Enrolments not yet open. Send expression of interest to mailto:joe_cali@hotmail.com
Or watch this page for enrolment listing
Spend the reconciliation day long weekend shooting and enjoying the stunning dark skies at "34 South," located 160km northwest of Canberra between Cowra and Young with expert astrophotographer, Joe Cali. In addition to some fixed tripod nightscape photography, this

workshop will mainly focus on tracking techniques. A few tracking devices will be available ranging from entry level tracker devices to a $10000 Takahashi EM-200 high precision mounting. Joe will demonstrate the set-up of these devices including all important polar alignment techniques. Bring your own tracker or take turns on Joe's trackers and precision mount.
Requirements: DSLR & lenses, tripod, remote release or intervalometer, sleeping bag and towel, very warm clothing, own transport.
*34 South is Joe's private home, 1 3/4 hours drive from Canberra. In addition to camera gear and warm clothes, you will need a sleeping bag and towel. Mattress, pillow and bed linen plus meals provided. Expected temperatures – night-time 0-5°C, daytime 15-22°C.

Image Processing Workshops

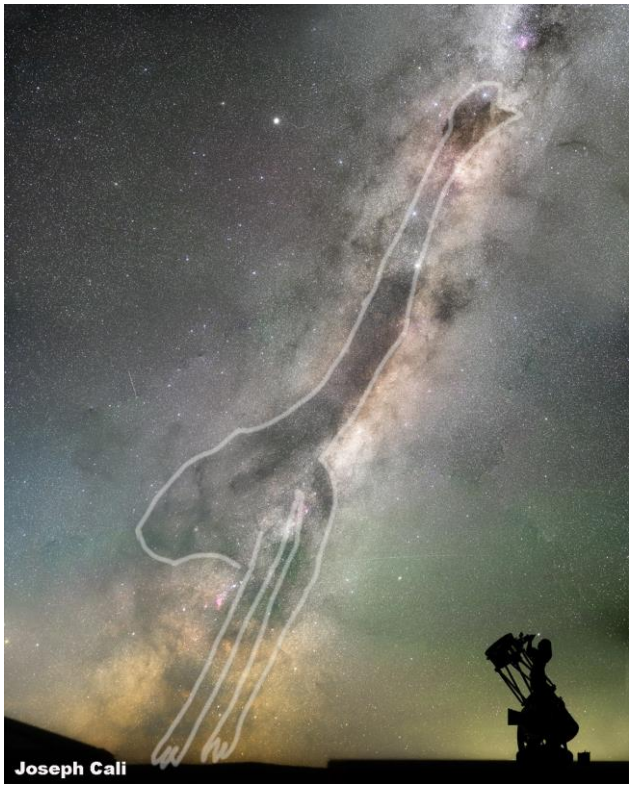
Do you look at elegantly processed images astronomical or otherwise and wish you could do that. Tutor Joe Cali has been using Adobe Photoshop since version 2 in 1992. He began teaching B&W photography workshops at photo access in 1995 and has taught Photoshop workshops since 2004. In this two-part series, Joe will give you a rapid ground up introduction to Lightroom and Photoshop before moving into more specialised astro-processing techniques in the second series. You will need to have licensed installed versions of Lightroom and Photoshop running on your own computer that you can bring to class to gain full benefit.
Enrolments will open soon here:- **https://www.photoaccess.org.au/learn/classes/**

Digital Toolbox – Lightroom & Photoshop. 12 hrs

Aimed at complete beginners, and over 4 three-hour sessions, Joe will start at the basics and quickly teach you a set of robust processing techniques essential for photographers that can be applied to astrophotographs or any other type of photograph. This is a face-to-face course that will cover both Lightroom and Photoshop. 12 hrs is not long to learn both programs. This workshop is better suited to quick learners. If you struggle using a computer and learning computer techniques, perhaps this is not the workshop for you.
Dates:
Term 1: 6,7, 13, 14 July
Term 2: 9, 10, 16, 17 November;
Venue: Photoaccess Manuka 6:00pm-9:00pm. ENROLMENTS OPENING MID-MARCH

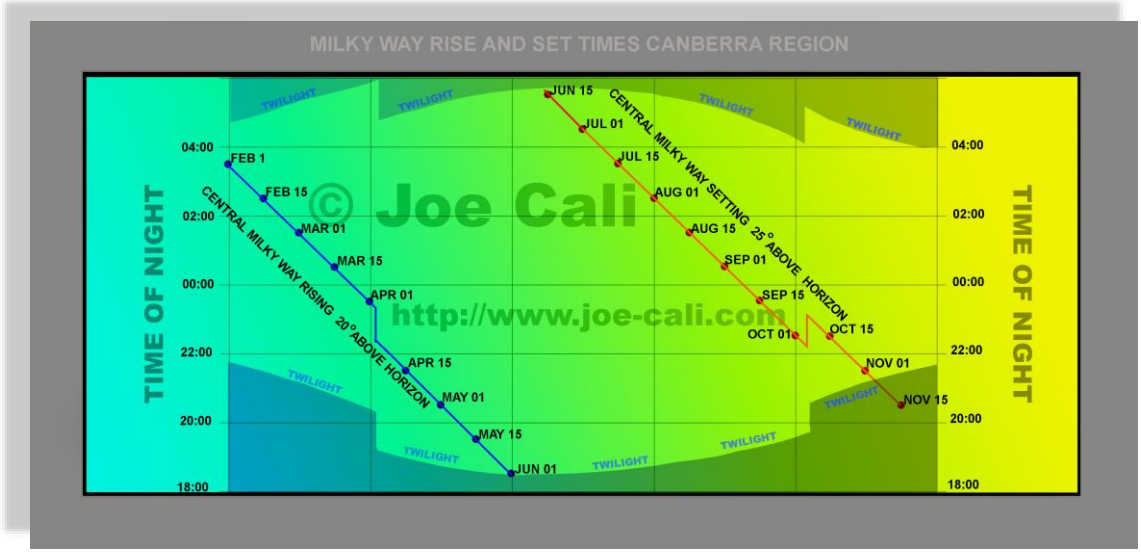
Specialist Astronomical Image Processing Techniques.

This four x 3hr session will cover specialist astronomical techniques such as stacking and averaging, advanced masking and blending, noise reduction and sharpening.
Dates: Term 2: November 30, December 1, 7, 8; 6:00pm-9:00pm



Gugurmin, the Wiradjiri name of the dark constellation more commonly known as the emu. Photo taken from my property, 34 South in Wiradjiri country near Young. The emu constellation interpretation exists in the dreamtime of all Australian indigenous mythologies. It also appears as an ostrich in ancient southern African cultures and also appears interpreted as a Rhea in South American cultures. This is a twelve-panel mosaic image, 2 images wide by 6 high stitched into a single 12000 x 19000 pixel image. 50mm f2.8 lens 60s exposures at ISO1600.

Milky Way Rise & Set – Canberra region



This rise and set graphic plots the time when the Milky Way centre is above the horizon at a "good" or "minimum" photographic altitude. I use the star Antares, at 20° altitude, for the rising Milky Way and the Trifid nebula at 25° for the setting Milky Way. These are somewhat arbitrary but values that I've found, by trial and error, work well for me. At lower altitudes, the muck in the atmosphere causes too much extinction. The discontinuity in the plots represents the shifts between eastern daylight savings time [EDT] and eastern standard time [EST] in autumn and spring respectively.

