

# **POTENTIAL EYE HAZARDS AND OTHER UNDESIRABLE FEATURES OF IN-GROUND TREE FLOODLIGHTING IN THE CITY OF YARRA**

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## **SUMMARY**

The potential eye hazards of in-ground tree lighting in Curtain Square, North Carlton, are re-examined. It appears that the lights may well represent a tangible risk of vision loss in incidents of 'light-gazing' by children, such as those already observed in and near Curtain Square and elsewhere. Light-gazing appears to be about as rare as sungazing, a well-documented activity often associated with solar eclipses and frequently resulting in vision loss. It appears that the risks connected with light-gazing are sufficient to justify removal of the lights.

Social, environmental and ecological issues relating to in-ground tree lights are presented. These also appear to justify removal of the tree lights in Curtain Square. Some of the issues go further in appearing to justify removal of all tree lighting anywhere within the City of Yarra and beyond.

Instead of proceeding with the tree lights removal as an ad hoc fix for a relatively minor problem, it is suggested that the process could usefully be actioned as part of a new outdoor lighting strategy for the City based on socially and environmentally successful ordinances and laws elsewhere. Many benefits, including reduced costs, would flow from such a strategy.

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## 1. INTRODUCTION

This matter arose earlier in 2003 when two local residents observed two children staring into upwardly-aimed operating in-ground tree floodlights while lying prone on the grass in the Curtain Square park, North Carlton. The children were still for a minute or two while doing this and each would then run to another in-ground luminaire and repeat the exposure. By the time that the story reached me, another witness had recalled seeing light-staring behaviour by two children about two weeks earlier at the upwardly-aimed operating in-ground floodlights outside the library across the road from the park. At this location, the lights are set in the pavement. The children were lying on the pavement, prone, for minutes at a time with their faces over the lights. There is no information about whether the total number of children involved in the two incidents is two, three or four. The identities of the children are apparently not known to the witnesses.

Also at night, one of the Curtain Square witnesses had observed children in Curtain Square dancing on the flush-mounted upper surface of the cover glasses of tree lights. The effect of this, and perhaps the motivation for it, was to light up their legs and clothing as they moved. The witness was quite sure that the children had their eyes open both while light-staring and while light-dancing. The library witness was also sure that the children she saw had their eyes open while light-staring. None of the witnesses has academic knowledge of visual optics, and could not be expected to be aware of the full significance of this part of the evidence in terms of its impact on hazard assessment.

The two incidents paralleled my own unexpected observations on 1999-12-07 at the Old Melbourne Observatory in the Domain. To avoid further misunderstanding of what actually took place, the following account has more details than I thought necessary to mention in previous versions.

While preparing to receive visitors for a scheduled observing tour at the Observatory, I looked out of the window of the South Equatorial dome to gauge the progress of twilight. Although I had previously written of the general possibility of individuals staring into low-mounted floodlights, I was surprised to see it actually happening: at least three pre-teenage children were prone on the grass, each with their nose/face in contact with or close to the cover glass of one lit in-ground luminaire. This was so unusual that I left the building temporarily and moved closer to get a better view. I saw that two of the children certainly each had at least one eye wide open. I recall that at least one was a boy. The third child was smaller and appeared to be unable to get a direct view of the beam, despite noisy efforts to push in at ground level. The tree light concerned had no nearby tree to shine on, so all it usually illuminated were the bottoms of aircraft, birds and bats, and the sky. The in-ground lights can be switched off from the observatory buildings, but as on this occasion, switching off is often left until deep space objects are being observed with the telescopes.

I was aware of the potential injury significance of the open eyes at the time. While I was still outside, I spoke to a security guard, who refused to take any action because he considered the children were not in danger or other need of immediate assistance and their parents were apparently in the crowd attending a noisy evening social function at the Observatory Café, about 50 m away. He expressed annoyance that the children had previously been running

wild around the site by themselves and thought it good that they had stopped doing so and were now within sight of their parents.

One of my groups of visitors then arrived so I had to attend to them. Several minutes later I did take an opportunity to look briefly through the dome window again and saw that children (probably but not necessarily the same ones) were still prone on the grass with their faces over in-ground luminaires, plural this time. I mentioned the incident to members of another group of observatory visitors at the end of their tour. A few said they had noticed similar behaviour while they were walking between domes, which would have been about half an hour after my observations. I think it unlikely that the children had been light-staring for the whole of this time, but there was little prospect of checking this then and almost none now.

