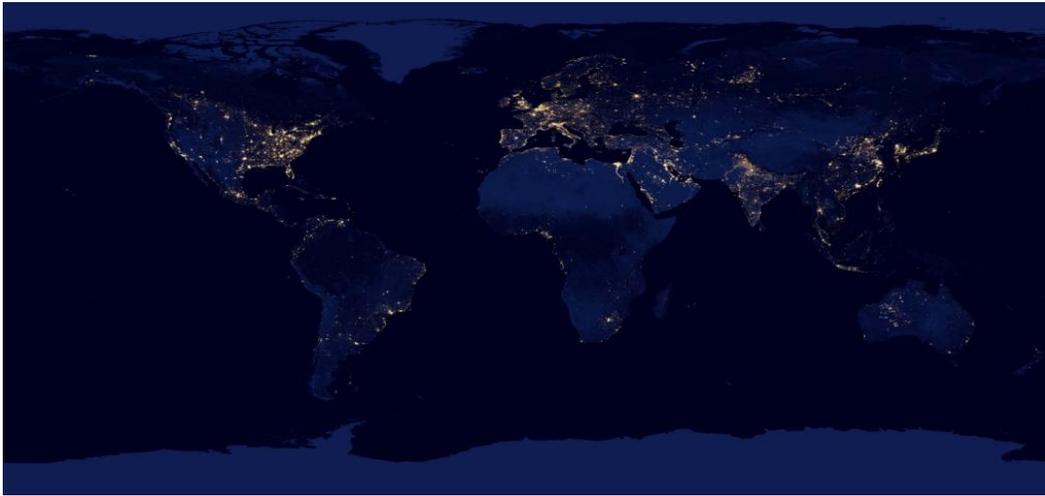


# How can we do things differently?

## Light Pollution – What is it?

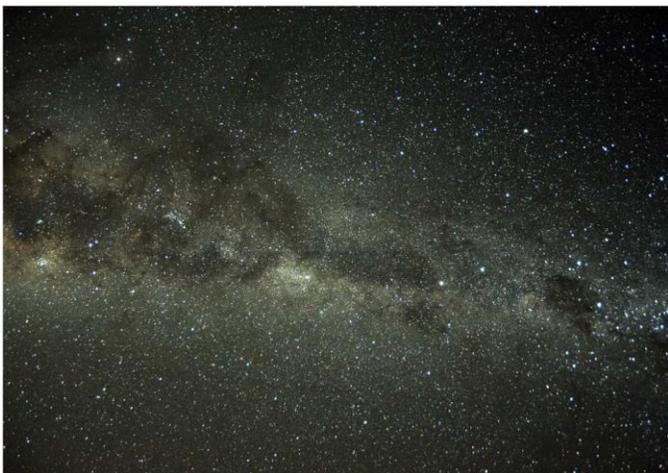
Light pollution is the upward spill of light from street lights, business lighting and house lights, and it is lost into the atmosphere. 1.The image below shows light pollution over the Earth. Credit: NASA, NOAA NGDC, Suomi-NPP, Earth Observatory *Data and Processing: Chris Elvidge and Robert Simmon*



### *The night sky – beautiful, mysterious and “infinite”.*

The band of the Milky Way is made up of numerous twinkling points of light. Over the years the night sky has “disappeared” and its wonders lay hidden behind the glow of light pollution from growing towns and cities. Ballarat still has good views of the Night Sky. Overseas visitors from Germany, Japan, China, England and elsewhere, are amazed at the amount of stars they can see.

2. The Milky Way. Credit: Mark Justice



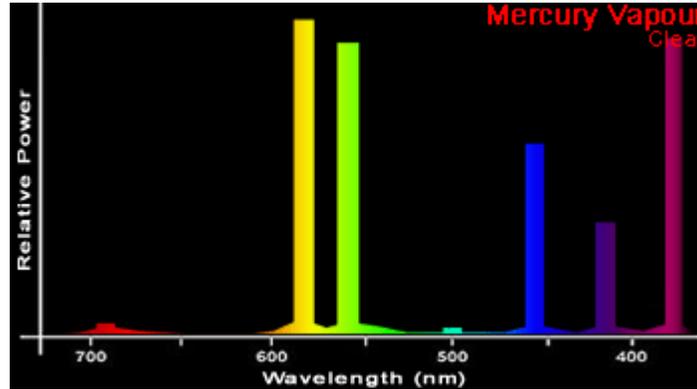
3. Looking North from the Jelbart Dome, Ballarat  
13 sec exp. 6 day old Moon. Observatory. Credit:  
Saeed Salimpour



