

## Dunedin's Light Pollution Awareness Project

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# *Milky Way over Dunedin*

### **Two thousand and fifteen “The International Year of Light”**

The International Year of Light, IYL2015 is a global initiative which will highlight to the citizens of the world the importance of light and optical technologies in their lives, for their futures, and for the development of society. It is a unique opportunity to inspire, educate, and connect on a global scale. A significant part of this initiative concerns light pollution and how to reduce it.

[www.light2015.org/Home/About/Latest-News/September2014/Citizen-Science-and-Globe-at-Night.html](http://www.light2015.org/Home/About/Latest-News/September2014/Citizen-Science-and-Globe-at-Night.html)

### **Citizen Science and Globe at Night to raise awareness of light pollution**

The International Astronomical Union (IAU) will be coordinating extensive activities to raise awareness of light pollution through running the Cosmic Light theme of IYL2015, and by partnering in particular with the very successful Globe at Night programme. Citizen science is a very broad term describing scientific research conducted by amateur or nonprofessional scientists, and is a rewarding and inclusive way to raise awareness amongst the public of many important issues. Citizen science during 2015 will address several areas, but one in particular will aim to raise worldwide awareness of the problems of light pollution. 2015 International Year of Light, [www.light2015.org](http://www.light2015.org) Globe at Night [www.globeatnight.org](http://www.globeatnight.org).

### **Dunedin's New LED Street Lighting**

The Dunedin City Council (DCC) is currently considering options for future city lighting. Light-emitting diode (LED) street lights are scheduled to be rolled out in the city from September 2016. The LED street lights being considered are to be found in the Vogel-Water street precinct, [www.dunedin.govt.nz/services/roads-and-footpaths/street-lights-trial](http://www.dunedin.govt.nz/services/roads-and-footpaths/street-lights-trial). The lamps have a colour temperature (CT) 4,100 K, which is similar in hue to moon light. Today this is considered best engineering practice for street lighting.

Colour temperature in lighting describes how the colour of the light appears from a lamp, measured in Kelvins (K). Colour temperature does not describe the actual temperature of the lamp itself but the colour it produces; the higher the CT the “cooler” or bluer a lamp will look. Conversely the lower the CT the “warmer” or yellower the lamp will look.

Evidence describing the effects light pollution has on people and the environment: plants, insects, animals and marine life are well documented. The International Dark Sky Association (IDA) [www.darksky.org](http://www.darksky.org) recommends a CT not more than 3,000 K to preserve dark skies and protect the environment. IDA Press Release Tucson, AZ - Dec. 1, 2014 - IDA Issues New Standards on Blue Light at Night. “Exposure to blue light at night has known negative effects on ecology and is thought to cause certain kinds of chronic disease in humans. It can increase glare compromising human vision,

## Dunedin Dark Skies Group

*especially in the aging eye. The blue component of outdoor white LED lighting also increases light pollution more than older lighting technologies.”*



This recent photo by Paul Le Compte of Dunedin shows there is plenty of opportunity for improvement with unshielded High Pressure Sodium (HPS) street lights. The cloud should not be lit, and each of the individual lamps should not be visible in this photo! (Steve Butler, RASNZ Dark Sky Group, DCC street lighting submission 2015.)

Fully-shielded LEDs ought to be an improvement over unshielded HPS, but this is fairly new technology. The IDA have stated *“The advent of new lighting technologies, particularly light-emitting diodes (LEDs), has raised concerns about the potential negative effects of blue-rich white light, even from fixtures with proper shielding.”*

White LEDs cause more light pollution than yellow-orange light high pressure sodium lamps due to Rayleigh scattering from the blue light component; the reason why the daytime sky is blue. The preferred LED for Dunedin according to the IDA would have a colour temperature not exceeding 3,000 K. This is similar to incandescent lamps (2,700 K) used in homes.

