Incorrect Street Light "Switch-On" Times?

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ABSTRACT

There is a great deal of science applicable to road illumination.

This paper explores the method we currently use to trigger the switch-on time for the street lights, asks "why we get it wrong?", explains the history and suggests a superior methodology.

This paper is based upon 2005 data and a discussion paper prepared by the author in 2012.

This paper has direct relevance to the Wellington Region and perhaps elsewhere.

INTRODUCTION

For some time (20+ years) the author has been anxious about how we manage the switch-on time for Street Lights. It is abundantly clear to most drivers that the onset of Street Light illumination is often irrational. Too early, and from a road safety point of view often too late on dark wet evenings especially during the Winter months when sunset coincides with peak traffic.

The consequences of too little illumination in terms of network efficiency and road safety have not been measured to the author's knowledge. It is reasonable to suggest that poorly illuminated roads on dark wet nights during the peak period will perform less well than a well light road.

The author postulates that in a highly trafficked urban areas drivers turn their headlights on for two reasons, to see and be seen. A crude measure of the need for the need (to see) was when 90% on cars have their headlights on. The Transit Traffic Operations Centre (now NZ Transport Agency Wellington Traffic Operations Centre NZTA WTOC) staff were asked to observe the SH1 Ngauranga Gorge traffic by Closed Circuit Television (CCTV) for 35 days and record the times when 90% of cars had headlights on (slightly subjective), legal sunset and the street light illumination time. The recorded data is listed in the Appendix. SH1 at this location carries about 44,000 vpd.

The plotted data shown in Figure 1 suggests that on average we are 12 minutes late (with a couple of extreme aberrations of 29 & 39 minutes late) based upon the sample of 35 winter evenings in 2005.

The fact that the entire Wellington Region street lighting is controlled by a single sensor located in Petone, Lower Hutt may explain some of the variations.

