

Enlightened, illuminated, or light polluted ?

A public submission on the draft
City of Perth Lighting Strategy

by John Goldsmith
22nd June 2014





Prepared by:

John Goldsmith
22nd June 2014.

Document version:

Endorsed final for issue as a public submission.

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Contact:

Via the online contacts page, at:
www.celestialvisions.com.au/enquiries.html

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"Enlightened"

Having or showing a rational, modern, and well-informed outlook.

"Illuminated"

To light up: Decorate (a building or structure) with lights for a special occasion.

"Light polluted"

1. excessive, unwanted or harmful light, as from bright street lights or neon signs.
2. *Astronomy.* artificial illumination of the sky that sets a limit on the faintness of stars that can be observed or photographed.

Source: Adapted from
<http://dictionary.reference.com/>

Forward

This document is a public submission prepared in response to the public consultation period for the draft City of Perth Lighting Strategy (2014), Western Australia.

Urban lighting provides a range of beneficial and detrimental effects. Urban lighting directly contributes towards the growing problem of Urban Light Pollution, where unwanted light causes various negative impacts on our community and environment.

This submission focuses on the draft lighting strategy from the point of view of astronomy and astrophotography. The issue of Urban Light Pollution is significant and is seriously under-recognised in the draft strategy. Urban light pollution draws international attention and access to starlight has been recognised as a common heritage. This has led to a “declaration in defence of the night sky and the right to starlight” (Marin & Jafari 2007, 3). The declaration, in its first principle, emphasises the importance of an unpolluted sky to the development of all people:

An unpolluted night sky that allows the enjoyment and contemplation of the firmament should be considered an inalienable right of humankind equivalent to all other environmental, social, and cultural rights, due to its impact on the development of all peoples...

This submission provides key information to help improve the strategy. The draft strategy needs to present valid, rational and balanced information and it needs to be based on adequate consultation with a broad range of the community, without undue emphasis on state government agencies.

Urban lighting represents a very significant source of energy use and should therefore be targeted to ensure energy efficiency, the avoidance of wasted energy, and the reduction of associated greenhouse gases.

The scope of the draft City of Perth lighting strategy is focussed on the City of Perth local government area which corresponds generally

to the Central Business District of Perth, and not to be confused with the much broader Perth Metropolitan Area. However, the draft strategy clearly will affect areas beyond the CBD, and also has the potential to influence other Local Government Authority areas in Perth. As a result, it is very important to maintain a broad view of the strategy and its implications, and to recognise that the issues raised in the draft strategy actually also relate to the entire Perth metropolitan area and beyond.

This submission is part photo essay, and part report. The photographs are used to visually show the effect of urban lighting, and urban light pollution.

In this submission, the draft City of Perth Lighting Strategy is generally referred to in that way, but may also be referred to simply as "the lighting strategy", or "the strategy".

The submission concludes with a set of specific recommendations, which the City of Perth is called upon to address.

Statement of endorsement

This document is endorsed by the following:

- **Dr John Goldsmith.** Astro-photographer, Celestial Visions. Member: The World at Night. Curator (2009-present): Astrofest astrophoto-graphy exhibition.
- **Prof. Peter Quinn.** Director: International Centre for Radio Astronomy Research.
- **Dr Andy Simmonds.** PhD FACS MIET. President: Astronomical Society of Western Australia Inc.
- **Ms Hilary Burns.** Vice President: Astronomical Society of Western Australia Inc.
- **Mr Pete Wheeler.** Manager of Outreach & Education, International Centre for Radio Astronomy Research. Australian representative for the International Astronomical Union's (IAU) 'Global Network for Astronomy Outreach'. Past Chair of Astronomy WA.
- **Mr Babak Tafreshi.** Founder / Director. The World at Night (Germany), Astrophotographer.
- **Mr Ajay Talwar** (Gurgaon / New Delhi, India). Member of The World at Night. Vice President of Amateur Astronomers Association Delhi.
- **Tunç Tezel.** BSc Civil Engineer; amateur astronomer and astrophotographer. Member: The World at Night (Turkey).
- **Mr Mike Salway.** Director: IceInSpace (Australia). www.iceinspace.com.au.
- **Mr Roger Groom.** Chairperson, Perth Observatory Volunteer Group. Astro Photo-graphy Australia.
- **Mr Lindsay Clarke.** Member: Astronomy Group of Western Australia, Astrofest organising group, Astronomy WA initiative.
- **Mrs Carol Redford.** Owner, Stargazers Club WA.
- **Mr James Athanassou.** Member: Astronomy Group of WA, AGWA Cosmic Landscape Group, Astronomer, Gingin Observatory, Astro-photographer.
- **Mr Andrew Pearce.** Member: American Association of Variable Star Observers (AAVSO).
- **Mr Ronald Tan.** Astrophotographer. Member: Astronomy Group of Western Australia.
- **Mr Noel Verweider.** Member: Astronomy Group of Western Australia.
- **Mr John Cooper.** Member: Astronomy Group of Western Australia.
- **Dr Chris Thorne.** Systemic. Astrophotographer.
- **Ralph Paramor.** Member: Astronomy Group of Western Australia.
- **Mr Franciscus Schutte.** Member: Astronomy Group of Western Australia.
- **Mr Colin Legg.** Geologist, Astrophotographer, www.colinleggphotography.com
- **Mr Paul Luckas.** MSc. Program Manager SPIRIT Telescope Initiative, The University of Western Australia.
- **Mr Andrew Lockwood.** Astrophotographer, Perth Observatory volunteer.
- **Mr Mark Davies.** Member: AGWA (Astronomical Group of WA), Astrofest Organising Group, AGWA Cosmic Landscape Group, Astronomer: Gingin Observatory, Star Viewing Guide: Perth Observatory Volunteer Group.
- **Mr Michael Goh.** Astrophotographer.
- **Mr Roy Stone.** Astrophotographer. Member: Astronomy Group of Western Australia.
- **Mr David Anderton.** (Bachelor of Electrical Engineering(Renewable energy and power), Bachelor of Mass Communication.
- **Mr Luke Busellato.** Astrophotographer. Member: Cosmic Landscape Group.
- **Mr Peter Payne.** Astrophotographer. Member: Cosmic Landscape Group
- **Mr Gregory Nicholls.** Astrophotographer.
- **Mr Chris Lord.** Amateur Radio Astronomer, Astrophotographer and a member of the Astronomy Group of WA and Stargazers Club WA.
- **Mrs Heather Lord.**
- **Mr Roy Deering, and Mrs Helen Deering.** Bassendean, WA.
- **Mr Doug Brown.** Astrophotographer. Member: Astronomical Society of Western Australia, & Astronomy Group of Western Australia.
- **Grant Boxer.** Amateur astronomer and astro-photographer. Member: Astronomy Group of Western Australia.
- **Ron Hille.** Astrophotographer. Member: Cosmic Landscape Group.