Rising – Antares 20 ^{0} altitude

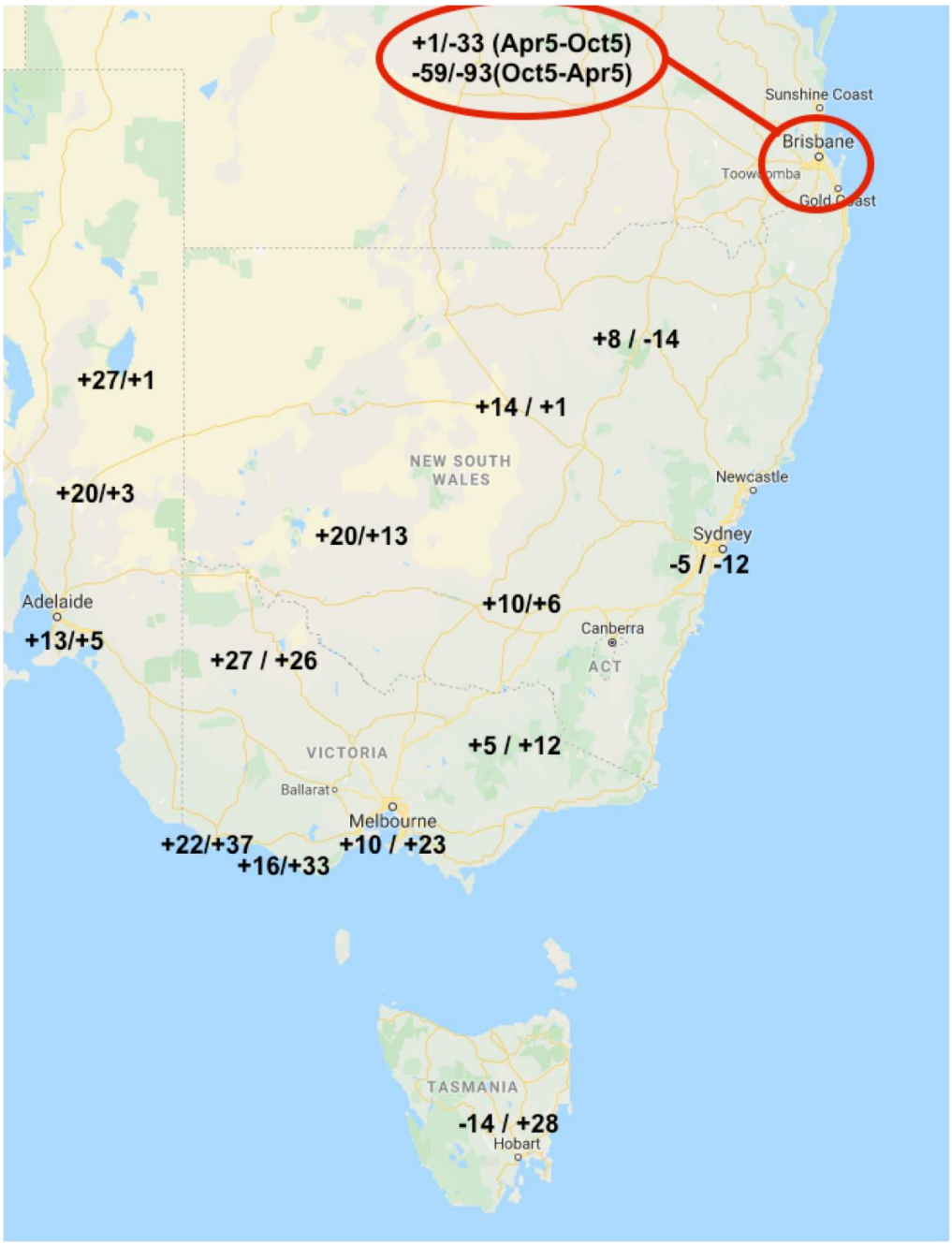
Setting – Triffid Nebula 25 ^{0} altitude

While a rising or setting Milky Way can be photographed at higher or lower altitudes. I find these to be good limits.

Milky Way Rise & Set
Time Corrections for Other Locations

Eg Narrabri +8 / -14 =>

- Add 8 mins to MW rise & morning twilight times.
- Subtract 14 mins from MW set and evening twilight times.
- These corrections only work for the Milky Way, not for the Moon and Sun because they have declinations that vary leading to variable corrections throughout the year.



Avoiding trailed star images

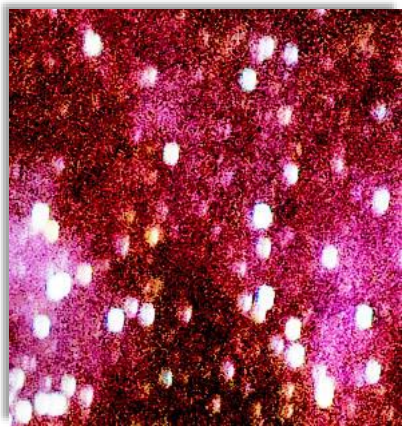
Reading about nightscape photography, you will have no doubt have come across someone claiming they have the perfect rule for pinpoint stars. One person will claim the "700 rule," another the "600, 500, 400, 300, 250 rule. I have read many such articles and posts. In almost every case the author does not understand the basics of astro-mechanics and the translation of moving stars onto a flat image plane when capturing nightscapes.

No simple "rule" can adequately calculate the maximum exposure for stars to appear stationary for all cameras, sensors and output formats. Why? Because it's a function of a number of factors –

- Sensor size
- Pixel size in the sensor
- Lens focal length
- Declination (stellar latitude) of the stars
- Final display output format/size

In 2013, I derived a formula that took all of these factors into account. At about the same time as I published my formula, I was contacted by Frédéric Michaud from the Société Astronòmique du Havre who, at about the same time, had derived a different formula now called the NPF rule. We compared our maths derivations and although we had approached the problem using different math derivations, and our formulae look very different, when we compared our results we found our two formulae to be quite consistent and any small differences had no practical effect on the image appearance.

To test the method at the extreme I shot the above image of Eta Carinae nebula using an APS camera, ISO12800, a 300mm f4 lens and a 4s exposure. The recommendation in the table is 2s for a 600px output image and when I blow this up to 100%, I can see oval shaped stars with trails twice as long as they are wide, perfectly consistent with the formula result.



Recently I re-examined the maths derivation and discovered a simplification based on using sensor dimension, lens focal length and final output size only. Other parameters are used but cancel out. You will note that as you make your desired output format smaller, you can afford to have more pixels of movement on the camera sensor and consequently, longer allowable exposure times. If you want to express this as a "600 rule" type of formula, the blue line indicates the number for the rule for various formats. You can see that it varies greatly with output format.

These techniques allow remarkable work to be produced with little more than a camera, tripod and remote release. There comes a point where, if you want to do very large prints or show work on large format 4K TV screens, you probably will need to move to using a tracking device else the exposures will be so short, the images will be very noisy.

Don't get too tied up in knots about capturing pinpoint images. If in pursuit of pinpoint stars, the exposures are so short that the captured image is full of noise then what's the point. Given the choice of a little trailing with good signal and no trailing with a lot of noise, I'll accept a little trailing any "night."

FULL FRAME CAMERA SENSOR					
	HIGHEST RESOLUTION OUTPUT DEVICE				
	A3 PRINT pixel width 4800	4K TV pixel width 4000	LAPTOP SCREEN/HD TV pixel width 2000	FACEBOOK pixel width 1000	600px web image pixel width 600
RULE FACTOR	105	126	252	504	840
Lens Focal length (mm)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)
4	26	32	63	126	210
8	13	16	32	63	105
10	11	13	25	50	84
12	9	11	21	42	70
14	8	9	18	36	60
16	7	8	16	32	53
18	6	7	14	28	47
20	5	6	13	25	42
24	4	5	11	21	35
28	3.8	5	9	18	30
35	3.0	3.6	7	14	24
40	2.6	3.2	6	13	21
45	2.3	2.8	6	11	19
50	2.1	2.5	5	10	17
60	1.8	2.1	4	8	14
70	1.5	1.8	3.6	7	12
80	1.3	1.6	3.2	6	11
90	1.2	1.4	2.8	6	9
100	1.1	1.3	2.5	5	8
120	0.9	1.1	2.1	4	7
135	0.8	0.9	1.9	3.7	6
150	0.7	0.8	1.7	3.4	6
200	0.5	0.6	1.3	2.5	4
300	0.4	0.4	0.8	1.7	2.8

APS Camera Sensor					
	HIGHEST RESOLUTION OUTPUT DEVICE				
	A3 PRINT pixel width 4800	4K TV pixel width 4000	LAPTOP SCREEN/HD TV pixel width 2000	FACEBOOK pixel width 1000	600px web image pixel width 600
RULE FACTOR	70	84	168	336	560
Lens Focal length (mm)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)
4	18	21	42	84	140
8	9	11	21	42	70
10	7	8	17	34	56
12	6	7	14	28	47
14	5	6	12	24	40
16	4	5	11	21	35
18	4	5	9	19	31
20	4	4	8	17	28
24	2.9	4	7	14	23
28	2.5	3.0	6	12	20
35	2.0	2.4	5	10	16
40	1.8	2.1	4	8	14
45	1.6	1.9	4	7	12
50	1.4	1.7	3.4	7	11
60	1.2	1.4	2.8	6	9
70	1.0	1.2	2.4	5	8
80	0.9	1.1	2.1	4	7
90	0.8	0.9	1.9	4	6
100	0.7	0.8	1.7	3.4	6
120	0.6	0.7	1.4	2.8	5
135	0.5	0.6	1.2	2.5	4
150	0.5	0.6	1.1	2.2	3.7
200	0.4	0.4	0.8	1.7	2.8
300	0.2	0.3	0.6	1.1	1.9

MICRO 4/3 SENSOR (OLYMPUS)					
	HIGHEST RESOLUTION OUTPUT DEVICE				
	A3 PRINT pixel width 4800	4K TV pixel width 4000	LAPTOP SCREEN/HD TV pixel width 2000	FACEBOOK pixel width 1000	600px web image pixel width 600
RULE FACTOR	50	61	121	242	404
Lens Focal length (mm)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)	MAX EXPOSURE TIME (s)
4	13	15	30	61	101
8	6	8	15	30	50
10	5	6	12	24	40
12	4	5	10	20	34
14	4	4	9	17	29
16	3.2	4	8	15	25
18	2.8	3.4	7	13	22
20	2.5	3.0	6	12	20
24	2.1	2.5	5	10	17
28	1.8	2.2	4	9	14
35	1.4	1.7	3.5	7	12
40	1.3	1.5	3.0	6	10
45	1.1	1.3	2.7	5	9
50	1.0	1.2	2.4	5	8
60	0.8	1.0	2.0	4	7
70	0.7	0.9	1.7	3.5	6
80	0.6	0.8	1.5	3.0	5
90	0.6	0.7	1.3	2.7	4
100	0.5	0.6	1.2	2.4	4
120	0.4	0.5	1.0	2.0	3.4
135	0.4	0.4	0.9	1.8	3.0
150	0.3	0.4	0.8	1.6	2.7
200	0.3	0.3	0.6	1.2	2.0
300	0.2	0.2	0.4	0.8	1.3

How to use it?