# Why do we need to do anything about light pollution?

Astronomers depend on a dark sky to study the heavens. Come up to the Observatory and have a look through the spectroscope. It will show you the spectra of some of the light pollution. This man made spectra, interferes with astronomers work.

4. The image below shows the spectra of a clear Mercury Vapour street light.



5. Below is the spectra of our Sun, a G2 spectral type star. The presence of dark lines in the spectrum of sunlight was first detected by a scientist named Fraunhofer, and can be seen in his original 1814 drawing. One of our nearest neighbours, Alpha Centauri is also a G2 type star.



## Melatonin

We all need the dark. Research has shown that our bodies' make melatonin at night, which helps to suppress cancer growth and keeps us healthy.

Melatonin cannot be produced at sufficient levels if there is too much light.

Too much light disturbs the cycles of many insects, birds, reptiles, mammals and amphibians. In fact all life forms are affected in some way by too much light pollution. The survival of turtles is critical in some parts of America. The turtles turn to the light from nearby cities, instead of the reflected moonlight off the ocean which they have used for thousands of years to guide them at night, and so some of the turtles die before they can reach the ocean.

## Crime and Light

Some people think that lighting reduces crime. It has been shown that in Regional and Metropolitan Cities, some of the worst areas for crime are well lit. Most burglaries occur on Friday afternoon when people are out getting ready for the weekend. A lot of crime occurs near hotels and venues that serve alcohol and open late into the early hours of the morning. Lighting helps the would be criminal to assess more quickly how to carry out their crime. More lighting does not keep you safe. Safe travel arrangements and security practises keep you safe. Drive to the conditions.

Graffiti areas are often well lit, eg. the corner of Peel and Main Road, Ballarat. One way to reduce graffiti is to build vertical green walls, a simple solution to an extensive problem. Green walls will save energy, money, reduce the temperature of a building, provide a carbon sink and help to clean the air in the city.

## What can we do?

As Ballarat and other areas grow, good planning is required to keep our night sky dark.

We need to preserve our forests and green corridors.

By addressing the growing electricity bill that Councils have, funds can be diverted into other areas for use by the community.

Reducing street lighting in environmentally friendly new developments and refurbishment of old suburbs, such as only placing street lights at intersections, having cut off lamps so that all light is directed downwards, where it is needed and no spill lighting goes up into the atmosphere, residences have their own gate light, which they can use a required, and all unnecessary residential and business lighting to be turned off.



In urban areas with unshielded lights, few stars are visible.

Light escapes up and to the side, diminishing all but the brightest stars and planets.

Glare can encroach on homes, prompting residents to erect shutters.

6a.

6. Credit: Martin Lewicki Adelaide Planetarium.

In the 1970's the street lights were turned off at midnight in Ballarat.

France has introduced new local laws to require all businesses to turn off their lights 1 hour after the shops close. There is much that we can do if we want to do it.

6b.



Lamp fixtures that direct light down illuminate the ground while reducing sky glow and glare.

This makes some faint stars visible again. Residents are also less likely to suffer from unwanted light while they sleep.



A dark sky in a rural setting far from any artificial lights reveals the Milky Way and thousands of faint stars.

6c.

