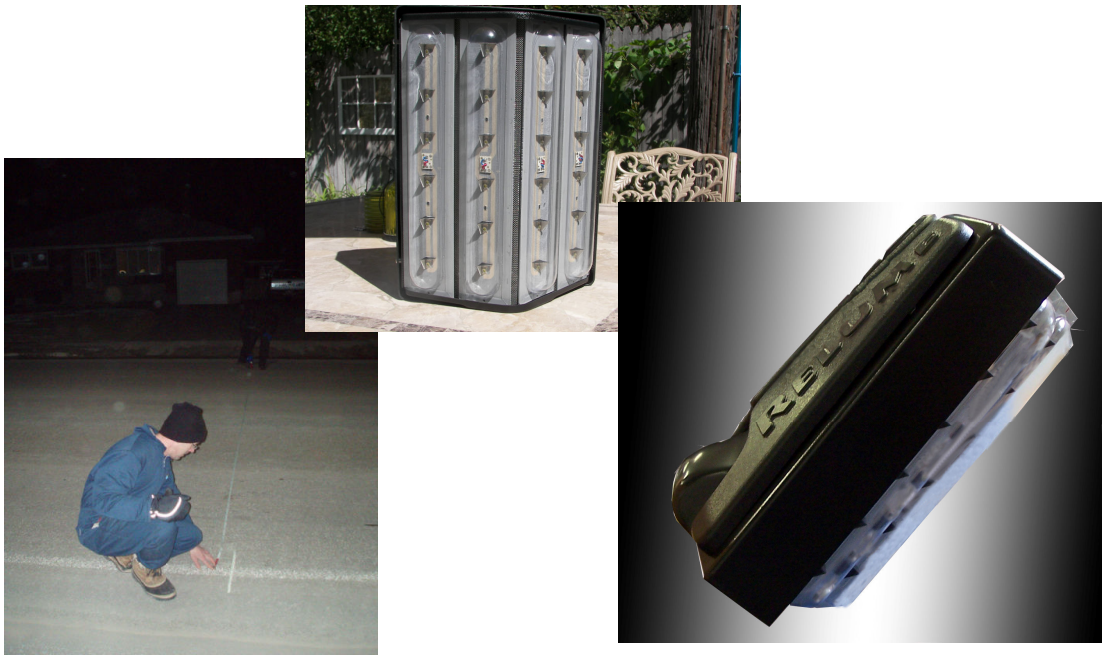
City of Welland
Light Emitting Diode (LED)
Streetlight Installation on Fitch Street

Review of Technical and Public Perception Analysis
Summary Report

March 5, 2008



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1. Fitch Street LED Streetlight Installation Background

City of Welland took the initiative to address exterior roadway lighting needs along Fitch Street. 47 Lumecon Type 3 Distribution LED fixtures provided by Relume were installed along Fitch St between South Pelham Street and Prince Charles Drive North. The LED installation provides lighting in commercial, school and residential zones along Fitch Street. As a result, The City of Welland is is now host to the largest LED roadway installation in Canada.

The installation was completed in November of 2007. LED fixtures were placed on existing, evenly spaced, poles along the street. Two versions of the Lumecon fixtures were installed; the R30 fixtures were placed in front of the commercial plaza and the R20 fixtures were installed along the remainder of the road. The R20 version uses 90 watts while the R30 uses 120 watts and have an average life rating of 70,000 hours.

2. Evaluation Scope

greenTbiz completed the following activities in order to review the photopics and scotopic performance of the LED luminaires:

1) Third Party Validation of the lumen output, lumen depreciation and colour temperature of the LED luminaire. This included a comparison between the LED and the original high pressure sodium (HPS) luminaires where appropriate. This process included on-site testing and lab analysis.

2) Public Perception Analysis and Survey. An online surevey was made available via the City of Welland and greenTbiz websites. In addition, door-to-door surveys were conducted along Fitch Street in the residential and commercial areas.

3. Summary of Third Party Validation

Lighting Sciences was contracted by greenTbiz to complete the third party technical validation. Lighting Sciences completed the on-site testing on February 21, 2007 and the lab testing in late January 2007. The testing was conducted on R30 and R20 models after 1000 hours of use and compared with a new R20 fixture. The full technical validation report from Lighting Sciences can be found attached to the current report (Appendix A).

In summary, the following highlights the significant findings from the technical validation report:

- The luminaires are classified as Type III, very short. This will require poles to be close together or in future, would be placed closer together.
- As the luminaires has a full cut-off rating, they are Dark Sky compliant.
- The lumen output is relatively low for a roadway luminaire. The luminaire contains 24 CREE XRE LEDs contained within, running at 1 amp.