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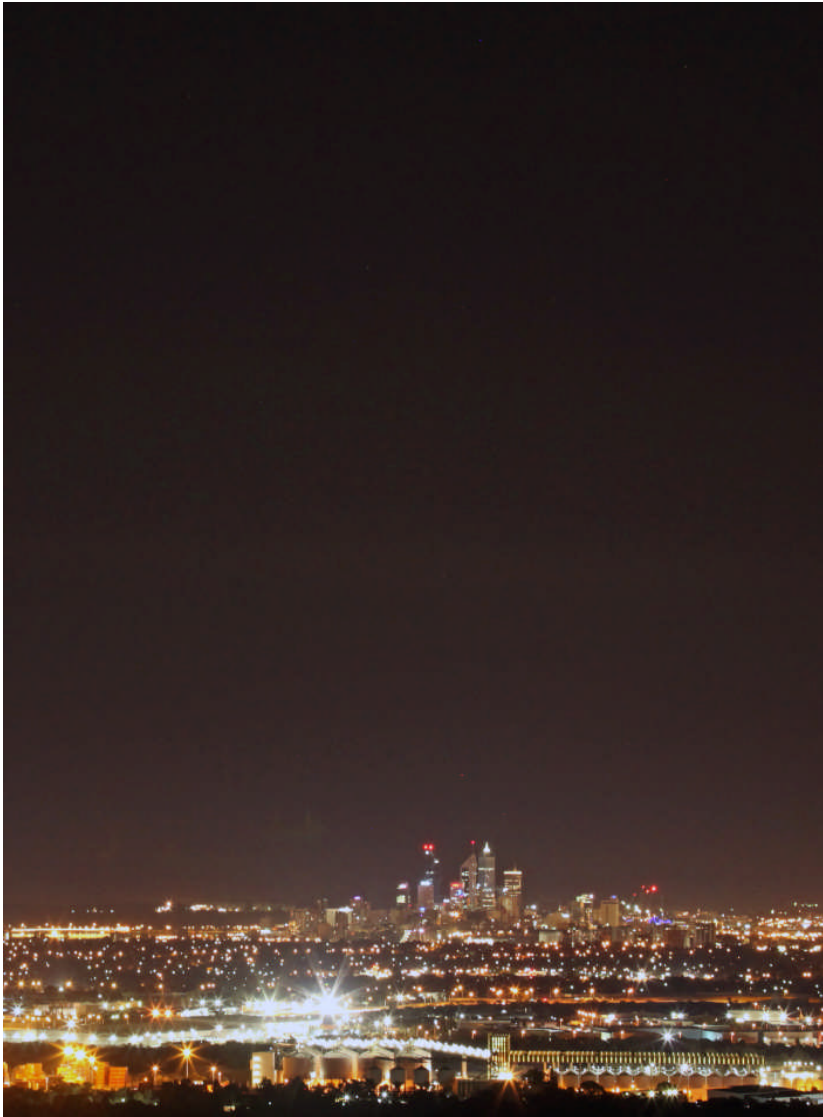
Key messages



The national identity of Australia is inspired by the night sky and the Southern Cross.

The night sky is an important part of our heritage and every Australian should have the opportunity to experience the night sky and to see and recognise the Southern Cross.


Urban light pollution degrades the night sky and substantially reduces the opportunity for our community to enjoy and experience a star filled night sky.



Urban light pollution means very bright night-skies with few stars visible (Perth, June 2014).



A truly dark night sky shows a spectacular view of the Milky Way galaxy (Lake Ballard, WA)