As required by the terms of my part-time employment at the Observatory, which is managed by the Royal Botanic Gardens, I submitted a brief report of the incident to the RBG. As I recall, the eventual response was that the RBG had accepted an assurance that the luminaires were not hazardous and the situation had essentially been a matter for parental control. However, I suspect that lamps with a lower wattage or a lower colour temperature or both were installed subsequently in some of the in-ground luminaires in question.

Of the three light-staring incidents, at least two were unrelated, which indicates that this bizarre behaviour of children is not unique, and therefore warrants further investigation. I have enough familiarity with ocular effects of optical radiation to consider the circumstances as possibly hazardous to vision, and accordingly advised the North Carlton witnesses to report their observations to the responsible authority, the City of Yarra, along with my supporting statement and a suggestion that the City should consult an acknowledged expert about the possible hazard. In subsequent discussion with one witness I suggested that Professor Barry Cole should be contacted at the Department of Optometry and Vision Sciences, University of Melbourne. I am pleased to see that this consultation did take place.

Professor Cole's report for the City of Yarra is dated 2003-06-26. It was copied to me on 2003-07-25 by Yarra staff in response to a request from one of the witnesses mentioned above. Following are comments on the report and then on relevant environmental matters.

## **2. MATTERS ARISING FROM PROFESSOR COLE'S REPORT**

Professor Cole's report is headed 'Ocular hazard of up-lights in Curtain Square, North Carlton'. Reasonably, its scope is restricted to this topic. The present document covers broader ground, including details not previously provided about the observations, and additional material that bears on the overall issue of whether floodlighting trees is a good thing or not.

### **2.1 OUTPUT LUMINANCE**

The last paragraph of page 1 of the report indicates that the output luminance of the in-ground luminaires was calculated using the luminaire supplier's value for the peak output intensity and the assumption that the flux was uniformly distributed across the clear aperture of the cover glass. Subsequently I examined the output light distribution of the actual luminaires

with the aid of a welding filter that transmitted only about one ten-thousandth of the light and thereby allowed comfortable vision.

At distances from my eye height down to near-contact with the cover glass, it was apparent that the cover glass or some other transmissive element in the luminaire incorporates a fine diffusing stipple pattern that spreads the beam. This is in addition to a diffusing finish on the arc's transparent envelope inside the metal halide lamp. Both means of diffusion increase the apparent angular size of the electric arc, thereby reducing its apparent luminance and any associated eye hazard. Nevertheless, the arc area of the lamp still had a discernably greater luminance than the output light that had travelled via the reflector, as could be expected.

The reflector did not appear to be fully or uniformly 'flushed' from any near-field viewing position. (An effect like this, but for a tungsten filament lamp, is shown in Figure 17 of Sliney and Freasier (1973).) The import of these details is that the actual peak output luminance from the luminaire may sometimes exceed the mean value of peak luminance derived in the report. An initial estimate of the increase in peak output from the arc area would be the reciprocal of reflectance of the luminaire reflector for blue light, viz about  $1/0.8$  or 1.25, a 25% increase. The maximum safe exposure time depends strongly on the actual peak output luminance. Appropriately revised values could well be shorter than the 15 or 22 minutes suggested in the report.

The actual value of output luminance as seen by an eye from any position in front of one of the luminaires, and looking in any direction, could be calculated with sufficient accuracy if all relevant factors, such as the actual 3-dimensional shape of the reflector and the characteristics of the two diffusers, were known precisely. This would generally be too time-consuming to be practicable. Direct photometric measurements on an installed floodlight, using an optical system mimicking the imaging characteristics of the human eye, would be quicker, but would still be costly and difficult to achieve. Measurements with simpler arrangements would be easier to set up, but the results would require numerical integration.

In the absence of accurate knowledge of the peak luminance seen by an eye in the near field of a particular luminaire, a safety factor should be applied in a way that decreases the calculated allowable safe exposure duration. There is little information on which to base an estimate of this safety factor, so any such estimate at present would need to be larger than could be justified for a better defined case. Another increment in the safety factor would be required to cover the known likely error of several percent in absolute photometric calibrations against national standards.