The *“gold”* standard for minimizing light pollution is low-pressure sodium (LPS). LPS is used around the world in observatories like Mount John and HPS in nearby towns like Tekapo village, New Zealand. The light from LPS is nearly monochromatic and, unlike white light, it can be filtered out for astronomy and photography. *“Sky glow from the lowest-impact commonly used LED (4100K CCT) appears nearly seven times as bright as that from an equal amount of LPS, and 2.7x times brighter than HPS. This is a dramatic effect. Even without changing light amount or shielding, switching a lighting installation from HPS to 4100K LED will increase sky glow as if the amount of HPS light had been increased 170%, or nearly doubled; if changing from LPS the sky glow brightness would increase 540%.”* [www.flagstaffdarkskies.org/for-wonks/lamp-spectrum-light-pollution](http://www.flagstaffdarkskies.org/for-wonks/lamp-spectrum-light-pollution)

There are alternative LEDs which are less light-polluting than the one being considered for Dunedin. A straw-yellow filtered LED, where most of the blue light has been removed, is used in Hawai'i. It has about half the sky glow of the 4,100 K LEDs in Vogel Street. Narrow-band amber LEDs have sky glow impacts essentially the same as LPS. Some phosphor-converted amber LEDs, have sky glow impacts very similar to HPS.

## **Dunedin Dark Skies Group**

Jerry Rock-Archer and Laura Sargisson have produced a documentary about light pollution called “Dark Sky” for their Master of Science Communication in film making. The short film may be viewed from [vimeo.com/100674223](https://vimeo.com/100674223) and [www.youtube.com/watch?v=Pp\\_JxqGuDZk](https://www.youtube.com/watch?v=Pp_JxqGuDZk) lasting 25 minutes and 20 minutes respectively.

## **Street Lighting Dunedin City Council’s Annual Plan Hearing**

The Dunedin Dark Skies Group will make a submission regarding the proposed street lighting at the DCC’s annual plan meeting being held over 4 - 8 May, 2015. Results obtained from Dunedin’s Light Pollution Project “Milky Way over Dunedin” may be used in supporting this submission. You are invited to make your own submissions.

The draft Annual Plan 2014-2015 is available on the DCC website. The public may make submissions from 14 March until 14 April. Submissions must be made in writing and may be presented in person. A form for making submissions will be made available from the DCC website [www.dunedin.govt.nz](http://www.dunedin.govt.nz)

## **Light Pollution Awareness Project “*Milky Way over Dunedin*”**

The goal of the “Milky Way over Dunedin” project is to determine the impact of LED street lights on light pollution by measuring sky quality. The Dunedin Dark Skies Group invites you, your friends, schools and communities to participate. Here are some suggestions as to what you can do.

## **Documenting light pollution**

- Visually by observing a constellation e.g. Orion and recording the number of stars visible to the naked eye. The Globe at Night project [www.globeatnight.org](http://www.globeatnight.org) shows you how to document light pollution. It also provides facilities for entering your results. Visual observations are ideal for school-age children, youth groups and their families.
- Using a Sky Quality Meter. Steve Butler, Royal Astronomical Society of New Zealand Dark Sky Group, has loaned his Unihedron Sky Quality Meter SQM-L [www.unihedron.com/projects/darksky](http://www.unihedron.com/projects/darksky). This meter may be used alone or in conjunction with other methods to record sky glow from light pollution. More meters are being ordered. The Dunedin Dark Skies group will have several available for use.
- Cameras, Digital Single Lens Reflex (DSLR) and other types may be used document light pollution. There are published procedures, see Steve Butler’s list of websites below. It is important to be consistent with the camera settings and lens selection. Repeated observations from the same sites are desirable.