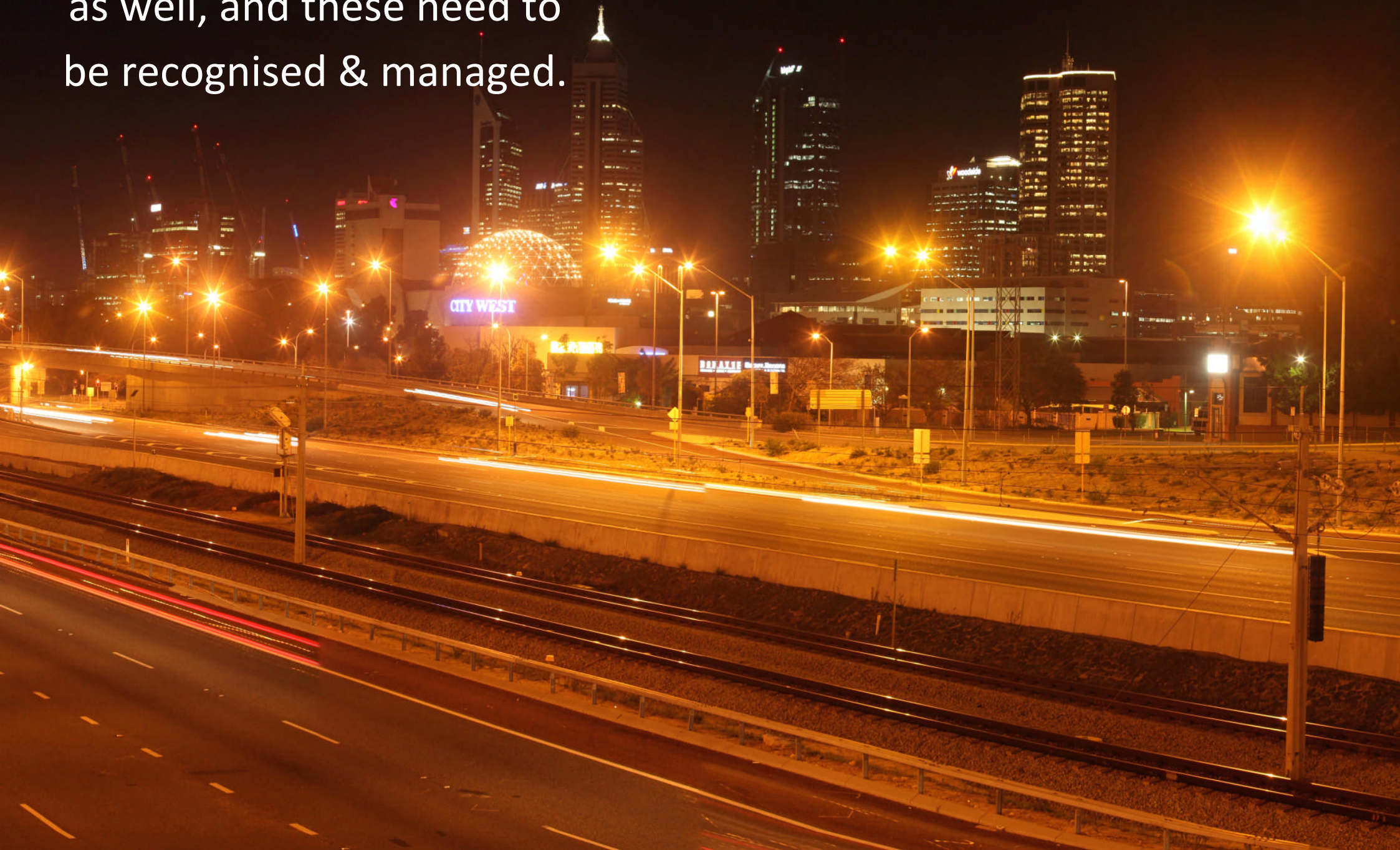


1.7+ million people
live inside Perth's bubble
of urban light pollution.

Whilst there are useful purposes for outdoor lighting at night,



there are negative impacts
as well, and these need to
be recognised & managed.



The draft lighting strategy does not adequately address the issue of urban light pollution.



Wasteful, poorly designed,
un-necessary and excessive lighting
is not supported.



Lighting that is necessary and useful, well designed and operated, well shielded and directed, is supported.





Urban light pollution from Perth affects the whole Perth community, and also causes impacts hundreds of kilometres away.



The City of Perth lighting strategy
should have an objective to reduce
Urban Light Pollution.

Every unshielded light visible in this single photo shown
over six pages, is contributing towards urban light pollution.



Urban lighting, safety / security & health

Public safety is often used as a justification for increasing public lighting. This approach feeds from a fear of the dark, and a fear of personal security at night-time.

The draft strategy claims evidence that public lighting improves safety and reduces crime (City of Perth, 2014).

The International Dark-sky Association (IDA) presents a wide range of evidence to the contrary. See for example resources at <http://www.darksky.org/light-pollution-topics/lighting-crime-safety>.

The International Dark-sky Association also presents information about the human health effects associated with urban lighting and light pollution, and impacts on wildlife. See

for example, de Castella (nd) and The Royal Astronomical Society of Canada (2012). Other sources of information regarding human health impacts are available from:

- <http://www.darksky.org/research/reports-and-studies-index#HumanHealth>

In relation to urban lighting and impact on wildlife:

- <http://www.darksky.org/research/reports-and-studies-index#EcologyBiology>

The draft lighting strategy should be more balanced in its presentation of information, studies and evidence, and all such information sources should be properly referenced.



Street lighting and Local Government

A local government perspective about street lighting has been provided by the Western Australian Local Government Authority (WALGA) Executive Manager Infrastructure, Mr Ian Duncan (pers com 2014). In the very limited time available for the preparation of this submission, it was not possible to source authoritative information via WALGA, about street lighting and local government, however, WALGA has provided its best available estimates.

According to WALGA, there are approximately 227,000 streetlights operated by Western Power in the south west part of the State. WALGA estimate that this accounts for about 90% of the public lighting in this area. A number of Councils, including the City of Perth, provide public lighting

separate to the Western Power / Synergy offering for part of their jurisdiction.

Around half of the Western Power street lights are 80 watt mercury vapour lamps.

The most recent estimate of street light energy consumption in south west WA is 120,000 Mwh/year (this is a best estimate, as an authoritative reference could not be sourced).

WALGA's research indicates that Local Governments in the Perth region spend approximately \$45 million per year on street lighting.

Issues noted by WALGA include the fragmented nature of data relating to

energy consumption, and also the lack of currency of data derived from the Cities for Climate Protection program, which is an energy management and greenhouse gas reduction initiative, implemented by many local government authorities throughout Australia.

From an international perspective, the economics of urban light pollution have been investigated by Gallaway, Olsen and Mitchell (2010). They indicated that *"Light pollution generates significant costs including negative impacts on wildlife, health, astronomy, and wasted energy—which in the U.S. amounts to nearly 7 billion dollars annually"* (Gallaway, Olsen and Mitchell 2010, 658).

The City of Lights: A historical perspective

Lisa Scaffidi, Lord Mayor of the City of Perth notes in the forward of the draft lighting strategy that:

Perth is proudly known as the City of Lights – an honour bestowed on our great city in 1962 when US astronaut John Glenn commented on the visibility of Perth from space as he completed his solo orbit of Earth. (City of Perth, 2014).

Since 1962, Perth has dramatically expanded in size, population and urban light pollution.

In 1998 and at the age of 77, John Glenn became the oldest person to fly in space, during a mission aboard the Discovery Space Shuttle (Taylor Redd, 2012). The photograph on the right shows the City of Perth in 1998, on the night of John Glenn's orbit in the Shuttle. This historical image shows Perth strongly illuminated, with city lights reflected in the Swan River.

It is a common mis-perception that John Glenn named Perth the "City of Lights". Whilst in orbit, he commented about the visibility of Perth, but apparently did not use the phrase "City of Lights", which came into use later (City of Perth, nd).