## **2.2 BLUE LIGHT HAZARD**

### **2.2.1 Threshold Value**

It is widely accepted that photochemical effects of intense light exposure can damage the light detectors in human eyes. However, the spectral variation of the effect and particularly its threshold value are still under discussion over three decades after the original experiments. Knowledge of the effect is incomplete, as illustrated by Stuck's (1998) finding that it is accompanied by a temperature rise of about  $1\text{ C}^\circ$ . Since then, it has been discovered that the mammalian retina includes blue-light-sensitive ganglion cells with neurological pathways to

the pineal gland (eg Brainard, Hanifin, Greeson et al. 2001). Note that the human pupil response to light has long been known to have a peak in the blue part of the spectrum.

Laser display organisations and, to a lesser extent, military-industrial organisations, stand to benefit substantially by blue-light-hazard revisions that would reduce the calculated hazard of lasers and other intense light sources. Any such claims need close scrutiny, especially if there is a potential for bias as a consequence of conflicts of interest arising, for example, from the source of study funds.

Rosen (1948) reported three cases of solar retinitis from observation of the sun's reflection in a still water surface. The reflectance of a reasonably clean water surface for blue light is only about 2% at normal incidence, rising quite slowly with angle of incidence until the angles are large. In watching the sun's reflection, large angles would only occur if the sun were low in the sky, where its radiation is considerably attenuated in the blue and violet part of the visible spectrum and the potential for solar retinitis is much reduced accordingly. The three cases must therefore have occurred with the sun sufficiently high for the water reflectance to be somewhere between 2% and 3%, say. This indicates that light sources with only about 3% or less of the sun's radiance for blue light may be hazardous to vision in some cases. In turn, this could mean that the present values for the blue light hazard are not as conservative as might be thought, or even that they underestimate the hazard for individuals who are unusually susceptible. I have not systematically searched the literature on this point, however.

The International Commission on Illumination (CIE) has been active in studying the photobiological safety of lamps (CIE 1997). It points out:

“However, in some unusual situations, potentially hazardous levels [from lamps or luminaires] are accessible, and excessive light and infrared radiation are typically filtered or baffled to reduce discomfort. The natural aversion response of the eye to bright light, as well as thermal discomfort sensed by the skin normally will limit potentially hazardous exposure.”

“There are currently underway national efforts in the US, Australia, and some European countries to develop general lamp safety standards.”

It is therefore possible that manufacturers' claims for the eye safety of luminaires fitted with high intensity discharge lamps depend on the questionable assumption that the aversion response will always end an exposure before the retinal damage threshold exposure duration is reached.

IEC Standard 61167 refers to safety and performance of metal halide lamps, but I have not seen it. In any case, it may also depend on the dubious assumption.

### **2.2.2 Effects of Eye Abnormalities and Treatment**

Not much evidence is available about any additional photochemical damage susceptibility that might be associated with eyes of individuals suffering from conditions such as retinitis pigmentosa, macular degeneration and diabetic retinopathy. Increased phototoxicity as a result of medical treatment is known (Fishman 1986; Postel, Pulido, Byrnes et al. 1998), and so is the potential for photochemical and even thermal damage to the retina from the use of existing light sources during vitreous surgery (van den Biesen, Berenschot, Verdaasdonk et al.

2000). The standard blue light hazard values apparently do not incorporate safety factors to cover any of these unknowns.

### **2.2.3 Age and Susceptibility**

The crystalline lens yellows with age, decreasing transmission of blue light to the retina and thereby reducing susceptibility to the blue light hazard. Removal of the lens, or its replacement by a plastics substitute (as in operations for cataract), may restore blue-light transmittance (Charman 2003) and thereby restore susceptibility.

The blue light hazard tables I have seen did not appear to mention subject age. I suspect the values were derived for young adults, whose eyes transmit blue light well. The eyes of young children generally transmit a little more, possibly making them more susceptible to the hazard than standard calculations would indicate. The standard blue light values may therefore underestimate the hazard for young children.