## **Using a Digital Single Lens Reflex Camera**

John Drummond, [john\\_drummond@xtra.co.nz](mailto:john_drummond@xtra.co.nz) Royal Astronomical Society of New Zealand, made the following suggestions for documenting light pollution with a DSLR camera:

## Dunedin Dark Skies Group

For topics to photograph, of course, the settings of before and after the street light change should be kept the same – e.g. consistently use 800 ISO (ASA) and the same exposure length for each scenario. Good to keep notes of conditions/temp/humidity/wind/ etc. of all photos. I guess that I'd photograph the following – in conjunction with light meter readings -

1. Dunedin from about 30km away – to get the city dome. Try doing this over a range of atmospheric conditions – high humidity, low humidity, light drizzle, good and bad transparency etc. Replicate the photos later (hopefully after the LED lighting).
2. Photograph a white wall illuminated by Dunedin's glow in the distance – stand in front of it to create a shadow to show the change in contrast before and after the change-over.
3. Photograph the underside of clouds – in/near/far from Dunedin to illustrate light wastage (good to get LM readings in conjunction with this).
4. Photograph typical street lights using drizzle to show the cones of light – good to get a LED one also for comparison. See my examples of pre and post cut-offs lights the Gisborne District Council kindly installed for me.
5. Photograph the illuminated ground under a street light – and the same distance/conditions after the LED change.
6. Get some spectral/grating glasses and photograph a typical street light with them over the camera lens – to see what the key light wave transmissions are.
7. Photograph the Milky Way from a suburb before and after the change – same conditions and settings.

John welcomes any questions you may like to ask.

Steve Butler [urbanstars@rasnz.org.nz](mailto:urbanstars@rasnz.org.nz) has provided material related to DSLR or CCD monitoring of sky glow or sky quality.

[www.nature.nps.gov/night/methods.cfm](http://www.nature.nps.gov/night/methods.cfm)

[www.darksbiesawareness.org/zselic-dslr.php](http://www.darksbiesawareness.org/zselic-dslr.php)

[www.unihedron.com/projects/darksky/NELM2BCalc.html](http://www.unihedron.com/projects/darksky/NELM2BCalc.html)

[darkskydiary.wordpress.com/2010/12/18/how-to-carry-out-a-dark-sky-survey](http://darkskydiary.wordpress.com/2010/12/18/how-to-carry-out-a-dark-sky-survey)

[arxiv.org/abs/1209.2031](http://arxiv.org/abs/1209.2031)

[knightware.biz/sqm/reader.htm](http://knightware.biz/sqm/reader.htm)

More articles describing using DSLR and CCD cameras and meters are provided in the Dropbox link: [www.dropbox.com/sh/d8tbysyfy2kezb7/AACXG5mlynm1UCQj5yushCcJa?dl=0](https://www.dropbox.com/sh/d8tbysyfy2kezb7/AACXG5mlynm1UCQj5yushCcJa?dl=0) You should be able to access them by clicking on the link but if not you may need to install Dropbox on your computer from dropbox.com. This is straight forward.

Further information about light pollution is available from the Dunedin Astronomical Societies' Dark Skies website [sites.google.com/site/dunedinastronomy/dunedin-dark-skies](https://sites.google.com/site/dunedinastronomy/dunedin-dark-skies) and the RASNZ Dark Skies website [www.rasnz.org.nz/darksbies](http://www.rasnz.org.nz/darksbies)

## How to send your results

Dunedin Dark Skies welcomes your concerns and questions. Please send your light pollution measurements, photos and other material you gather concerning light pollution to Mike Broughton [dunedindarksbies@gmail.com](mailto:dunedindarksbies@gmail.com)

## **Dunedin Dark Skies Group**

### **Earth Hour**

The Dunedin Astronomical Society will be in the Octagon with telescopes and binoculars for Earth Hour Saturday, March 28th 8.30 pm [www.dunedintv.co.nz/content/dunedin-dims-lights-earth-hour](http://www.dunedintv.co.nz/content/dunedin-dims-lights-earth-hour)

The Dunedin Dark Skies group will also be there. This is an opportunity to inform people about Dunedin's new street lighting and our light pollution awareness project *Milky Way over Dunedin*.