Urban light pollution and the City of Perth.

Earth Hour

Earth Hour is a global initiative which began in 2007, with the aim of raising public awareness about the need for reducing energy usage and reducing greenhouse gas emissions.

The Earth Hour initiative increased public awareness about these issues via the voluntary global program of turning off lights for a one hour period. Cities in Australia including Perth have participated in Earth Hour.

The following two photographs document the 2009 Perth Earth Hour event. The photographs were taken with identical photographic exposures and as a result, the images provide a valid comparison by which urban light can be assessed.

The first image was taken immediately before Earth Hour and the second was taken during Earth Hour. The differences between the two photographs are obvious.

Lighting control during Earth Hour significantly reduced general brightness from the urban lighting.



Perth before (left) and during (right) Earth Hour, March 2009.
Each photo was taken using identical photographic exposures.

Perth Observatory & light pollution

Perth Observatory is Western Australia's oldest astronomical observatory, with the first Government Astronomer appointed in 1896, and the main observatory building constructed in 1897, situated near the centre of Perth CBD, where the current headquarters of the National Trust is located (Perth Observatory, 2012).

Continued encroachment of light pollution from the city meant that the observatory relocated to Bickley in 1966, some 23 kilometres from the Perth CBD, largely in an attempt to regain darker, less light polluted skies, so that its scientific research and related activities could continue (Perth Observatory, 2012).

In 2013, the State Government of Western Australia ceased funding amounting to approximately \$300,000 per annum, for research activities at Perth Observatory (The Age, 2013). This had major impacts on the scientific research programs of Perth Observatory, and since that time, the observatory has been operated on minimal

funding, with no research programme funded by the Western Australian State Government. The research capability of Perth Observatory has been eroded away, due to the loss of research funding, and as a result, it is currently not able to conduct research into topics such as urban light pollution, a key issue that affects the future of the observatory.

One of the last research results produced by Perth Observatory was a map covering 2400 square kilometres of the light pollution of Perth (Perth Observatory, 2012). This research is presented in the work of Biggs et al. (2012).

The Millennium Dome houses the Meade 40cm LX200 Schmidt Cassegrain telescope, one of seven telescopes located at Perth Observatory.



Comments on the draft City of Perth Lighting Strategy

The following provide specific comments about the draft City of Perth Lighting Strategy 2014 and the process relating to the strategy development.

1. Consultative process

The consultative process used to develop the strategy is seriously flawed.

- The public consultation period for the draft strategy is insufficient. Approximately one month was allowed for public review of the strategy. This is insufficient, and a three month period should have been used to allow more time for public review of the strategy.
- The stated consultation / communication process in the draft strategy (page 52) is heavily weighted towards State Government agencies, and only a few other non-government groups. This is unbalanced and greater attention should have been paid to non-government groups and community members. The consultation approach should be broadened to involve other non-government agencies and individuals.
- The draft strategy indicates its consultation with "Perth Astronomical Observatory" and this appears to be the only agency to be consulted in relation to astronomical perspectives.
- There is no such thing as "Perth Astronomical Observatory". Their correct name is Perth Observatory. The strategy should not contain errors such as this.
- There are numerous other astronomy related organisations and individuals, primarily focussed on Western Australia. Some examples include:
 - Astronomical Society of Western Australia
 - Astronomy Group of Western Australia
 - International Centre for Radio Astronomy Research (organisers of Astrofest, Western Australia's biggest annual astronomy festival)
 - Scitech / Horizon Planetarium
 - Gravity Discovery Centre
 - Gingin Observatory
 - University of Western Australia (eg. SPIRIT Telescope)
 - Curtin University.

- Zadko Telescope
 - The World at Night (WA rep: John Goldsmith).
- The draft lighting strategy should include consultation and engagement with the above astronomy related organisation and individuals.
 - It would have been preferable to engage with key interested parties, and provide opportunities for input, during the development of the draft strategy, rather than after the release of the draft strategy.

2. Objectives and principles of the draft strategy

- There should be a specific objective to reduce urban light pollution.

3. The issue of Urban Light Pollution

- Whilst the draft strategy refers to the historical reference of "City of Lights" relating to US astronaut John Glenn, and makes some reference to light pollution, the entire topic is simply not adequately addressed by the draft strategy.

- There needs to be a much greater emphasis on urban light pollution in the lighting strategy, with practical methods and strategies put forward to reduce urban light pollution.

4. Greater balance needed in the draft strategy

- The draft strategy generally suffers from a lack of balanced presentation and appraisal of relevant information.
- For example, section 2.3 presents the "Benefits to the City of the planned use of light". There is no subsequent discussion about negative effects of lighting, nor a discussion about "unplanned" uses of light or unintended consequences of urban lighting.
- This lack of balanced presentation and appraisal of information is a real problem for the draft strategy.

5. Illuminating the outline of buildings

The draft strategy and the accompanying media reporting (see for example Peter Law's Sunday Times article, 1 June 2014) has strongly emphasised the idea of "illuminating the outline of landmark buildings" in the Perth CBD.

This has also been accompanied by statements that down-play the cost and impacts of such an idea, and misplaced attitudes that Perth needs lighting because it is "fading into obscurity"; eg;

"We have got a great skyline, but at the moment you only see it during the day"

reported in the Sunday Times, attributed to Tourism Council of WA chief executive Evan Hall (Law, 2014).

COMMENT: The Perth skyline is brightly illuminated now and is easily visible. Its appearance is very dramatic, reflected in the Swan River. Claims that the skyline of the CBD is not visible at night are simply not valid.

"A new plan has been created to ensure The City of Lights 'stops fading into obscurity' after dark".

The opening line of the Sunday Times news item by Peter Law, introducing the draft lighting strategy.

COMMENT: This is simply mis-representation. Perth is not "fading away", it is a very bright city, and getting brighter.

"it shouldn't be that expensive..."
(ie, to illuminate the outline of CBD buildings)

Attributed to Lisa Scaffidi in the Sunday Times article (Law, 2014).