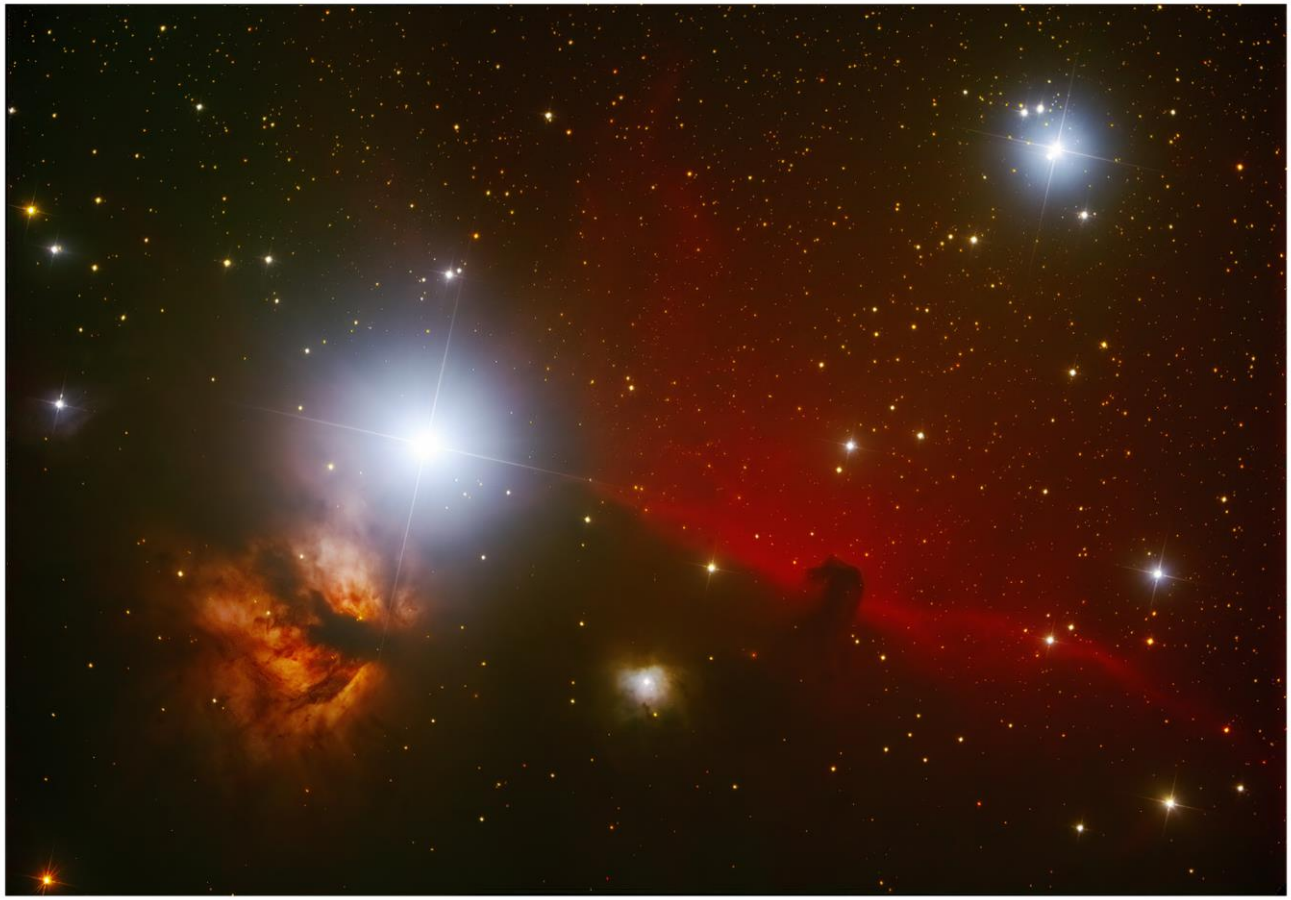
These tables use overall sensor size, final display size and lens focal length. While pixel size is important, it drops out when exposure times are calculated on final display scale. There are three tables on this page. Choose the table (full-frame, APS C, Micro 4/3rds) that corresponds to your DSLR or mirrorless camera sensor. Choose the row corresponding to the lens focal length and the column that is closest to your desired output. This is the maximum exposure time in seconds corresponding to a star movement of 1 pixel on your final output.

"Under the Milky Way tonight" © Joe Cali 2018

Panorama Stitching

When shooting panoramas, the final image ends up much bigger than the sensor's native pixel dimension. For example, my camera full frame sensor is 7400px wide. When using a 14mm lens for a 2000 pixel display the recommendation is 18s. If I produce a 21000 pixel wide pano like this one, approximately 3 times wider than my sensor, I can increase the exposure time for each panel to one minute as in the panorama example above. Trailing is visible in each individual panel when examined in detail. Once the image is stitched and down-sized for display, these short trails disappear.

When shooting star trails and time sequences, long exposures can be quite practical. In the star trail image on page 26, just after the meteor shower section, I did shoot many short 40s exposures. My original intention was to capture a time-lapse. Shooting short, point star images gives you the option of producing a star trail or a time lapse from an imaging session. When capturing for star trails only, I set my shutter speed to 2 minutes leaving me less images to composite and better signal to noise in the captured sub-exposures.



Horsehead and Flame Nebulae

Joseph Cali

Pentax K1 Vixen VC200L 1280mm f6.4

Two Panel Mosaic: ISO 12800 Left side: 23 x 120s Right Side: 17 x 120s

Times Of Sunrise And Sunset

	Jan		Feb		Mar		Apr		May		Jun	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	5:53	20:21	6:23	20:12	6:50	19:42	7:16	18:59	6:40	17:22	7:03	17:01
2	5:54	20:21	6:24	20:11	6:51	19:41	7:17	18:58	6:41	17:21	7:04	17:00
3	5:55	20:21	6:25	20:10	6:52	19:39	**6:18**	**17:57**	6:42	17:20	7:04	17:00
4	5:56	20:21	6:26	20:09	6:53	19:38	6:19	17:55	6:43	17:19	7:05	17:00
5	5:57	20:22	6:27	20:08	6:54	19:37	6:20	17:54	6:43	17:18	7:05	17:00
6	5:57	20:22	6:28	20:07	6:55	19:35	6:20	17:53	6:44	17:17	7:06	16:59
7	5:58	20:22	6:29	20:07	6:56	19:34	6:21	17:51	6:45	17:16	7:06	16:59
8	5:59	20:22	6:30	20:06	6:57	19:33	6:22	17:50	6:46	17:15	7:07	16:59
9	6:00	20:22	6:31	20:05	6:58	19:31	6:23	17:49	6:47	17:14	7:07	16:59
10	6:01	20:21	6:32	20:04	6:58	19:30	6:24	17:47	6:47	17:14	7:08	16:59
11	6:02	20:21	6:33	20:03	6:59	19:29	6:24	17:46	6:48	17:13	7:08	16:59
12	6:03	20:21	6:34	20:02	7:00	19:27	6:25	17:45	6:49	17:12	7:09	16:59
13	6:04	20:21	6:35	20:01	7:01	19:26	6:26	17:43	6:50	17:11	7:09	16:59
14	6:05	20:21	6:36	20:00	7:02	19:25	6:27	17:42	6:50	17:10	7:10	16:59
15	6:06	20:20	6:37	19:59	7:03	19:23	6:28	17:41	6:51	17:10	7:10	16:59
16	6:07	20:20	6:38	19:58	7:03	19:22	6:28	17:39	6:52	17:09	7:10	16:59
17	6:08	20:20	6:39	19:56	7:04	19:20	6:29	17:38	6:53	17:08	7:11	16:59
18	6:09	20:20	6:40	19:55	7:05	19:19	6:30	17:37	6:53	17:07	7:11	16:59
19	6:10	20:19	6:41	19:54	7:06	19:18	6:31	17:36	6:54	17:07	7:11	16:59
20	6:11	20:19	6:42	19:53	7:07	19:16	6:31	17:35	6:55	17:06	7:12	16:59
21	6:12	20:18	6:43	19:52	7:08	19:15	6:32	17:33	6:56	17:06	7:12	17:00
22	6:13	20:18	6:44	19:51	7:08	19:13	6:33	17:32	6:56	17:05	7:12	17:00
23	6:14	20:17	6:45	19:49	7:09	19:12	6:34	17:31	6:57	17:04	7:12	17:00
24	6:15	20:17	6:46	19:48	7:10	19:11	6:35	17:30	6:58	17:04	7:12	17:00
25	6:16	20:16	6:47	19:47	7:11	19:09	6:35	17:29	6:59	17:03	7:12	17:01
26	6:17	20:16	6:48	19:46	7:12	19:08	6:36	17:28	6:59	17:03	7:13	17:01
27	6:18	20:15	6:49	19:45	7:12	19:06	6:37	17:26	7:00	17:02	7:13	17:01
28	6:19	20:14	6:50	19:43	7:13	19:05	6:38	17:25	7:01	17:02	7:13	17:02
29	6:20	20:14			7:14	19:04	6:39	17:24	7:01	17:02	7:13	17:02
30	6:21	20:13			7:15	19:02	6:39	17:23	7:02	17:01	7:13	17:02
31	6:22	20:12			7:16	19:01			7:02	17:01		