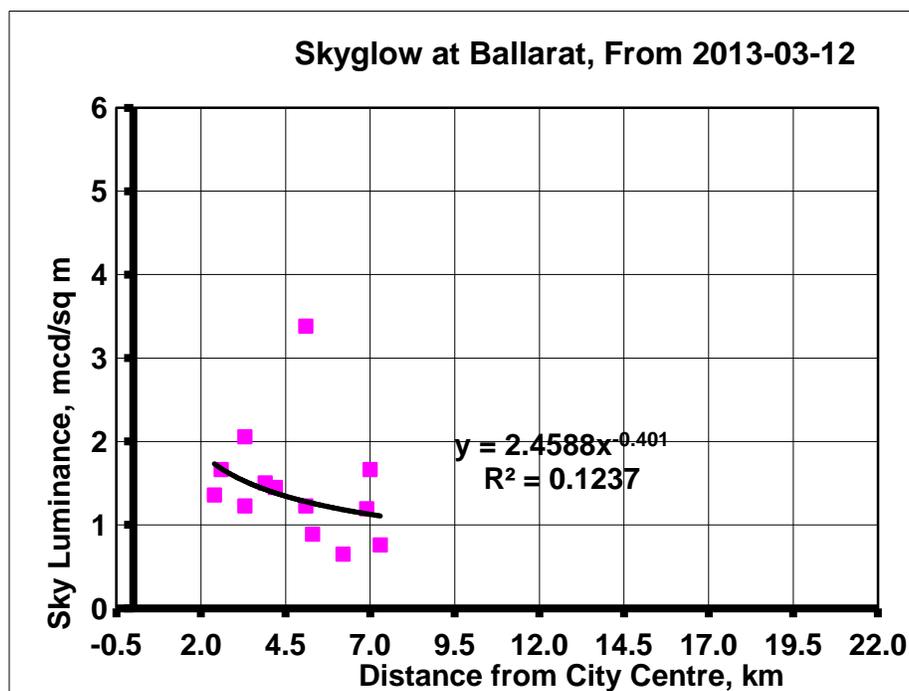
## Save energy & money

By designing our suburban streets so that only intersections are lighted, and having each house responsible for their own gate light, instead of street lights, this could go a very long way to reducing council's growing electricity bills and divert money into other areas where funding is more critical.

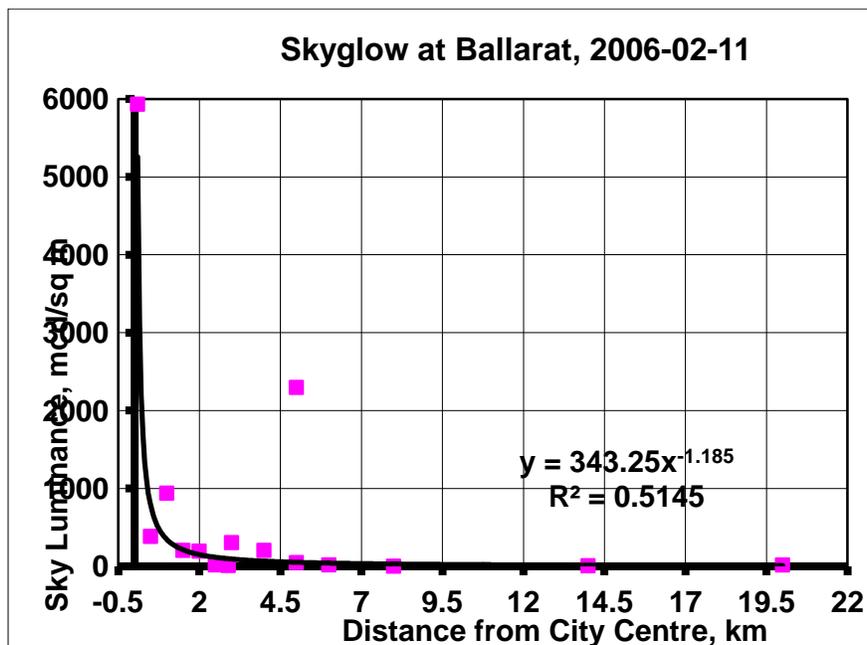
All lighting should have maximum cut off lamps so that light is directed downwards, and no spill lighting escapes into the atmosphere.

Statistics can tell you different information, look carefully at the following two graphs, they are very different. The first graph is more specific in the type of site chosen, whereas the second graph is more general in the locations chosen.

6. Below is a diagram of lighting measurements taken at various darker locations around Ballarat, typically near a park or less lit area. The highest reading is near the corner of Forest and Kirk Streets, Wendouree. The Canadian Forest area is the lowest reading on this graph. This graph shows how important our forests and parks are in preserving the quality of our night sky. The data was collected starting 1 hour after sunset finishing about 3 hours after sunset. This survey is ongoing.