COMMENT. It is strongly doubted that lighting systems as proposed by the draft lighting strategy, outlining city buildings, can validly be described as "not expensive". Rather than opinion, it would be much better to make available properly costed ideas, including long term operational / energy costs.

In general, the concept of outlining the buildings of the Perth CBD with bright and excessive lighting is not supported, as such intervention would increase, rather than decrease, urban light pollution.

6. "Good Lighting Practice Guide"

The draft strategy proposes that:

"the basics of good lighting practice be define (sic) in a published booklet. This booklet should address issues such as glare, light pollution, light colour, and integrating lighting within a building fabric. The publication should be available to all these trades and professions involved in exterior lighting"

(City of Perth 2014: 67).

Such a guide should contain a substantial section about the broad issue of urban light pollution, including extensive photographs to illustrate the issue.

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7. Referencing.

- The draft strategy is poorly referenced. All references should be included in a reference section.
- Any quotations should be referenced.
- Any key sources of information should be referenced.

Tourism and the night sky

The night sky is an important drawcard for tourism to Western Australia. Places such as the Pinnacles (Nambung National Park), the Bungle Bungles (Purnululu National Park) and Lake Ballard are particularly special places from which to experience the night sky.

The experience of seeing the night sky from Western Australia is featured in tourism campaigns.

For example, Tourism Western Australia conducted the 1001 Extraordinary Experiences campaign. According to their industry fact sheet:

Tourism Western Australia's new global campaign, 1001 Extraordinary Experiences, is an online campaign that shares the many personal extraordinary experiences had by West Australians and fans of WA - and highlights what Western Australia has to offer potential holidaymakers.

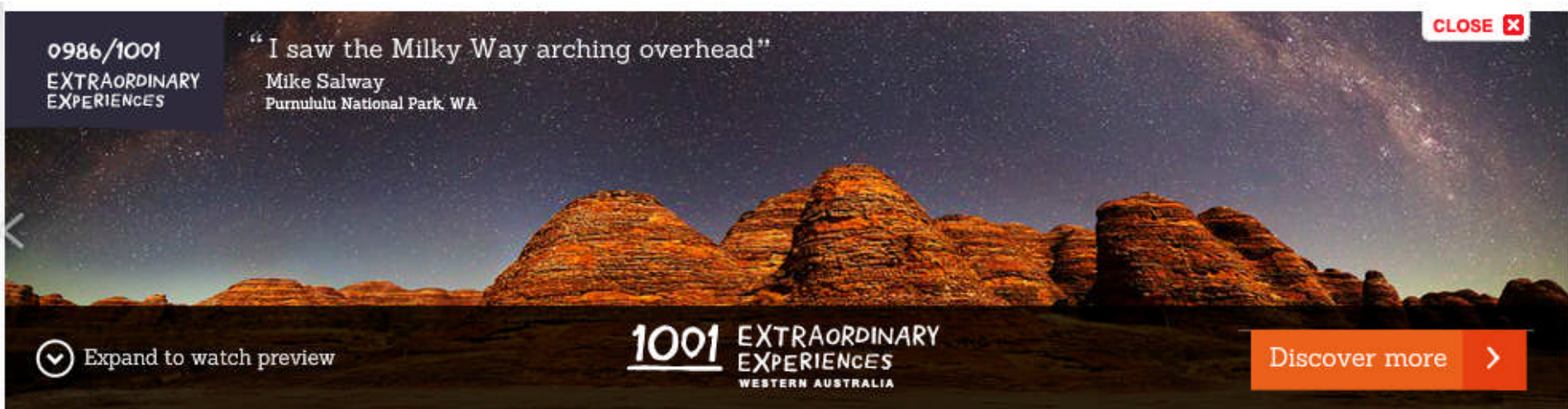
In early 2013, we asked fans via advertising, public relations and social

media to submit photos and written descriptions of their chosen extraordinary experience in Western Australia. This was completed via a dedicated page on Tourism WA's Facebook site and entrants were incentivised with the chance to win 1 of 5 extraordinary holidays to Western Australia.

Once the competition closed, the prize winners were selected and announced in The West Australian on Saturday 11 May. We received almost 6,000 entries from across 27 countries. The best 1001 images were then chosen to create a quick frame film and campaign microsite.

(Tourism Western Australia, nd).

One of the main prize winners was an image by Mike Salway, featuring the Milky Way arching over the Bungle Bungles. The image has featured in the online and advertising campaign.



Images supplied by Mike Salway and reproduced with permission.

International Dark-sky Association (IDA)

The International Dark-sky Association (IDA) is a membership based US based organisation founded in 1988, dedicated to preserving the night sky.

The association provides a wide range of information about the issue of urban light pollution, including urban light pollution's impact on astronomy, people's access to an unpolluted night sky, impacts on ecosystems, human health and energy wastage. The

association also provides information about practical management options that reduce urban light pollution.

The association's web site details information about outdoor lighting, night sky conservation, education and resources. In relation to night sky conservation, the IDA provides extensive information about practical methods to conserve and protect dark skies. The concept of "International dark sky places" is

discussed, in conjunction with introductory programs, IDA policy, research, local action and associated dark sky conservation initiatives, such as the UNESCO's starlight reserves.

The IDA web site is available at <http://www.darksky.org/>

Dark Sky Reserves: New Zealand

There are positive examples from other parts of the world where the night sky has been preserved and used as a key driver for tourism. For example, in New Zealand, an international dark sky reserve has been established at Aoraki/MtCook National Park and the adjoining Mackenzie Basin in the central South Island of New Zealand.

From their application to the International Dark-sky Association (UC, RASNZ et al. 2012), some key quotes include:

Page 29:

"Light Pollution. Outdoor lighting is an indispensable element of modern civilised societies for safety, recreation, and decorating purposes. However, poorly designed lighting systems and excessive illumination levels can lead to a huge waste of energy and a range of undesirable environmental impacts.

and:

"Light pollution can be significantly reduced by using fully-shielded lights that direct light onto the target area and prevent it from escaping upwards and sideways".