Times Of Sunrise And Sunset												
	July	July	Aug	Aug	Sept	Sept	Oct	Oct	Nov	Nov	Dec	Dec
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	7:13	17:03	6:59	17:22	6:24	17:45	5:41	18:07	6:02	19:33	5:43	20:02
2	7:13	17:03	6:58	17:23	6:22	17:45	6:39	19:07	6:01	19:34	5:43	20:03
3	7:13	17:04	6:57	17:23	6:21	17:46	6:38	19:08	6:00	19:35	5:43	20:04
4	7:13	17:04	6:56	17:24	6:19	17:47	6:37	19:09	5:59	19:36	5:43	20:05
5	7:12	17:05	6:55	17:25	6:18	17:48	6:35	19:10	5:58	19:37	5:43	20:06
6	7:12	17:05	6:54	17:26	6:17	17:48	6:34	19:10	5:57	19:38	5:43	20:07
7	7:12	17:06	6:53	17:26	6:15	17:49	6:32	19:11	5:56	19:39	5:43	20:07
8	7:12	17:06	6:52	17:27	6:14	17:50	6:31	19:12	5:55	19:40	5:43	20:08
9	7:12	17:07	6:51	17:28	6:12	17:51	6:30	19:13	5:54	19:41	5:43	20:09
10	7:11	17:07	6:50	17:29	6:11	17:51	6:28	19:14	5:54	19:42	5:43	20:10
11	7:11	17:08	6:49	17:29	6:10	17:52	6:27	19:14	5:53	19:43	5:43	20:11
12	7:11	17:08	6:48	17:30	6:08	17:53	6:26	19:15	5:52	19:44	5:43	20:11
13	7:10	17:09	6:47	17:31	6:07	17:53	6:24	19:16	5:51	19:45	5:44	20:12
14	7:10	17:10	6:46	17:32	6:05	17:54	6:23	19:17	5:51	19:46	5:44	20:13
15	7:10	17:10	6:45	17:32	6:04	17:55	6:22	19:18	5:50	19:47	5:44	20:13
16	7:09	17:11	6:44	17:33	6:03	17:56	6:20	19:19	5:49	19:48	5:44	20:14
17	7:09	17:12	6:43	17:34	6:01	17:56	6:19	19:19	5:49	19:49	5:45	20:15
18	7:08	17:12	6:41	17:35	6:00	17:57	6:18	19:20	5:48	19:50	5:45	20:15
19	7:08	17:13	6:40	17:35	5:58	17:58	6:17	19:21	5:48	19:51	5:45	20:16
20	7:07	17:14	6:39	17:36	5:57	17:58	6:15	19:22	5:47	19:52	5:46	20:16
21	7:07	17:14	6:38	17:37	5:55	17:59	6:14	19:23	5:47	19:53	5:46	20:17
22	7:06	17:15	6:37	17:37	5:54	18:00	6:13	19:24	5:46	19:54	5:47	20:18
23	7:05	17:16	6:35	17:38	5:52	18:01	6:12	19:25	5:46	19:55	5:47	20:18
24	7:05	17:16	6:34	17:39	5:51	18:01	6:11	19:26	5:45	19:56	5:48	20:18
25	7:04	17:17	6:33	17:40	5:50	18:02	6:09	19:27	5:45	19:57	5:48	20:19
26	7:03	17:18	6:31	17:40	5:48	18:03	6:08	19:27	5:44	19:58	5:49	20:19
27	7:03	17:18	6:30	17:41	5:47	18:04	6:07	19:28	5:44	19:59	5:50	20:20
28	7:02	17:19	6:29	17:42	5:45	18:04	6:06	19:29	5:44	19:59	5:50	20:20
29	7:01	17:20	6:28	17:43	5:44	18:05	6:05	19:30	5:44	20:00	5:51	20:20
30	7:00	17:21	6:26	17:43	5:42	18:06	6:04	19:31	5:43	20:01	5:52	20:21
31	7:00	17:21	6:25	17:44			6:03	19:32			5:52	20:21

Times in blue are Australian Eastern Summer Time. Those in black are Eastern Standard Time.

All rise and set times are generated for Canberra in Starry Night Pro by Simulation Curriculum. They should be correct to within 5-10 mins for all of SE and central west NSW.

Times Of Astronomical Twilight

	Jan		Feb		Mar		Apr		May		Jun	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	4:07	22:07	4:47	21:48	5:23	21:10	5:52	20:23	5:14	18:48	5:33	18:30
2	4:08	22:07	4:48	21:47	5:24	21:08	5:53	20:22	5:15	18:47	5:34	18:30
3	4:09	22:07	4:50	21:46	5:25	21:07	4:54	19:21	5:16	18:46	5:34	18:30
4	4:10	22:07	4:51	21:44	5:26	21:05	4:55	19:19	5:16	18:45	5:35	18:30
5	4:11	22:07	4:52	21:43	5:27	21:04	4:56	19:18	5:17	18:44	5:35	18:30
6	4:12	22:07	4:54	21:42	5:28	21:02	4:56	19:17	5:18	18:44	5:36	18:29
7	4:13	22:06	4:55	21:41	5:29	21:00	4:57	19:15	5:18	18:43	5:36	18:29
8	4:14	22:06	4:56	21:39	5:30	20:59	4:58	19:14	5:19	18:42	5:37	18:29
9	4:16	22:06	4:58	21:38	5:31	20:57	4:59	19:13	5:20	18:41	5:37	18:29
10	4:17	22:06	4:59	21:37	5:32	20:56	4:59	19:11	5:20	18:40	5:38	18:29
11	4:18	22:05	5:01	21:36	5:33	20:54	5:00	19:10	5:21	18:40	5:38	18:29
12	4:19	22:05	5:02	21:34	5:34	20:53	5:01	19:09	5:22	18:39	5:38	18:29
13	4:21	22:04	5:03	21:33	5:35	20:51	5:02	19:08	5:22	18:38	5:39	18:29
14	4:22	22:04	5:04	21:31	5:36	20:50	5:02	19:06	5:23	18:38	5:39	18:29
15	4:23	22:03	5:06	21:30	5:37	20:48	5:03	19:05	5:24	18:37	5:39	18:30
16	4:24	22:02	5:07	21:29	5:38	20:47	5:04	19:04	5:24	18:37	5:40	18:30
17	4:26	22:02	5:08	21:27	5:39	20:45	5:05	19:03	5:25	18:36	5:40	18:30
18	4:27	22:01	5:10	21:26	5:40	20:44	5:05	19:02	5:25	18:35	5:40	18:30
19	4:28	22:00	5:11	21:24	5:41	20:42	5:06	19:00	5:26	18:35	5:41	18:30
20	4:30	22:00	5:12	21:23	5:42	20:41	5:07	18:59	5:27	18:34	5:41	18:30
21	4:31	21:59	5:13	21:21	5:43	20:39	5:08	18:58	5:27	18:34	5:41	18:30
22	4:33	21:58	5:15	21:20	5:44	20:38	5:08	18:57	5:28	18:33	5:41	18:31
23	4:34	21:57	5:16	21:19	5:45	20:36	5:09	18:56	5:28	18:33	5:41	18:31
24	4:35	21:56	5:17	21:17	5:46	20:35	5:10	18:55	5:29	18:33	5:42	18:31
25	4:37	21:55	5:18	21:16	5:46	20:33	5:10	18:54	5:30	18:32	5:42	18:31
26	4:38	21:54	5:19	21:14	5:47	20:32	5:11	18:53	5:30	18:32	5:42	18:32
27	4:40	21:53	5:21	21:13	5:48	20:30	5:12	18:52	5:31	18:32	5:42	18:32
28	4:41	21:52	5:22	21:11	5:49	20:29	5:12	18:51	5:31	18:31	5:42	18:32
29	4:42	21:51			5:50	20:28	5:13	18:50	5:32	18:31	5:42	18:33
30	4:44	21:50			5:51	20:26	5:14	18:49	5:32	18:31	5:42	18:33
31	4:45	21:49			5:51	20:25			5:33	18:30		