### **2.2.4 Vision Recovery**

As mentioned in the report, it is well established that after intense optical irradiation of the retina, any resultant vision loss tends to diminish over the following months. Unfortunately, recovery of pre-exposure visual function may not be total in severe cases of solar retinopathy, even when central visual acuity of 6/6 has been regained (MacFaul 1969). Of 47 patients injured by eclipse watching, Knudtson (1948) found that 40 still showed signs of damage 18 months later. Postel et al. (1998) found that foveal phototoxic injuries generally had a worse long-term outcome than did extra-foveal injuries.

The seriousness either of an occurrence of photoretinitis and associated vision loss or a significant prospect of such an occurrence should not be regarded as trivial, even if affected vision appears likely to improve over time. It seems there can be no guarantees of full and certain recovery at present. In the case of a child, reduced vision even for a few months could have an undesirable retarding effect on education and development. An associated damages suit would not be a nice reason to have to put up council rates.

## **2.3 PROTECTION MECHANISMS**

It is possible that the usual constriction of the pupil in bright light might be reduced or absent in some individuals, thereby not providing part or all of the protection factor of 16 mentioned in the report. (In recent weeks, I saw a journal article that included failures of pupil constriction during intense light exposure to eyes of laboratory animals.)

The report discusses the discomfort and even pain of exposure to excessively bright light, and protection provided by the usual blink reflex and eye and head movements. These protective responses can be subject to voluntary control, however. They are overridden in the case of sun-gazing, which occurs for reasons such as religious purposes or the influences of drugs or mental illness (eg MacFaul 1969), or curiosity in cases of large sunspots or solar eclipses. From my introductory remarks, it is clear that at least some of the children concerned in the light-gazing incidents were directly observing intense light steadily for minutes at a time, sometimes repeatedly. The supposition in the report, that all eyes were actually shut, is inapplicable.

In the Introduction, the ‘light-gazing’ behaviour of the children is described as bizarre. A recent personal experience of trying to look momentarily at one of the tree luminaires from within its beam was so unpleasant that staring into it would seem unlikely to the point of complete disbelief that anyone could possibly succeed in doing it. But the sun is even brighter, albeit over an angular subtense usually limited to about 0.5° instead of many degrees in the case of the luminaires. Instances of vision loss from sungazing are reported in the hundreds, if not thousands, in the ophthalmic literature. Sungazing is not non-existent just because it is too awful to imagine, and now we have to accept that although light-gazing might not be as bizarre as sungazing is, light-gazing is every bit as real and quite possibly comparable in order of magnitude of population incidence per exposure opportunity. Its existence may lead to the reassessment of luminaires for eye hazards on the basis of the degree of access that children and others have to the near field of the luminaires in practice.

## **2.4 BIAS AND RISK ASSESSMENT**

The report draws attention to my publications on light pollution at the website of the Astronomical Society of Victoria, Inc. This is much appreciated. Had it not been for my interest in astronomy and light pollution, the light-gazing instances in question would probably have remained unreported and unconnected. Instead, the matter now seems worthy of recording and discussion in a scientific journal paper.

Scientific method requires researchers to be indifferent to the way their findings fall. Like others, I make a conscious effort to avoid bias in reporting and analysis. I do not believe that my report of light-gazing at the Old Melbourne Observatory is overstated in any way. The unexpected independent corroboration of the observed behaviour supports this belief. Nevertheless, recent studies of pharmaceutical trials indicate that the effect of unwitting bias (eg conflict of interest from funding) can be much larger than formerly believed (see Clark 2002). All scientific work should continue to be open to examination about conflicts of interest.

Certainly I do wish to see light polluting fixtures removed or rectified, but compelling reasons to justify this already exist. Although the potential eye hazard might help to get rid of the present tree lighting, that has not been my prime motivation in bringing the matter to attention. I am not an optometrist, but I have been a member of the Victorian College of Optometry for decades and I support that organisation’s efforts to help research, optimise, preserve and protect vision in the populace to the maximum practicable extent. Ensuring that children are not unduly exposed to an avoidable risk of temporary or permanent vision loss is a worthy part of that.

As a result of the issues raised in the preceding sections, it seems that the actual level of risk might be greater than the existing assessment in the report indicates. I suggest that luminaires with high-intensity discharge lamps are at least undesirable in any place where the near-field beam is accessible to children of any age.