From page 63:

"Astro-tourism is becoming an increasingly important aspect of tourism in the Mackenzie. The Japanese market is already well established as "a recent survey in Japan showed that 72 % of people listed star gazing as the main reason they wanted to visit New Zealand" [60]. As the rest of the world is losing sight of the night sky, astro-tourism is a way for New Zealand businesses to capitalize on the natural beauty of the sky above, educate tourists and visitors about the seriousness of light pollution and to inspire people to take an interest in space with a passion that is only achieved by seeing the sky in its full brilliance."

From page 65:

"The tours can be quite emotional for many tourists. Some of the guests express a sense of loss for the night sky, which they are missing in their home town/country, while others are exhilarated by what they see, or are overtaken by curiosity about the observatory equipment."

Urban light pollution impacts the cultural heritage of the night sky

The night sky is an important part of many cultures throughout the world, including Aboriginal communities in Australia. Many Aboriginal communities have their own distinctive stories and knowledge relating to the night sky (see for example, Goldsmith 1999, Norris and Norris, 2009, and Goldsmith 2014).

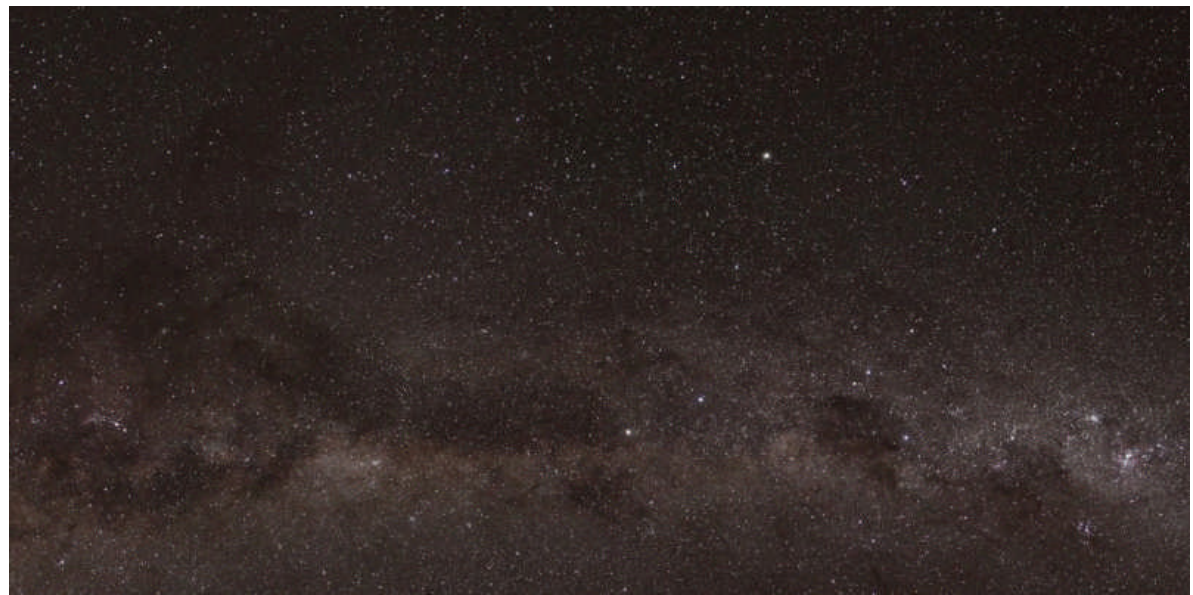
Well known Aboriginal sky patterns include the Seven Sisters (Pleiades) and the "Emu" in the sky.

The "Emu in the sky" is recognised very widely across Australia. The Emu pattern differs to other star patterns (constellations) in that it is formed by the dark areas in the Milky Way between Scorpius and Crux (Southern Cross). However, to be able to see the Emu pattern requires dark sky conditions, largely free of moonlight and urban light pollution.

Degradation of the night sky, caused by excessive urban and city lighting, has resulted in a serious loss of

quality of the night sky. This has profound implications for our society, as generations will no longer have regular access to truly dark night skies. The cultural heritage of the night sky is therefore becoming increasingly difficult to experience.

Dark sky view. Upper image: The southern Milky Way between Scorpius and the Southern Cross, photographed from a dark sky location in Western Australia. The dark areas (comprising dark dust lanes) are clearly visible in the Milky Way. These features are recognised by many Aboriginal communities in Australia as "The Emu" in the sky.



Light polluted sky. Lower image: The same expanse of the sky as shown above, but photographed from 14km from the centre of Perth. Urban light pollution means that the sky is much brighter, and the Milky Way is barely visible, and the dark dust lanes in the Milky Way are now virtually completely obscured from view. Due to the bright sky from urban light pollution, the photographic exposures had to be reduced.



Urban light pollution & Comet Lovejoy, 2011.

Urban light pollution has an enormous impact on the visibility of the night sky, and the experience people can have of astronomical events, such as the appearance of comets.

In late 2011, Comet Lovejoy developed into a remarkably beautiful comet with a tail about 20° long, in the pre-dawn skies.

The appearance of the comet differed greatly, depending upon where the comet was observed from.

From the centre of Perth, light pollution meant that only the brightest part of the comet was visible. However, when seen from dark sky locations east of Perth, the comet showed a stunning sight.

It is now a fact of life that you have to travel substantial distances out of Perth to be able to experience good, dark views of the night sky.

The remarkable impact that city and urban light pollution causes is shown in the following images.