Times Of Astronomical Twilight

	Jul		Aug		Sep		Oct		Nov		Dec	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	5:42	18:33	5:32	18:49	4:59	19:09	4:15	19:32	4:29	21:06	4:00	21:46
2	5:42	18:34	5:31	18:50	4:58	19:10	5:14	20:33	4:27	21:07	3:59	21:47
3	5:42	18:34	5:30	18:50	4:57	19:10	5:12	20:34	4:26	21:09	3:59	21:48
4	5:42	18:35	5:29	18:51	4:55	19:11	5:11	20:35	4:25	21:10	3:58	21:49
5	5:42	18:35	5:28	18:52	4:54	19:12	5:09	20:36	4:24	21:11	3:58	21:51
6	5:42	18:35	5:28	18:52	4:53	19:12	5:08	20:37	4:22	21:13	3:58	21:52
7	5:42	18:36	5:27	18:53	4:51	19:13	5:06	20:38	4:21	21:14	3:57	21:53
8	5:42	18:36	5:26	18:53	4:50	19:14	5:04	20:39	4:20	21:15	3:57	21:54
9	5:42	18:37	5:25	18:54	4:49	19:14	5:03	20:40	4:19	21:17	3:57	21:55
10	5:42	18:37	5:24	18:55	4:47	19:15	5:01	20:41	4:17	21:18	3:57	21:56
11	5:41	18:38	5:23	18:55	4:46	19:16	5:00	20:42	4:16	21:19	3:57	21:57
12	5:41	18:38	5:22	18:56	4:44	19:17	4:58	20:43	4:15	21:21	3:57	21:58
13	5:41	18:39	5:21	18:57	4:43	19:17	4:57	20:44	4:14	21:22	3:57	21:59
14	5:41	18:39	5:20	18:57	4:41	19:18	4:55	20:45	4:13	21:24	3:57	21:59
15	5:40	18:40	5:19	18:58	4:40	19:19	4:54	20:46	4:12	21:25	3:57	22:00
16	5:40	18:40	5:18	18:58	4:38	19:20	4:52	20:47	4:11	21:26	3:58	22:01
17	5:40	18:41	5:17	18:59	4:37	19:20	4:51	20:48	4:10	21:28	3:58	22:02
18	5:39	18:41	5:16	19:00	4:35	19:21	4:49	20:49	4:09	21:29	3:58	22:02
19	5:39	18:42	5:15	19:00	4:34	19:22	4:48	20:50	4:08	21:30	3:58	22:03
20	5:38	18:42	5:14	19:01	4:32	19:23	4:46	20:51	4:07	21:32	3:59	22:04
21	5:38	18:43	5:13	19:02	4:31	19:24	4:45	20:53	4:06	21:33	3:59	22:04
22	5:38	18:43	5:12	19:02	4:29	19:24	4:43	20:54	4:05	21:34	4:00	22:05
23	5:37	18:44	5:11	19:03	4:28	19:25	4:42	20:55	4:05	21:36	4:00	22:05
24	5:37	18:45	5:09	19:04	4:26	19:26	4:40	20:56	4:04	21:37	4:01	22:06
25	5:36	18:45	5:08	19:04	4:25	19:27	4:39	20:57	4:03	21:38	4:01	22:06
26	5:35	18:46	5:07	19:05	4:23	19:28	4:37	20:59	4:02	21:40	4:02	22:06
27	5:35	18:46	5:06	19:06	4:22	19:29	4:36	21:00	4:02	21:41	4:03	22:07
28	5:34	18:47	5:05	19:06	4:20	19:30	4:34	21:01	4:01	21:42	4:04	22:07
29	5:34	18:47	5:03	19:07	4:19	19:30	4:33	21:02	4:01	21:43	4:04	22:07
30	5:33	18:48	5:02	19:08	4:17	19:31	4:32	21:04	4:00	21:45	4:05	22:07
31	5:32	18:49	5:01	19:08			4:30	21:05			4:06	22:07

Times in blue are Australian Eastern Summer Time. Those in black are Eastern Standard Time.

All rise and set times are generated for Canberra in Starry Night Pro by Simulation Curriculum. They should be correct to within 5-10 mins for all of SE and central west NSW.


The
Moon

Moon Rise and Moon Set 2022

Times Of Moonrise And Moonset												
	Jan		Feb		Mar		Apr		May		Jun	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	3:50	18:53	5:46	20:34	4:37	19:08	6:51	19:10	6:43	17:34	8:32	18:05
2	4:45	20:05	6:59	21:14	5:48	19:44	7:53	19:37	7:44	18:06	9:26	18:56
3	5:49	21:08	8:10	21:48	6:57	20:15	7:54	19:04	8:45	18:42	10:13	19:51
4	7:00	22:01	9:18	22:18	8:03	20:43	8:55	19:34	9:43	19:23	10:55	20:48
5	8:13	22:45	10:22	22:45	9:06	21:10	9:56	20:08	10:39	20:10	11:32	21:48
6	9:25	23:21	11:23	23:12	10:08	21:37	10:56	20:46	11:31	21:02	12:04	22:48
7	10:33	23:52	12:23	23:39	11:09	22:06	11:53	21:29	12:17	21:58	12:33	23:48
8	11:37		13:22		12:09	22:37	12:47	22:18	12:57	22:58	13:00	
9	12:37	0:19	14:21	0:07	13:08	23:12	13:37	23:12	13:32	23:58	13:26	0:49
10	13:36	0:45	15:19	0:39	14:07	23:51	14:21		14:03		13:54	1:52
11	14:34	1:11	16:17	1:16	15:03		14:59	0:10	14:32	0:59	14:24	2:58
12	15:32	1:38	17:12	1:58	15:55	0:37	15:33	1:11	15:00	2:02	14:59	4:07
13	16:30	2:08	18:02	2:46	16:43	1:28	16:04	2:13	15:27	3:05	15:40	5:21
14	17:28	2:41	18:48	3:39	17:25	2:25	16:33	3:16	15:57	4:11	16:31	6:37
15	18:25	3:20	19:29	4:38	18:02	3:25	17:01	4:20	16:30	5:20	17:33	7:52
16	19:19	4:04	20:04	5:39	18:35	4:27	17:30	5:26	17:08	6:33	18:43	8:59
17	20:08	4:54	20:36	6:41	19:06	5:30	18:01	6:33	17:54	7:49	19:56	9:56
18	20:52	5:49	21:05	7:44	19:34	6:34	18:36	7:44	18:49	9:04	21:10	10:43
19	21:30	6:48	21:33	8:47	20:02	7:38	19:16	8:57	19:53	10:14	22:20	11:21
20	22:04	7:49	22:01	9:50	20:31	8:44	20:04	10:11	21:03	11:15	23:27	11:53
21	22:34	8:51	22:30	10:55	21:03	9:51	21:02	11:22	22:15	12:06		12:21
22	23:02	9:53	23:02	12:01	21:38	11:01	22:06	12:26	23:25	12:47	0:30	12:48
23	23:30	10:54	23:39	13:10	22:21	12:12	23:15	13:22		13:21	1:30	13:14
24	23:57	11:57		14:20	23:11	13:23		14:07	0:31	13:51	2:30	13:41
25		13:01	0:23	15:30		14:30	0:25	14:45	1:35	14:18	3:30	14:10
26	0:27	14:08	1:15	16:36	0:09	15:31	1:33	15:18	2:36	14:44	4:30	14:42
27	1:01	15:19	2:17	17:35	1:14	16:23	2:38	15:46	3:36	15:10	5:29	15:20
28	1:41	16:31	3:25	18:26	2:23	17:06	3:41	16:13	4:36	15:37	6:27	16:03
29	2:29	17:42			3:33	17:43	4:42	16:39	5:36	16:07	7:21	16:51
30	3:27	18:48			4:42	18:15	5:43	17:06	6:36	16:41	8:11	17:45
31	4:34	19:46			5:47	18:43			7:35	17:20		

Times in blue are Australian Eastern Summer Time. Those in black are Eastern Standard Time.