7. The City Centre required a much higher luminance scale up to 6000 instead of 6. This survey was the first undertaken in 2006. The readings were taken at intersections in the city and then heading across the Whitehorse Ridge towards Buninyong, then onto Clarendon. It is a cross section of very bright intersections to dark areas without lights and on to darker intersections. The data was collected starting just before midnight and finished just after midnight. The outlier at 5km was near the Ambulance Centre at Mt Helen, before the lights had their shades changed to reduce light spill, things can be improved with good communication.



The Australian Standards for Outdoor lighting are a guide. Councils can make decisions that are more in tune with the 21<sup>st</sup> century and our growing environmental awareness.

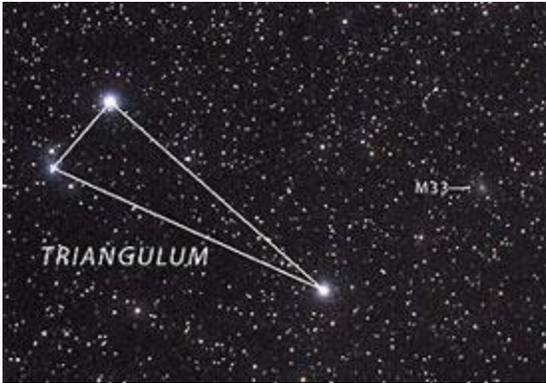
The Warrumbungle Shire Council in NSW has addressed the need to keep the sky dark for the Australian Astronomical Observatory at Siding Springs.

We need to create environmentally friendly urban developments. We owe this to ourselves, our children and future generations. If you live out in the country, there is little street lighting and the skies are dark.

**Turn off all unnecessary lighting and enjoy the night !**

Further Information is available at the Ballarat Observatory. E: [bas@cbl.com.au](mailto:bas@cbl.com.au) P : 03 5332 7526 Judith Bailey 2013

# HOW DARK IS YOUR NIGHT SKY?



Most observers today cannot get to a truly dark location within reasonable driving distance. Thus, upon finding a semirural observing site where stars of magnitude 6.0 to 6.3 are marginally apparent to the unaided eye, they believe they have located an observing Nirvana!

1. *The Pin Wheel galaxy M33 in Triangulum is a key indicator of sky conditions. A fully dark adapted observer should be able to spot it under skies good enough to rate Class 4 or better.*

*Credit: Akira Fujii*

## **RATE YOUR SKIES** with the Bortle Dark Sky Scale.

**Class 1: Excellent dark-sky site.** The zodiacal light, gegenschein, and zodiacal band are all visible — the zodiacal light to a striking degree, and the zodiacal band spanning the entire sky. Even with direct vision, the galaxy M33 is an obvious naked-eye object. The Scorpius and Sagittarius region of the Milky Way casts obvious diffuse shadows on the ground. To the unaided eye the limiting magnitude is 7.6 to 8.0 (with effort); the presence of Jupiter or Venus in the sky seems to degrade dark adaptation. Airglow (a very faint, naturally occurring glow most evident within about 15° of the horizon) is readily apparent. With a 32-centimeter (12½-inch) scope, stars to magnitude 17.5 can be detected with effort, while a 50-cm (20-inch) instrument used with moderate magnification will reach 19th magnitude. If you are observing on a grass-covered field bordered by trees, your telescope, companions, and vehicle are almost totally invisible. This is an observer's Nirvana!

**Class 2: Typical truly dark site.** Airglow may be weakly apparent along the horizon. M33 is rather easily seen with direct vision. The summer Milky Way is highly structured to the unaided eye, and its brightest parts look like veined marble when viewed with ordinary binoculars. The zodiacal light is still bright enough to cast weak shadows just before dawn and after dusk, and its color can be seen as distinctly yellowish when compared with the blue-white of the Milky Way. Any clouds in the sky are visible only as dark holes or voids in the starry background. You can see your telescope and surroundings only vaguely, except where they project against the sky. Many of the Messier globular clusters are distinct naked-eye objects. The limiting naked-eye magnitude is as faint as 7.1 to 7.5, while a 32-cm telescope reaches to magnitude 16 or 17.