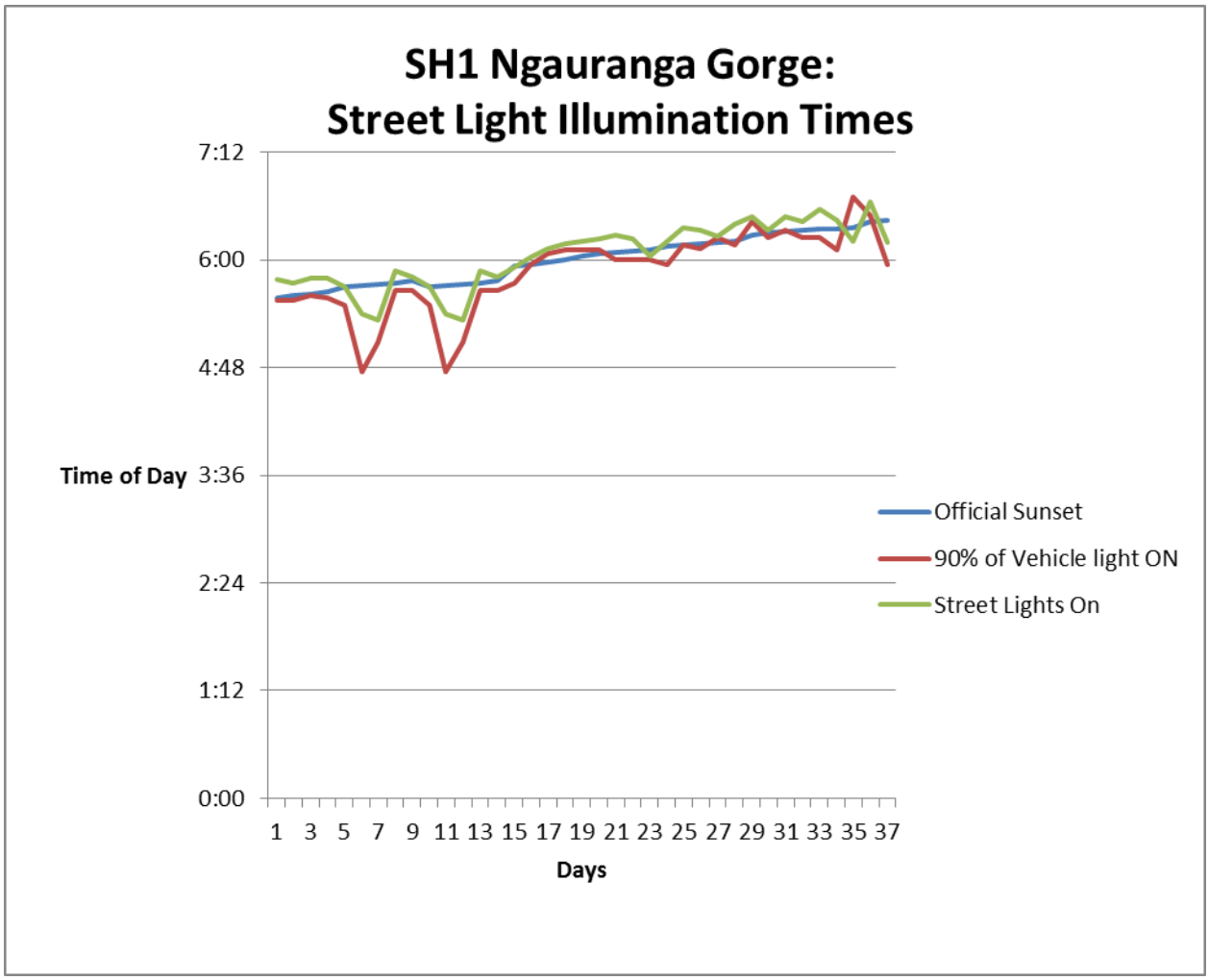

Figure 1: Observed Street Light "Switch-On" (2005)

CONTROL MECHANISM

The author has recently made contact with the engineer in charge of the master switch for the Wellington Region, which is currently managed by Wellington Electricity Ltd.

They have clarified that:

- There is only one light meter for the bulk of the region (Lyall Bay – Pukerua Bay – Kaitoke). The light meter is located on the Petone Foreshore. It is a white plate with light sensor that reacts to the night sky conditions.

- It triggers the "ON" signal automatically. The electricity system operator can give the circuit a "Nudge" if they do not all turn on automatically, provided somebody tells them.

- The system operator is able to override the switch-on time to turn-on earlier or later, but there is no evidence they do (except in very rare/emergency cases).

- The full switch-on lantern load will take up to 3 minutes to kick-in as the load is ramped up quite deliberately with the relay logic. (The author presumes that full light is therefore not available to all the network motorists until the ramp-up signal burst completes, and the lamp warm-up is completed. (5-10 minutes?), during which time light levels will have sagged below the trigger value, especially in the important Winter months when peak traffic

coincides with sunset.) Figure 2 shows the rapid decline in light values that occurs on a 10-15 minute period at sunset.

- The light level trigger meter was reset to an arbitrary low ~60 Lux level. This step was taken during a long ago power crisis as an energy saving measure. WElectricity ask "*What should it be now?".* WElectricity are apparently open to a revised trigger value setting. The Road Controlling Authorities should set the value.

Measured data (Lighting level (LUX) vs Time of day Figure 2) provided by Mike Jackett shows that horizontal LUX drops from ~140 Lux to ~30 Lux over a 15 minutes period. This rapid decline in light level is of similar magnitude to the warm up time for street lights. With current incandescent lamps and ramp-up illumination times we are probably reacting just too late.

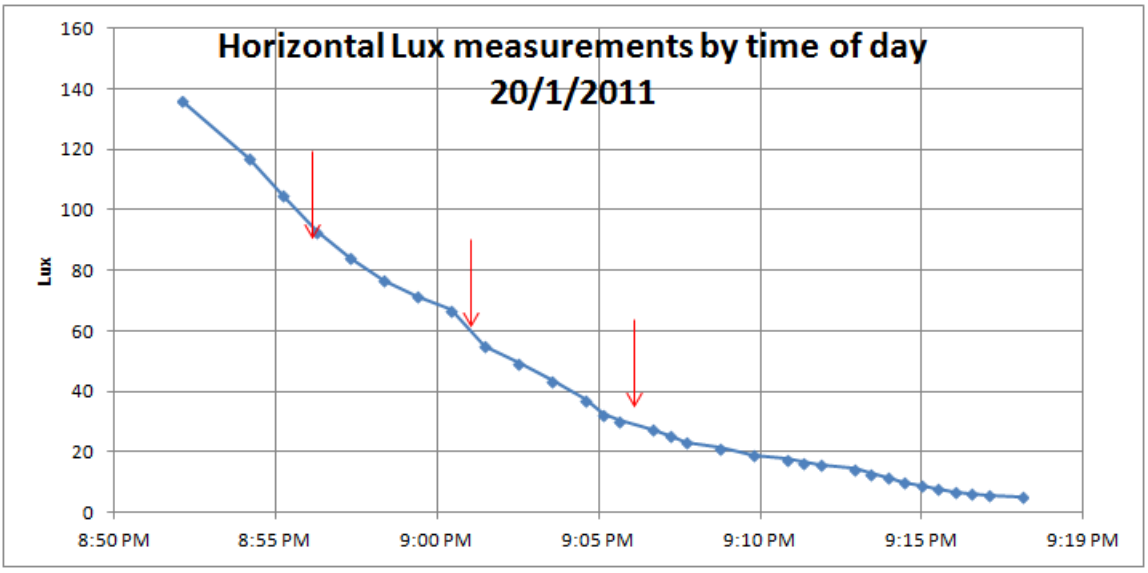

Figure 2: Decline of Sunlight around Sunset (gathered near Paraparaumu).