All rise and set times are generated for Canberra in Starry Night Pro by Simulation Curriculum.
They should be correct to within 5-10 mins for all of SE and central west NSW.

Times Of Moonrise And Moonset												
	Jul		Aug		Sep		Oct		Nov		Dec	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	8:54	18:42	9:06	20:34	8:56	22:37	8:46	23:56	**11:46**	**1:52**	**13:07**	**1:49**
2	9:32	19:41	9:32	21:34	9:27	23:44	**10:37**		**12:57**	**2:37**	**14:13**	**2:19**
3	10:06	20:41	9:58	22:35	10:04		**11:36**	**2:03**	**14:07**	**3:14**	**15:16**	**2:46**
4	10:35	21:40	10:24	23:38	10:48	0:54	**12:44**	**3:03**	**15:15**	**3:46**	**16:18**	**3:12**
5	11:02	22:40	10:53		11:42	2:04	**13:55**	**3:54**	**16:20**	**4:15**	**17:21**	**3:39**
6	11:28	23:40	11:27	0:44	12:46	3:09	**15:07**	**4:36**	**17:24**	**4:42**	**18:23**	**4:08**
7	11:55		12:06	1:54	13:57	4:08	**16:18**	**5:12**	**18:27**	**5:09**	**19:25**	**4:41**
8	12:22	0:43	12:55	3:05	15:11	4:57	**17:26**	**5:44**	**19:31**	**5:37**	**20:26**	**5:18**
9	12:54	1:48	13:55	4:16	16:25	5:39	**18:33**	**6:13**	**20:34**	**6:07**	**21:23**	**6:01**
10	13:30	2:58	15:04	5:21	17:36	6:14	**19:37**	**6:40**	**21:36**	**6:42**	**22:14**	**6:49**
11	14:15	4:11	16:19	6:18	18:45	6:45	**20:42**	**7:08**	**22:36**	**7:21**	**22:59**	**7:43**
12	15:11	5:25	17:35	7:06	19:51	7:13	**21:46**	**7:37**	**23:31**	**8:06**	**23:38**	**8:41**
13	16:17	6:37	18:49	7:45	20:55	7:41	**22:49**	**8:09**		**8:57**		**9:39**
14	17:30	7:40	19:59	8:18	21:59	8:09	**23:50**	**8:46**	**0:20**	**9:52**	**0:11**	**10:38**
15	18:47	8:32	21:05	8:48	23:02	8:40		**9:27**	**1:03**	**10:50**	**0:40**	**11:37**
16	20:01	9:15	22:09	9:15		9:13	**0:47**	**10:14**	**1:39**	**11:49**	**1:07**	**12:35**
17	21:11	9:51	23:12	9:43	0:03	9:51	**1:40**	**11:07**	**2:11**	**12:49**	**1:32**	**13:34**
18	22:18	10:21		10:11	1:02	10:35	**2:26**	**12:04**	**2:40**	**13:48**	**1:57**	**14:34**
19	23:21	10:49	0:13	10:42	1:57	11:24	**3:06**	**13:02**	**3:06**	**14:48**	**2:22**	**15:38**
20		11:16	1:14	11:17	2:47	12:18	**3:41**	**14:02**	**3:31**	**15:49**	**2:52**	**16:45**
21	0:22	11:43	2:14	11:57	3:30	13:16	**4:12**	**15:03**	**3:57**	**16:53**	**3:26**	**17:58**
22	1:23	12:12	3:11	12:42	4:08	14:16	**4:40**	**16:04**	**4:25**	**18:00**	**4:07**	**19:12**
23	2:23	12:43	4:04	13:33	4:42	15:16	**5:06**	**17:05**	**4:57**	**19:11**	**4:58**	**20:25**
24	3:23	13:19	4:51	14:28	5:11	16:17	**5:32**	**18:08**	**5:35**	**20:25**	**6:01**	**21:31**
25	4:21	14:00	5:33	15:27	5:39	17:18	**5:59**	**19:13**	**6:21**	**21:39**	**7:12**	**22:26**
26	5:17	14:47	6:09	16:27	6:05	18:20	**6:28**	**20:22**	**7:17**	**22:47**	**8:29**	**23:12**
27	6:08	15:39	6:41	17:28	6:31	19:23	**7:02**	**21:34**	**8:23**	**23:47**	**9:44**	**23:49**
28	6:53	16:36	7:09	18:28	6:58	20:28	**7:43**	**22:46**	**9:34**		**10:56**	
29	7:33	17:35	7:36	19:28	7:29	21:36	**8:31**	**23:56**	**10:47**	**0:36**	**12:04**	**0:21**
30	8:08	18:35	8:02	20:29	8:04	22:46	**9:29**		**11:59**	**1:16**	**13:09**	**0:49**
31	8:38	19:35	8:28	21:32			**10:35**	**0:59**			**14:12**	**1:16**

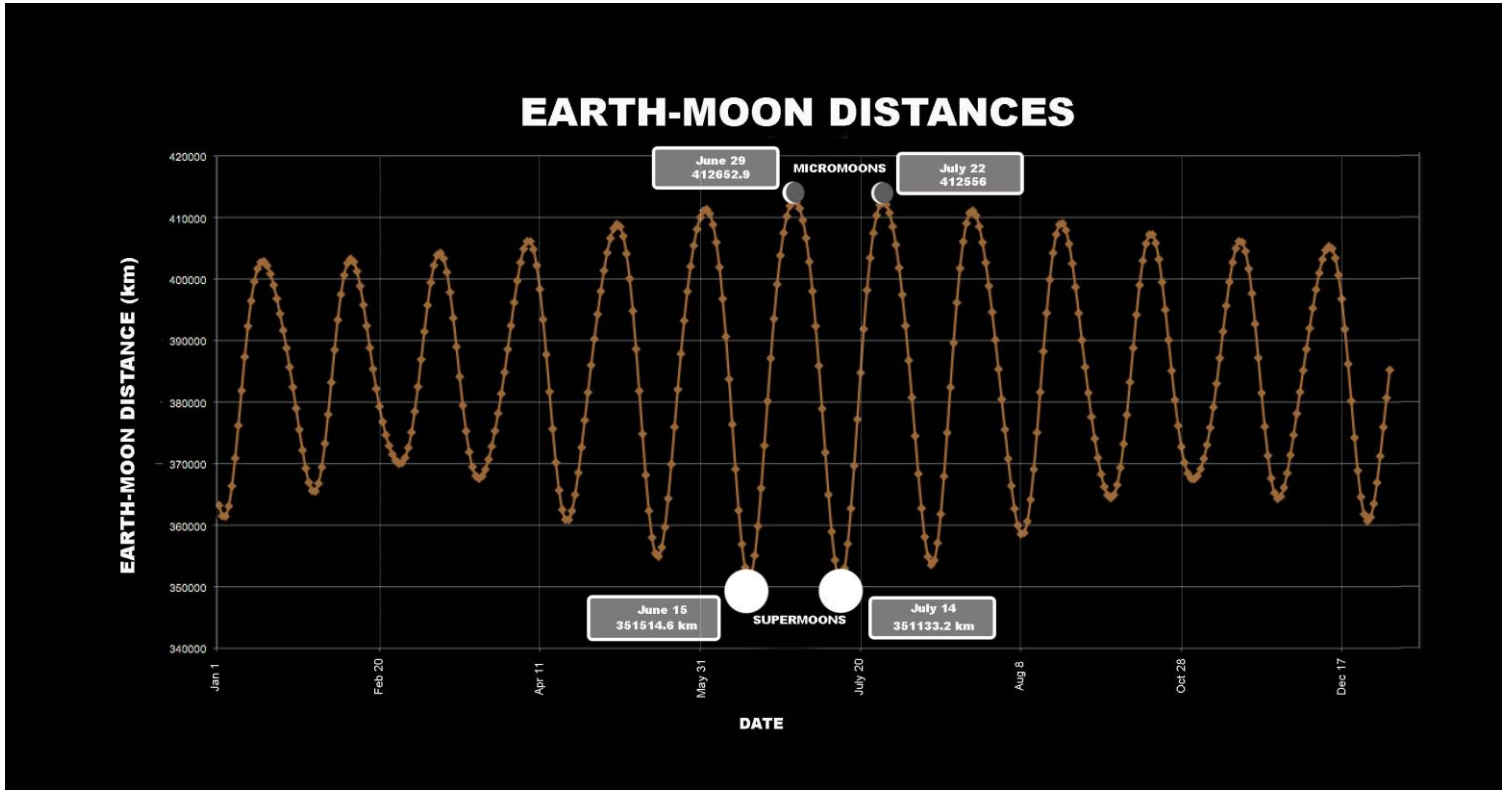
Source: Computed using National Mapping Division's moonrisenset program, version 1.2

Times in blue are Australian Eastern Summer Time. Those in black are Eastern Standard Time.