**Class 3: Rural sky.** Some indication of light pollution is evident along the horizon. Clouds may appear faintly illuminated in the brightest parts of the sky near the horizon but are dark overhead. The Milky Way still appears complex, and globular clusters such as M4, M5, M15, and M22 are all distinct naked-eye objects. M33 is easy to see with averted vision. The zodiacal light is striking in spring and autumn (when it extends  $60^\circ$  above the horizon after dusk and before dawn) and its color is at least weakly indicated. Your telescope is vaguely apparent at a distance of 20 or 30 feet. The naked-eye limiting magnitude is 6.6 to 7.0, and a 32-cm reflector will reach to 16th magnitude.

**Class 4: Rural/suburban transition.** Fairly obvious light-pollution domes are apparent over population centers in several directions. The zodiacal light is clearly evident but doesn't even extend halfway to the zenith at the beginning or end of twilight. The Milky Way well above the horizon is still impressive but lacks all but the most obvious structure. M33 is a difficult averted-vision object and is detectable only when at an altitude higher than  $50^\circ$ . Clouds in the direction of light-pollution sources are illuminated but only slightly so, and are still dark overhead. You can make out your telescope rather clearly at a distance. The maximum naked-eye limiting magnitude is 6.1 to 6.5, and a 32-cm reflector used with moderate magnification will reveal stars of magnitude 15.5.



*2. Winter constellations in a suburban or rural-suburban transition sky, with the winter Milky Way visible but not dramatically so. Such a sky, fairly good by many people's standards, might rate 4 or 5 on Bortle's scale. Many fainter stars than are depicted here would be visible with close scrutiny. Credit: John Bianchi*

*close scrutiny. Credit: John Bianchi*

**Class 5: Suburban sky.** Only hints of the zodiacal light are seen on the best spring and autumn nights. The Milky Way is very weak or invisible near the horizon and looks rather washed out overhead. Light sources are evident in most if not all directions. Over most or all of the sky, clouds are quite noticeably brighter than the sky itself. The naked-eye limit is around 5.6 to 6.0, and a 32-cm reflector will reach about magnitude 14.5 to 15.

**Class 6: Bright suburban sky.** No trace of the zodiacal light can be seen, even on the best nights. Any indications of the Milky Way are apparent only toward the zenith. The sky within  $35^\circ$  of the horizon glows grayish white. Clouds anywhere in the sky appear fairly bright. You have no trouble seeing eyepieces and telescope accessories on an observing table. M33 is impossible to see without binoculars, and M31 is only modestly apparent to the unaided eye. The naked-eye limit is about 5.5, and a 32-cm telescope used at moderate powers will show stars at magnitude 14.0 to 14.5.

**Class 7: Suburban/urban transition.** The entire sky background has a vague, grayish white hue. Strong light sources are evident in all directions. The Milky Way is totally invisible or

nearly so. M44 or M31 may be glimpsed with the unaided eye but are very indistinct. Clouds are brilliantly lit. Even in moderate-size telescopes, the brightest Messier objects are pale ghosts of their true selves. The naked-eye limiting magnitude is 5.0 if you really try, and a 32-cm reflector will barely reach 14th magnitude.

**Class 8: City sky.** The sky glows whitish gray or orangish, and you can read newspaper headlines without difficulty. M31 and M44 may be barely glimpsed by an experienced observer on good nights, and only the bright Messier objects are detectable with a modest-size telescope. Some of the stars making up the familiar constellation patterns are difficult to see or are absent entirely. The naked eye can pick out stars down to magnitude 4.5 at best, if you know just where to look, and the stellar limit for a 32-cm reflector is little better than magnitude 13.

**Class 9: Inner-city sky.** The entire sky is brightly lit, even at the zenith. Many stars making up familiar constellation figures are invisible, and dim constellations such as Cancer and Pisces are not seen at all. Aside from perhaps the Pleiades, no Messier objects are visible to the unaided eye. The only celestial objects that really provide pleasing telescopic views are the Moon, the planets, and a few of the brightest star clusters (if you can find them). The naked-eye limiting magnitude is 4.0 or less.



*3. The same constellation panorama in an urban, Class 8 or 9 sky.  
Credit: John Bianchi*