## **2.5 RISK CONTAINMENT**

It might be possible to contain the present potential eye hazard without abandoning use of the existing in-ground luminaires, eg physically surround each of them with a large wire fence or

cage incorporating climb barriers. However, as will be seen in Section 3 below, the social, environmental and ecological cases against the use of tree floodlighting are so strong that I see retention of the luminaires as totally inappropriate and complete removal as the only fully acceptable outcome. The reasons for removal apply to tree lighting in general, not only to in-ground luminaires for tree lighting.

### **3. REASONS AGAINST TREE LIGHTING**

It could be argued that a balanced assessment of the pros and cons of tree lighting would be appropriate here, with a neutral heading. However, reasons for tree lighting all appear to be associated with its supposed decorative or aesthetic value, which leaves little scope for padding out that side of a two-sided presentation.

#### **3.1 NON-ASTRONOMICAL VIEWS**

*Night Blight!*, a report on the undesirable aesthetic and other consequences of excessive artificial light and light spill in rural areas at night, was issued recently by the Campaign for the Protection of Rural England (CPRE 2003). The CPRE emphasise that they are not astronomers. The report has already had a big impact in the UK and elsewhere in terms of news coverage.

Not least of the problems of excessive artificial light are the adverse effects it has on urban wildlife (UWG 2002).

Van den Berg (2000) is a thorough review of the many issues about excessive outdoor lighting in Holland, and likewise illustrates the wide range of environmental problems caused or exacerbated by poor lighting practices.

#### **3.2 ASTRONOMICAL VIEWS**

Wasteful, inefficient, inconsiderate and selfish outdoor lighting practices cause much of the light pollution that illuminates molecules and suspended particulate matter in the atmosphere. Some of this light is scattered downwards and is visible as artificial skyglow. In the City of Yarra, the rest of suburban Melbourne and elsewhere, artificial skyglow blots out literally billions of deep-space objects, hiding them from telescopic study.

Light pollution investigators have estimated that as much as 95% of the output of floodlights upwardly aimed at trees actually misses branches and foliage and contributes directly to light pollution and skyglow. Vertically upwards aiming generally maximises the skyglow caused by a lamp of given type and wattage.

Amateur equipment is now able to detect Melbourne light pollution high in the sky at every part of Victoria. It takes only a few microseconds for the light to cover the whole of the state. Switching off tree lighting and other upwardly aimed or inclined floodlights in the City of Yarra likewise would take only microseconds to achieve a small but worthwhile reduction in light pollution affecting Mildura to Mallacoota and all in between.

Astronomical research is one of the primary wellsprings of understanding of the physical world. Hampering it inevitably slows the pace of technological advancement that has had

such a positive impact on daily life. Education also suffers if the sky is blotted out. Tree lighting, like other lighting excesses, comes at great hidden cost.

The International Astronomical Union (IAU 1997) has resolved that the night sky is the heritage of all humanity and should therefore be preserved untouched and receive no less protection than has been given to the world heritage sites at Earth's surface. The technicality, that no one country (or group of countries, as in the case of Antarctica) claims sovereignty over the sky, has so far prevented the award of heritage status. Regardless, there is an obligation on all authorities to try to protect natural heritage.

### **3.3 AESTHETICS AND TOURISM**

In much of metropolitan Melbourne, less than 3% of the 2700 stars naturally visible at a given time can now be seen with unaided vision. This loss has a devastating impact on the grand natural spectacle of the night sky. The southern sky is intrinsically richer than the northern sky, and many northern hemisphere tourists arrive with advice to look at it if they ever get the chance. The Southern Cross is a special favourite and a national icon. But its fourth and fifth stars are gradually disappearing from view because of skyglow.

On p 82 of the Proceedings of the Conference on Light Pollution and Protection of the Night Environment, Venice, May 2002 (Cinzano 2002), Professor Giuliano Romano says:

"It would be incredibly stupid and cruel to magnify the false beauty of an artificial world if we were to ignore the more genuine, profound and precious one represented by nature and especially by the spectacle of the starry sky."

The quote refers to floodlighting of man-made outdoor objects rather than trees but the principle still applies.

### **3.4 GREENHOUSE GASES**

Light pollution measurements in Melbourne (Clark 2003) indicate that over the 1990-2000 decade, outdoor lighting has grown at over twenty times the maximum rate set for overall growth of greenhouse gas emissions in Australia according to the Kyoto Protocol. Accordingly, there is an urgent need to decommission half of all existing outdoor lighting in Melbourne, or to take other actions that would end up with a comparable reduction in fossil-fuel usage for outdoor lighting. Tree lighting would have to be at or near the top of the list of unnecessary lighting that should be removed.