All rise and set times are generated for Canberra in Starry Night Pro by Simulation Curriculum.
They should be correct to within 5-10 mins for all of SE and central west NSW.

Lunar Distance and Size, Super Moons and Micro Moons

I must admit that I am not a fan of the media "hype" terms for Moons - supermoon, micromoon, blood moon etc etc. It's the Moon. But for the sake of completeness, here is an orbital plot showing the dates of all lunar perigees and highlighting the so called supermoons and micromoons. The difference between the size of the Moon at perigee and apogee(micromoon-supermoon) is just 14%. Photographing the Moon at micro moon with a 400mm lens will result in the same size image as an image taken with a 350mm lens at supermoon. Images of the Moon at phases other than full show much more geographic relief due to side lighting on the mountains on the terminator (see the picture at the start of the Moon section). The two closest perigee moons for 2022 occur near full moons on June 15 and July 14. The two apogee micromoons occur at the new moon on June 29(not observable) and just after last quarter in July.
Data: Starry Night Pro Graphic by Joe Cali



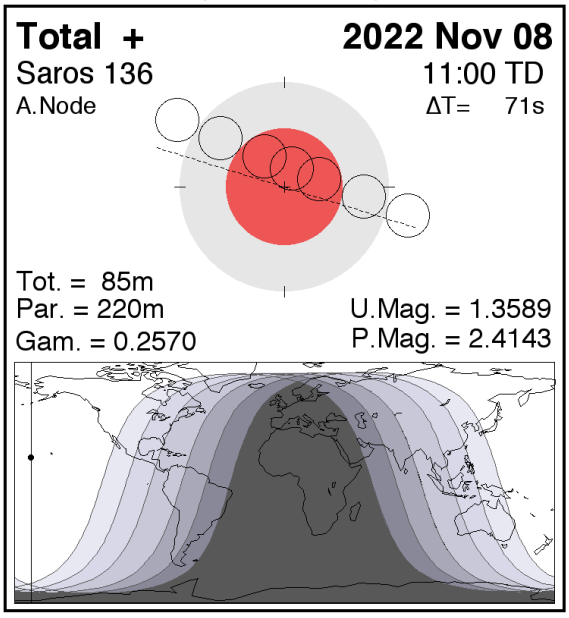
Eclipses of 2022

Eclipse Predictions and some graphics by Fred Espenak, http://www.EclipseWise.com
Reproduced by permission.

There are two lunar eclipses that occur world-wide during 2022 on May 16 and November 8. The first is not visible from Canberra. There is a total lunar eclipse on Nov 8th, 2022 and almost observable in its entirety from the Canberra region

Total Lunar Eclipse of 2022 November 8th

www.EclipseWise.com/eclipse.html

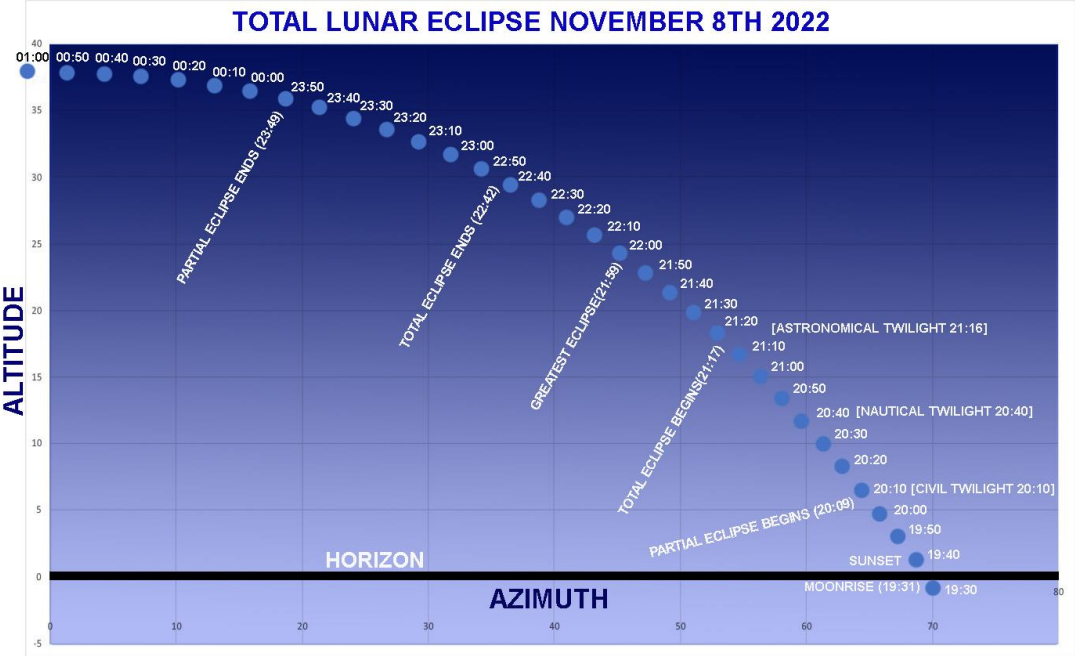


Thousand Year Canon of Lunar Eclipses

The penumbral ingress phase of this eclipse occurs before and during local Moonrise in Canberra which occurs at 19:31EDT. The partial eclipse begins (U1) at 20:09EDT at the same time as Civil Twilight and continues through Nautical Twilight. Totality begins at 21:17EDT coincident with Astronomical Twilight and all of totality can be observed in darkness.

Event	Contact	Time (EDT)	Position Angle	Axis Distance
Penumbral Begins	P1	19:02:16	256.9°	1.4726°
Partial Begins	U1	20:09:14	262.4°	0.9340°
Total Begins	U2	21:16:41	282.1°	0.4236°
Greatest Eclipse	Greatest	21:59:11	337.5°	0.2404°
Total Ends	U3	22:41:40	32.9°	0.4232°
Partial Ends	U4	23:49:06	52.6°	0.9323°
Penumbral Ends	P4	0:56:13	58.1°	1.4699°

Data converted to Australian EDT from a table by Fred Espenak, on http://www.EclipseWise.com



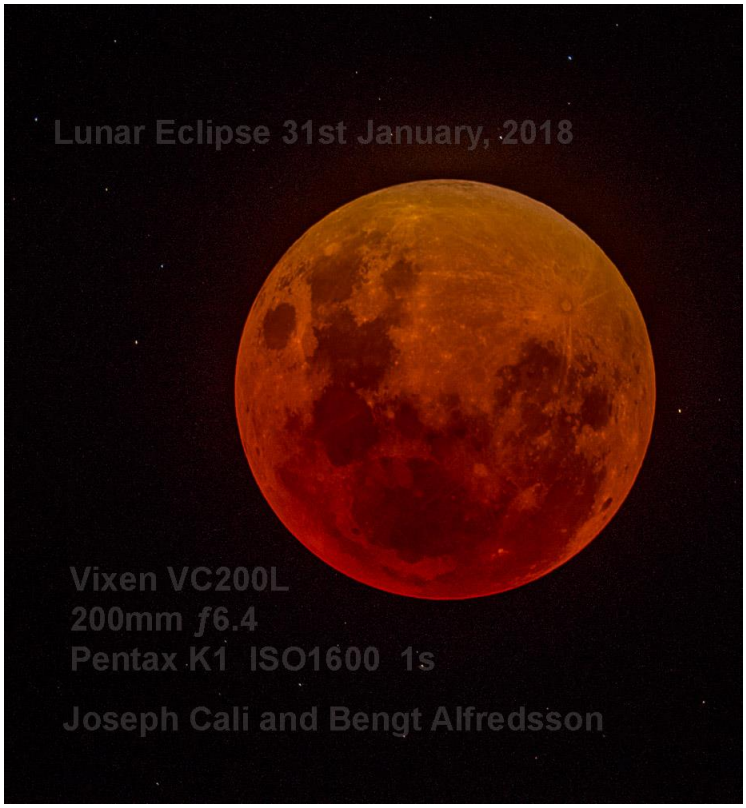
Above: Illustration showing the altitude, azimuth and times of transition from full to penumbral, partial, total, partial, penumbral, full. Penumbral eclipses are barely detectable to the human eye.

"In the Earth's Shadow"

Total Eclipse of the Moon May 26th, 2021

Combining many exposures taken during totality and during partial phases this outline of the Earth's shadow was created. The image was published in the September 2021 international edition of Sky and Telescope.