- The correlated colour temperature (CCT) is 7,000K. This could be considered high for nighttime applications due to intensity related to mesopic vision at night. Otherwise, as daylight (D65) is 6500K, it is relatively close to daylight.
- There was no lumen depreciation at 1000 hours. There was an acceptable increase in lumens at 1000 hours, which was verified in the report.
- With respect to the R20 model luminaire, the CCT shifted from 5991K to 7005K, which is both noticeable and requires a technical explanation. CREE colour stability at 1 amp needs to be defined and explored further with the manufacturer as to whether this is practicable.

4. Summary of Public Perception Analysis

The purpose of this survey is to understand the community's opinions regarding the LED streetlight installation along Fitch Street in Welland. Door-to-door surveys were conducted along Fitch Street on January 22nd and January 23rd, 2008. Additionally, an online survey was available through the City of Welland and greenTbiz websites between December 5th, 2007 and February 23rd, 2008.

The door-to-door surveys were conducted with 66 residents of Fitch Street and 8 business owners/managers/employees working in the commercial properties on Fitch Street; resulting in a total of 74 door-to-door surveys. In total, 123 online surveys were attempted.

The survey results demonstrate that 73% of all respondents prefer the new LED streetlights, while 17% prefer the old HPS streetlights and 10% have no preference between the two types of streetlights. The most cited reasons for preferring the LED streetlights are: energy savings, cost savings, brighter light, whiter colour and decreased glare. The respondents that prefer the old HPS streetlights say that LED is not bright enough and decreases visibility, produces a patchy distribution resulting in dark patches along the road, sidewalk and yards, and as a result, poses a safety hazard to drivers, pedestrians and residents.

When asked if their opinion of LED streetlights would change if they were told that LED streetlights use 50% less energy than traditional HPS streetlights and thus would reduce environmental impact as well as the city of Welland's electricity cost, 61% (22 of 36) of respondents answered no. Reasons for this response include the opinion that LED streetlights do not provide enough light and pose a safety hazard due to reduced visibility. 25% of respondents stated that their opinion of this technology may change if LED streetlights could give off more light than they currently do and would not pose a safety hazard.

36.5% of respondents believe that the amount of light on Fitch Street has improved with the LED installation. Alternatively, the same percentage (36.5) of respondents believes that the amount of light on Fitch Street has not improved with the LED installation. 27% of respondents are unsure if the amount of light has improved or not.

Furthermore, the results demonstrate that 44% of respondents believe that the LED streetlights improve the quality of light on Fitch Street. Less glare, improved colour, increased brightness and visibility were among the top reasons for this finding. 30% of respondents believe that the quality of light has not improved citing that LEDs provide insufficient light and a patchy, uneven illumination.

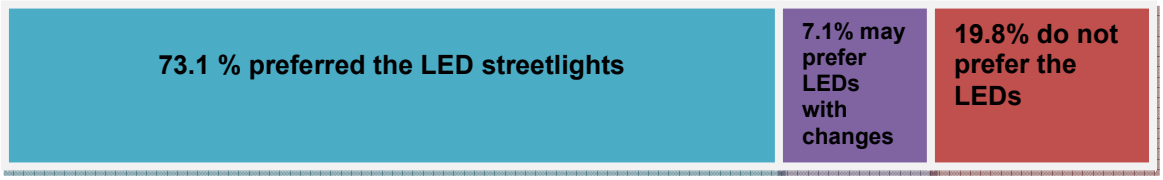
When asked about safety, 69% of respondents do not feel safer under the LED streetlight, while 31% feel an increased sense of security with the new LED streetlights. It should be noted that many respondents do not believe there to be a relation between streetlights and personal safety.

57% of respondents believe that LED streetlights have positive effects. The most common positive effects mentioned include, decreased operational costs, decreased energy consumption, aesthetically pleasing, reduced glare and decreased light pollution.

47% of respondents believe that LED streetlights have negative effects. The most common mentioned include, LEDs do not give off enough light and they produce dark patchy areas due to uneven distribution of light, all of which result in decreased visibility and safety.

When asked if they would be in favour of the City of Welland changing all of the streetlights to LED 64% (89 out of 140) respondents answered yes, 21% (30 out of 140) answered maybe and 15% (21 out of 140) answered no for reasons aforementioned.

In summary, the general public perception of the LED streetlight installation can be summarized by the following visual depiction:



6. Appendices

Please find attached as the following electronic documents:

- Appendix A: Report from Lighting Science.
- Appendix B: Complete Public Perception Analysis Findings.