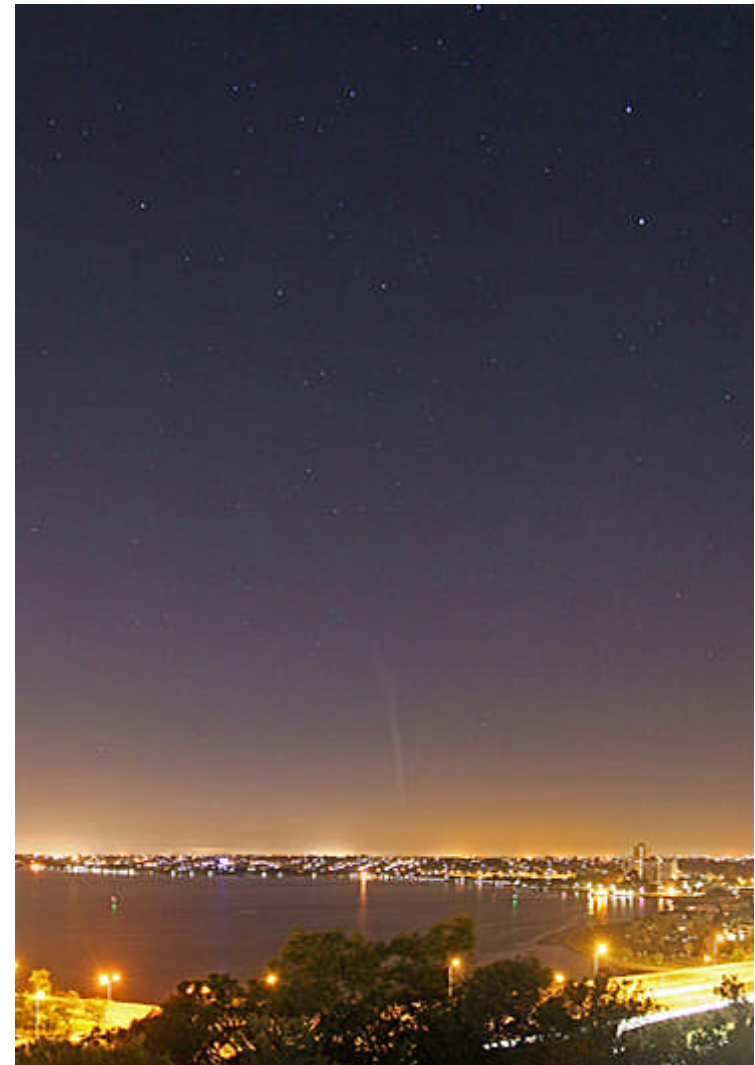
On the next page, Comet Lovejoy is shown as photographed with relatively dark sky conditions (taken 70 kilometres east of Perth), and under heavily light polluted conditions from the Perth (Kings Park). These photographs are details taken from two 360° panoramic images which are shown on the subsequent page.

The two 360° panoramic images are orientated and scaled in approximately the same way to enable comparison.

Whilst Comet Lovejoy is barely visible in the light polluted skies, from the dark skies, the comet shows a dramatic view with 20 degrees of tail visible.

The upper image also shows the dome of urban light pollution from Perth, which can be detected at a distance of several hundred kilometres.

These examples illustrate the impact that city and urban light pollution has on the visibility of the night sky.



Comet Lovejoy photographed from dark sky and urban light polluted locations.
Urban light pollution from Perth dramatically reduces the visibility of the comet. (Photos © John Goldsmith).



Two 360° panoramic views of Comet Lovejoy (Dec 2011).
Dark sky (above) and light polluted views (below). Note that the Urban light pollution of Perth appears as the dome of yellow light in the central portion of the upper image. The lower image was taken from the centre of the urban light pollution bubble. (Photos © John Goldsmith).

Comet McNaught and Perth CBD, 2007.

In 2007, Comet McNaught made a dramatic appearance in the evening sky, for southern hemisphere skywatchers.

The comet developed a very bright and strongly curved dust tail, and was perhaps the most visually impressive comet witnessed in more than 40 years from the southern hemisphere. The exceptional brightness of the comet meant that it was visible even from the light polluted skies of central Perth.

The photograph (right) was taken with a 135mm telephoto lens, as the comet set, amongst evening twilight and city lights. This image has become a historical image very quickly, the Perth skyline has now changed significantly.



Comet McNaught appearing above Perth, WA, 2007.
(Photo © John Goldsmith).

The World at Night

The World at Night is an international collaborative network of advanced astronomical landscape photographers.

Known as TWAN, the network developed in 2007 and played a key role during the International Year of Astronomy 2009 (IAU 2010). TWAN collaborates with the US based organisation Astronomers Without Borders (AWB) (Simmons & Tafreshi 2008).

TWAN is dedicated to photographically documenting astronomical events together with terrestrial landscapes, on a global basis. Key locations include World Heritage areas and places of natural and cultural heritage. The

online collection of astronomical images (at www.twanight.org) include an extensive and constantly developing collection of astro-images, as well as timelapse and 360 degree imaging. The TWAN collection has developed into an important global resource for astronomical landscape images.

The TWAN network consists of 33 members located around the world. There are three Australian TWAN members: the acclaimed astro-imager Dr David Malin, Alex Cherney (Victoria) and John Goldsmith (Western Australia).

TWAN has developed hundreds of astrophotography and astro-imaging

exhibitions and related events since 2007, around the world.

Two examples of events in Western Australia featuring astro-imaging by Western Australian TWAN astro-photographer John Goldsmith include the Commonwealth Heads of Government Meeting (CHOGM) in Perth, 2011, and the Luminous Night celebrations marking the occasion of The University of Western Australia's 100th year centenary celebration. Both events involved large scale projection / display of astro-images featuring Western Australian landscapes. Examples are provided on the following page.



Astro-image projections onto Winthrop Hall, UWA, part of the Luminous Night celebrations marking the occasion of The University of Western Australia's 100th year centenary celebration.



The setting moon above the Pinnacles, (timelapse production) featured at the opening ceremony of CHOGM, 2011.



Pinnacles timelapse featured at the CHOGM 2011 opening ceremony.

Opening ceremony produced by Great Big Events.
Image reproduced with permission.

Practical measures to reduce light pollution

There are many practical examples of methods for reducing light pollution, improving energy management, and increasing energy efficiency. The *"Practical guide for lighting to reduce light pollution and save energy"* by Astrolab Du Mont Megantic (nd), details numerous examples of how communities have significantly reduced light pollution, with additional benefits including cost savings on energy costs. These examples include:

- Lighting design and management.
- Roadway illumination.
- Rural and residential areas.
- Building facades and surroundings.
- Businesses
- Parking lots and shopping centres.
- Service stations.
- Car dealer showgrounds.
- Loading and handling zones.
- Security lighting.