Above: wide field nightscape image of the total lunar eclipse 27th July, 2018.
Below: close up of total lunar eclipse of 31 January, 2018.



The Andromeda Galaxy Joseph Cali

Meteor Shower Calendar

The meteor showers listed below are the easiest to observe and provide the most activity from the Canberra region. Particular attention should be noted to the time and moonlight conditions. **Most showers are best seen after midnight when the part of the night sky you are observing is heading towards the oncoming meteors. Early evening, the night sky is trailing the Earth's motion.** Most are not even visible until after midnight. Showers that peak with the moon's phase greater than one half illuminated (first quarter to last quarter) will be affected by moonlight and difficult to observe. While the time each shower is best seen remains much the same year after year, the moonlight conditions change considerably from one year to the next.

Lyrids

Active from April 16th to April 25th. Peak night Apr 21-22.

Medium strength shower with decent rates for three nights around the maximum. Fireballs possible. In Canberra, the radiant is low in the sky, just 20º altitude & due north at 4:20am. Activity from this shower can be seen from the southern hemisphere, but at a lower rate. Even though these are called the Lyrids, the radiant is in Hercules not far from Vega. At peak on April 21-22 a bright 21 day old last quarter Moon will interfere with observations in the pre-dawn hours.

Radiant: RA:18:04 **DEC:** +34° - **ZHR**: 18 - Velocity: 30 miles/sec (medium - 48.4km/sec) - Parent Object: C/1861 G1 (Thatcher)

Eta Aquariids

Active from April 19th to May 26th. Peak night May 6-7

Great shower when viewed from northern Australia where they can produce rates of 40-60 per hour. I saw a display like this from Karjini National Park in 2013 just before dawn on a couple of mornings. Rates I've observed from Canberra's latitude have been disappointing by comparison to the show at Karjini. Activity is near peak for a week centred on May 6-7. On May 6-7, a first quarter Moon will set around midnight leaving a moonless morning sky.

Radiant: RA:22:32 **DEC:** -1° - **ZHR**: 55 - Velocity: 42 miles/sec (swift - 66.9km/sec) - Parent Object: 1P/Halley

Southern Delta Aquariids

Active from July 21st to August 23rd. Peak night Jul 29-30

The Delta Aquariids, like the Eta Aquarids are best observed from northern Australia. These meteors also produce numbers for a week centred July 29-30. These are usually faint meteors that lack both persistent trains and fireballs. In 2022, the peak coincides with the new Moon.
Radiant: RA: 22:40 **DEC:** -16.4° - **ZHR**: 16 - Velocity: 26 miles/sec (medium - 42km/sec) - Parent Object: 96P/Machholz

Alpha Capricornids

Active from July 11th to August 10th. Peak night Jul 26-27

The Alpha Capricornids are not very active with peak rates of five shower members per hour. The shower can produce bright fireballs and are seen as well from Canberra's latitude as anywhere else. In 2022, the peak coincides with near New Moon with a small waning crescent in the sky.
Radiant: RA: 20:28 **DEC:** -10.2° - **ZHR**: 5 - Velocity: 15 miles/sec (slow - 24km/sec) - Parent Object: 169P/NEAT

Perseids

Active from July 13th to August 26th. Peak night Aug 11-12

The Perseids are the most popular meteor shower internationally as they peak on warm August nights as seen from the northern hemisphere. The Perseids are active from July 13 to August 26. They reach a strong maximum on August 12 or 13, depending on the year. Normal rates seen from rural locations range from 50-75 shower members per hour at maximum. They are well worth a look if you are in the northern hemisphere or even far north Australia but from Canberra, the radiant never rises above the horizon and so we don't see much of a show though some meteors are always visible. In 2022, the peak occurs just a couple of days before new Moon.
Radiant: RA: 03:12 **DEC:** +57.6° - **ZHR**: 100 - Velocity: 37 miles/sec (swift - 60km/sec) - Parent Object: 109P/Swift-Tuttle

Orionids

Active from September 23rd to November 27th. Peak night Oct 21-22

The Orionids are a medium strength shower that sometimes reaches high strength activity. In a normal year the Orionids produce 20-25 shower members at maximum. In exceptional years, such as 2006-2009, the peak rates were on par with the Perseids (50-75 per hour). No accurate prediction model exists but a 12-year cycle is theorised. In 2022, the peak occurs 4-5 days before full Moon so a biggish lunar crescent will interfere slightly.
Radiant: RA: 06:20 **DEC:** +15.5° - **ZHR:** 25 - Velocity: 41 miles/sec (swift - 67km/sec) - Parent Object: 1P/Halley

Southern Taurids

Active from September 23rd to November 19th. Peak night Oct 28-29

The Southern Taurids are a long-lasting shower with several minor peaks in October and November. The shower is active for two months but rarely produces more than five shower members per hour, even at maximum activity. The Taurids (both branches) are most notable for colourful fireballs and are often responsible for an increased number of fireball reports from September through November. The shower is active for nearly two months so organise pre-dawn observing activities anytime from new Moons until a few days before full Moons. Peak night of October 28 is a few days after new Moon.

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Radiant: RA: 03:12 **DEC:** +12.8° - **ZHR**: 5 - Velocity: 17 miles/sec (slow - 27km/sec) - Parent Object: 2P/Encke

Northern Taurids

Active from October 19th to December 10th. Peak night Nov 10-11.

This shower is much like the Southern Taurids, just active a bit later in the year. When the two showers are active simultaneously in late October and early November, there is sometimes a notable increase in the fireball activity. There seems to be a seven-year periodicity with these fireballs. 2008 was the last remarkable year so 2022 is a possibility. The shower is active for

nearly two months so organise pre-dawn observing activities anytime from new Moons until a few days before full Moons. The peak nights of Nov 10-11 are just after the November 8 full Moon in 2022. However, there is a prediction that the northern Taurids might be very active this year due to the Earth encountering a more dense debris cluster. It might be worth a look.
Radiant: RA: 03:52 **DEC:** +22.7° - **ZHR**: 5 - Velocity: 18 miles/sec (medium - 30km/sec) - Parent Object: 2P/Encke

Leonids
Active from November 5th to November 30th. Peak night Nov 17-18.
The Leonids are best known for producing great meteor storms in the years of 1833, 1866, 1966, and 2001.

In the late 1990's, Asher and McNaught modelled the orbits of clusters of material reduced from observations of earlier outbursts. They published predictions of high activity, predicting both time and geographic location for high activity showers during the 1999-2001 peak.

- https://www.theguardian.com/science/2000/nov/16/technology
- https://science.nasa.gov/science-news/science-at-nasa/2001/ast08nov_1

This was a seminal paper and ground-breaking prediction technique. I drove to western Queensland (near Quilpie) in November 2001 using these predictions and was privileged to see a great display of bright Leonid fireballs perhaps 60 per hour. These outbursts of meteor activity are best seen when the parent object, comet 55P/Tempel-Tuttle, is closest to the Sun.

Unfortunately, it appears that the Earth will not encounter any dense clouds of debris again until 2099. Therefore, when the comet returns in 2031 and 2064, there will be no meteor storms, but perhaps several good displays of Leonid activity when rates are in excess of 100 per hour. The best we can hope for now until the year 2030 is peaks of around 15 shower members per hour and perhaps an occasional weak outburst when the earth passes near a debris trail. The Leonids are often bright meteors with a high percentage of persistent trains. . This year's event peaks around last quarter so a bright half moon will interfere with observations.

Radiant: RA: 10:08 **DEC:** +21.6° - **ZHR**: 15 - Velocity: 44 miles/sec (swift - 71km/sec) - Parent Object: 55P/Tempel-Tuttle

Geminids
Active from December 4th to December 16th. 2018 Peak night Dec 13-14 2018
The Geminids are usually the strongest meteor shower of the year for northern hemisphere observers. The Geminids are often bright and intensely coloured. Due to their medium-slow velocity, persistent trains are not usually seen. These meteors are also seen in the southern hemisphere, but at a reduced rate. On the peak night in 2022, the Moon is 5 days after full rising late evening and leaving the early morning hours blown with bright moonlight for meteor observations. **Radiant: RA:** 07:28 **DEC:** +32.2° - **ZHR**: 120 - Velocity: 22 miles/sec (medium - 35km/sec) - Parent Object: 3200 Phaethon (asteroid)

Comet Leonard C/2021-A1 with intruding meteor

On Boxing Day 2021, Comet Leonard was at what was probably at its brightest. In other pictures taken that night I recorded a 10+ degree tail through the thin cloud

Pentax K1 Rokinon 135mm ED f2
Single exposure raw processed in Adobe Lightroom and Adobe Photoshop.