### **3.5 SUSTAINABILITY**

The energy required to generate the light pollution that goes into the sky above Melbourne exceeds the total generating capacity of Victoria's present wind farms. This is not a situation that the City of Yarra should be exacerbating by operating tree lighting and other wasteful outdoor lighting.

### **3.6 MAMMALS**

To help vision in the darkest of conditions, nocturnal mammals such as possums have 'fast' optical systems in their eyes, concentrating more light on the retina than in diurnal mammals such as humans. Whatever the unpleasantness that humans might experience in the glare of the tree floodlights at Curtain Square, it is notionally worse for the thirty or more brushtail possums that live there. The lights are as much as millions of times brighter than natural conditions at night. Perhaps the City is committing an illegal act of cruelty to animals.

The durations of human melatonin secretion and sleep both change in accordance with the natural change of daylight duration as the seasons progress (Wehr 1991). Other endocrine processes in mammals also depend on the annual photoperiodic cycle, eg as in species that generate and store body fat in summer to prepare for the forthcoming winter, and species in which breeding is triggered by the lengthening of daylight duration in spring. The presence of tree lighting interferes locally with the daily light-dark cycle. Disrupting natural cycles in ignorance with artificial light is a remarkably unclever act that appears to have profoundly undesirable effects in human populations (Wiley and Formby 2000). The year-round artificially long 'summer' days cause susceptible individuals to crave carbohydrates and store body fat for the famine of the winter that never comes. Obesity tends to result, followed by increased risks of diabetes and depression, for example.

The production of melatonin tends to take place only in relatively dim light. Suppression of melatonin production by artificial light at night has been theorised as reducing cancer inhibition. Reliable evidence supporting this has been found experimentally in rats (threshold 0.2 lux, less than the maximum illuminance of moonlight) and epidemiologically in humans (eg in nurses who work night shifts). The increased cancer risk has been known for some years (eg Batt 2000). Although light spill from the tree lights in question is unlikely by itself to reach thresholds for known adverse effects in nearby residences (eg, as little as 0.1 lux at the outside vertical plane of windows of habitable rooms can cause sleep disturbance), it does add to all other undesirable stray light in bedrooms at night.

Before the tree lights were installed, were local residents asked if they would accept the resultant small increments in risk of breast cancer and other cancers, and in risk of traffic accidents from fatigue resulting from sleep disturbance?

Decommissioning of the tree lights and other park lights that produce excessive light spill appears to be the healthiest option.

### **3.7 BIRDS**

Birds are spatially disoriented (eg seagulls circling the Bolte Bridge towers and the Arts Centre spire) and geographically disorientated by upwardly aimed floodlights at night. Fatal Light Awareness Program (FLAP) surveys indicate that the total annual bird kill at night from collision with illuminated towers, buildings and other tall objects in North America is about 100 million (Ogden 1996). The 230 bird species identified in this toll include many of endangered status (Shire, Brown and Winegrad (2000).

Upwardly aimed lights disrupt bird migration (eg Fornasari 2002). Many migration paths across Australia converge through south central Victoria. Is the City of Yarra happy to continue making its tree-lighting contribution to the disruption of bird migration and the threat this entails to biodiversity?

Owls are sometimes seen at night in city and suburban parklands and near the Yarra River. The river banks are notorious for their black rat populations. Owls are understood to have better night vision than rodents, which gives owls an advantage in predation in the dimmest conditions. Present levels of light pollution greatly reduce this advantage, favouring the rat population. The Curtain Square tree lights are not close to the river, but there is a principle involved.

### **3.8 TREES**

Deciduous trees illuminated by bright artificial light at night show abnormal growth patterns and cell damage (Casagrande and Giulini 2000; Roman, Cinzano, Giacometti and Giulini 2000). The life of the tree may be shortened. Trees so affected are also subject to increased probability of frost damage to buds and leaves (USDA & BARC 1975). Given the notional monetary value of the large deciduous trees in Curtain Park, treating them to tree lights might turn out to be a serious misuse of ratepayers' money.