One such example relates to the lighting of car dealer showgrounds, and the practical measures to reduce light pollution and improving cost savings from reduced operational costs (page 15):

"This dealer displays the rows of cars with luminaires that take 400 W metal halide lamps. The luminaires supply an average illuminance of about 60 lux to the ground. This is four times less than that normally generated for this type of application using floodlights of 1,000 to 1,500W. In addition, it is strongly recommended to extinguish at least some of the lighting outside business hours. Reducing illuminance levels and occasionally turning off the lights in a dealership with 32 such luminaires could save 115,000 kWh/year, which would result in a difference of about \$10,000 per year".

Recommendations

It is recommended that;

1. the draft lighting strategy be substantially revised to address urban light pollution in much greater detail.
2. the lighting strategy adopt a specific objective directed towards reducing urban light pollution.
3. a more balanced appraisal of information be included in the lighting strategy.
4. consultation periods for the draft lighting strategy be extended to a minimum of three months.
5. in addition to strategy consultation being directed to Perth Observatory, that specific efforts are made to extend consultation to other astronomical organisations and individuals, whether they are of a professional or "amateur" nature.
6. the proposed "Good Practice Lighting Guide" includes a substantial section about the issue of urban light pollution.
7. any specific proposed initiative derived from the lighting strategy, such as the illumination of building outlines in the Perth CBD, be fully costed (from concept, scoping, definition, tendering, implementation, ongoing energy and operational costs), and that such costings and details be readily publically available.
8. any future projection events in Perth consider incorporating astronomical themed astro-images, particularly images that showcase the Western Australian nocturnal landscape.
9. the strategy be amended to include substantially improved referencing of information throughout the strategy.
10. all public submissions in relation to the City of Perth draft lighting strategy be made publically available (unless any such submissions request otherwise).

References

- Astrolab Du Mont Megantic. (nd) Practical guide for lighting to reduce light pollution and save energy. Viewed 16 June 2014 <<http://www.darksky.org/assets/documents/MMPG.pdf>>
- Biggs, J. D. Fouché, T., Bilki F. & Zadnik M. G. 2012. Measuring and mapping the night sky brightness of Perth, Western Australia. *Mon. Not. R. Astron. Soc.* doi:10.1111/j.1365-2966.2012.20416.x
- City of Perth. (nd), 1962: The City of Light and the Commonwealth Games. Viewed 6 June 2014. <<http://www.perth.wa.gov.au/sites/default/files/City%20of%20Light%20catalogue.pdf>>.
- City of Perth. 2014. Draft Lighting Strategy 2014. Draft document 11 November 2013, for public comment, 17 April 2014. City of Perth, Western Australia. Viewed 1 June 2014, <<http://www.perth.wa.gov.au/sites/default/files/Draft%20Lighting%20Strategy.pdf>>
- de Castella, T. The plague of light in our bedrooms. Viewed 4 June 2014 <<http://www.bbc.com/news/magazine-27661394>>.
- Environmental Impact of Light Pollution and its Abatement. December 2012, Special Report of the *Journal of The Royal Astronomical Society of Canada*. Viewed 1 June 2014. <http://www.rasc.ca/sites/default/files/LPA_Special_Issue_LR.pdf>.
- Galloway, T., Olsen, R. N., Mitchell D. M. 2010. The economics of global light pollution. *Ecological Economics* 69 (2010) 658–665.
- Goldsmith, J. 1999. “The emu in the sky”. *Australian Geographic, The Journal of the Australian Geographic Society*. July/September 1999 edition, no. 55. Australian Geographic Society. Terry Hills, NSW.
- Goldsmith, John M. 2014. Cosmos, culture and landscape: Documenting, learning and sharing Aboriginal astronomical knowledge in contemporary society. PhD thesis, Curtin University, Western Australia.
- International Astronomical Union. 2010. “International Year of Astronomy 2009 final report”. Russo, P & Lindberg Christensen L. (ed.). UNESCO, IAU. <http://www.astronomy2009.org/resources/documents/detail/iya2009_final_report/>
- Law, P. 2014. How our city could look with a flick of a high-tech switch. *Sunday Time Newspaper* (1st June 2014), Western Australia. pp. 14-15.
- Marin, C., & Jafari, J. (ed.) 2007, “Starlight, a common heritage”. Canary Islands, Spain: Starlight Initiative & Instituto De Astrofisica De Canarias (IAC).
- Norris, R., & Norris, C. 2009. *Emu Dreaming, an introduction to Aboriginal astronomy*. Emu Dreaming, Sydney.
- Perth Observatory. 2012. History of the Perth Observatory. Viewed 6 June 2014, <http://www.perthobservatory.wa.gov.au/history.htm>
- Simmons, M. & Tafreshi, B. 2008. “The world at night, a new International Year of Astronomy Project”. *CAP Journal* vol. 2 pp.17–21.
- Starlight. Declaration in Defence of the Night Sky and the Right to Starlight. 2007, Canary Islands, Starlight Initiative, Spain.
- Taylor Redd, N. 2012. John Glenn, 1st American to orbit Earth, oldest man in space. Online article 23 August 2012. Viewed 7 June 2014. <<http://www.space.com/17263-john-glenn-astronaut-biography.html>>
- The Age. 2013. Research at Perth Observatory axed. Online article dated 22 January 2013. Viewed 6 June 2014, <<http://www.theaustralian.com.au/news/latest-news/research-at-perth-observatory-axed/story-fn3dxiwe-1226559343187>>
- Tourism Western Australia (nd). 1001 Extraordinary Experiences Campaign Fact Sheet How WA industry suppliers can get involved? Viewed 4 June 2014. <http://www.tourism.wa.gov.au/marketing/Marketing_activities/Documents/Tourism_industry_fact_sheet_promote_phase.pdf>.
- University of Canterbury, RASNZ, Department of Conservation. 2012. An Application to the International Dark-Sky Association for a Starlight Reserve in the Aoraki/Mt Cook National Park and the Mackenzie Basin of the central South Island of New Zealand 27 January 2012. Viewed 17 June 2014. <http://darksky.org/assets/Night_Sky_Conservation/New_Zealand_IDSP_app.pdf>

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Enlightened, illuminated, or light polluted ?

A public submission on the draft
City of Perth Lighting Strategy