In the authors opinion there is clear evidence that we are not getting it right, and this small sample of data gives this view some credibility.

SYSTEM WEAKNESSES

From the author's discussions with traffic engineers and the NZ National Meteorological Service (MetServices) it is fully agreed that one sensor in Petone is not sufficient to gauge the correct light levels for the region. Decisions made by the single sensor will be at best a very crude blunt tool.

- The electricity controller can turn the lights on early. The Territorial Local Authority's (TLA's) Traffic Engineers are unlikely to know how to this. The electricity controller is likely to be very surprised to receive such a request and not know how to react as it effects several Road Controlling Authorities (RCA's). Does NZTA WTOC have the quick-facility to ask WElectricity to turn on the lights?

- WElectricity acknowledge that they have no idea why 60 Lux was selected, nor how much tolerance is in the system. Is it 59-61Lux, or more like 50-70Lux? Nor is the relationship between upward night sky observation and road surface illumination fully understood by the author.

- It is understood (Lyle Earl Hutt City Council Lighting Engineer and WElectricity) that the 60/70 Lux level was adopted during a Power Crisis many years ago. It was dropped (halved) from 140/150 Lux to 60/70 Lux. Should it be restored? To what Lux level?

- It probably takes the network luminaires 2-15 minutes to come up to full output post switch on. We need to trigger early enough to allow for this warm-up period.

- At best the single sensor that looks upward is a surrogate for road surface illumination.

- The August 2014 NZTA Spec M30 makes some reference to trigger values (50-70 lux)

  16.8 Light Point Controller
  The use of a light point controller on the luminaire requires different specifications for different light sources. HID luminaires require a switch on level of around 50 - 70 lux to allow time for the lamp to run up to full brightness. With instant start up light sources, such as LED, the switch on threshold can be lower.
  Light point controllers with a negative switching differential can be specified for HID. These should not be used for instant start up light sources.

  This trigger value is similar to value we believe the current sensor operate at, yet the 90% headlights-on test suggests that this on average it is12 minutes late. The author believes that this indicates the 50-70 lux trigger value is too low, or the current sensor is poorly calibrated.

- Perhaps in the future NZTA, TLA's and the electric supply company might be willing to provide additional Light level indicators (LUX meters).

- Perhaps we could consider bringing street lights on earlier in some locations that are known to have a poorer twilight/dark Crash record (Both ends of The Esplanade, the Wainuiomata Hill Road and Eastern Hutt Road are obvious candidates in Lower Hutt.)

- Perhaps we could have the NZTA WTOC unit assist WElectricity to assess the correct light level, by repeating my exercise and monitoring car headlights on the Esplanade outside the Petone WElectricity Light Sensor. This may be a good place to start.

- The NZTA WTOCnow has a full array of traffic cameras covering the region in far more detail. All under constant monitoring conditions.

- The NZTA may be able to provide additional and more appropriate LUX data to WElectricity via say sensors at Traffic Signals, Active Traffic Management Signs (ATMS) or visual CCTV, communicating via Sydney Coordinated Adaptive Traffic System (SCATS) or otherwise.

- Would it be wise to consider artificially advancing the "ON" time for the week following the end on Daylight Saving? Crash Analysis System (CAS)research project?

- Having too many sub-systems separately switched can be an issue for the network company WElectricity. It leads to too many *"Why aren't my street light on yet, when others are?"* complaints.

CONCLUSION

The current system of street light illumination is outdated and in urgent need of improvement. As the system covers several Road Controlling Authorities, NZTA should take the lead role in implementing the necessary changes.

There would be an incremental cost for energy usage.

RECOMMENDATIONS

Now

- Have WElectricity raise the Lux Trigger to the pre Power Crisis level of ~140/150 Lux a trial period.
- Have NZTA WTOC repeat the *90% headlights-on* trial for the same period for the same trial period. Consider a parallel travel time survey
- Consider a travel time survey to determine if poor illumination disrupts the steady flow of traffic.
- Do some analysis to see if travel times improve and/or crashes diminish.
- Have the electrical engineers review the trigger mechanism methodology with the possible aim of adding additional automatic sensors or manual methods (WTOC CCTV observations and a telephone call to WElectricity may be a very practical solution?)

Longer Term
Gather a working party together to investigate

- More Lux Trigger Locations (MetServices may be able to help?)
- Early Start lighting on Arterial routes, *(with data gathered from ATMS Signs and Traffic Signal Lux sensors? Most of which are located on the key arterial routes).*