### **3.9 INSECTS**

Lepidopterists have blamed increasing outdoor lighting for declines in many moth populations by disturbing flight, navigation, vision, migration, dispersal, oviposition, mating, feeding and crypsis, circadian rhythms and photoperiodism, and exposure to increased predation (Frank 1988). This has since been claimed to favour increases in populations of insects that are not attracted to lights and do not fly at night, such as flies and cockroaches. Were nearby residents told this and given a choice about whether the tree lights should be installed? Note that Victoria's planning laws prohibit actions that are likely to degrade the health and safety of residents.

### **3.10 LIGHT AND CRIME**

Lighting at night allays the fear of crime, especially if the lights are close to being glare-free. (This goes against the tree lights.) However, there is virtually no reliable evidence that outdoor lighting prevents or deters crime. Instead, there is overwhelming evidence that light has a net facilitating effect on crime (Clark 2002, 2003).

Curtain Park is a prime example of pro-crime high-glare lighting. The tree lights contribute their bad share. There is so much stray light in the park from surrounding streetlights, and commercial and residential lighting, that park lighting for mobility safety is probably unnecessary or only minimally necessary. If a soft transition to environmentally friendly lighting is desired, the tree lights should be the first to go, followed by removal of all spotlamps and replacement of the light-polluting pole-mounted lights by low-wattage full-cutoff luminaires. The present concentration of light at and near the toilets invites crime and provides a place at night for illicit injections. The full benefit of low-glare low-waste relighting is unlikely to occur until similar moderation and real improvement of all of the

surrounding public, commercial (including shopfronts and lit advertisements) and residential lighting has been carried out.

Instead of any such lighting modifications being done on an ad hoc basis, it would make sense for the City of Yarra to do them as a trial for a city-wide outdoor lighting strategy, based on the low-crime success of the Amherst, New York lighting ordinance and the environmentally friendly lighting law of Lombardy in Italy (Clark 2003).

#### **4. DISCUSSION**

I understand that the present recommendation of City staff is to leave the tree lights as they are because the risk of permanent eye damage is effectively considered negligible. This goes beyond the recommendations of the report, which takes a somewhat more cautious line.

In greater detail, the staff recommendation would appear equivalent to saying that exposure leading to vision loss is unlikely and if any persistent loss of vision were suffered, vision would probably recover fully in the following months. I see this as analogous to allowing packets of razor blades to continue littering an adventure playground because very few children would be able to open the packets and any cuts that are sustained would tend to heal completely within a few months.

When the issues raised in Section 2 are considered, the risks of short- or long-term vision loss in children appear to be greater than found by the report. The City of Yarra does have a duty of care to its park users, especially children, to prevent access to known or likely hazards. Accordingly, the in-ground tree lights should be decommissioned immediately and permanently removed in due course.

It appears that a similar conclusion could be reached as each of the ten points in Section 3 is considered in turn. The combination of these reasons progressively increases the case for decommissioning and removal. The hidden net costs of the tree lights to ratepayers might be embarrassingly large. Early removal of the lights would also demonstrate that the City of Yarra has started to face up to currently unmet obligations, including the need to help preserve the night sky, to reduce the blowout in greenhouse gas emissions associated with the uncontrolled proliferation of outdoor lighting, and to reduce crime. Reducing the substantial waste of the existing outdoor lighting infrastructure would undoubtedly also save money.

#### **5. CONCLUSIONS**

The Curtain Square in-ground treelights may present an appreciable risk of vision loss to children who choose to stare into the luminaires at close range. This behaviour is now a known, albeit infrequent, behaviour pattern for pre-teenage children. This is considered sufficient justification for the immediate decommissioning of the lights. Ten separate social, environmental and ecological reasons for doing the same present an overwhelming case against retention of tree lights, not only at Curtain Square but within the municipality generally.

Removal of the tree lights could reasonably be the first step in moderation of the park lighting system to make the park, and eventually the whole municipality, more environmentally

friendly and less affected by crime. The use of full-cutoff, low-glare luminaires would help to contain the fear of crime. It is suggested that the City of Yarra should take such actions as the trial introduction of elements of a new outdoor lighting strategy to be developed along the lines of socially and environmentally successful lighting ordinances and laws already in operation elsewhere. Considerable monetary savings could be expected as one of the numerous benefits of implementing such a strategy.

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