City of Bellingham
210 Lottie Street
Bellingham, WA 98225

MEMORANDUM

TO:	BELLINGHAM CITY COUNCIL
	KELLI LINVILLE, MAYOR
FROM:	TED CARLSON, PUBLIC WORKS DIRECTOR
SUBJECT:	STREET LIGHTING LED RETROFIT PROJECT UPDATE
DATE:	JULY 15, 2019

BACKGROUND

On April 13, 2015, the City Council authorized a project to retrofit approximately 3,600 city owned street lights with solid state light emitting diode technology (LED).[1] The primary purpose of the project was to reduce energy consumption and thereby reduce the City's impact on climate change. Policy basis for the project was established in the 2007 with the Climate Action Plan[2].

Based on standards used by other municipalities[3], WSDOT[4] and the US Department of Energy,[5] as well as recommendations from lighting experts hired for the project, LED's streetlights of various styles were installed to match existing high pressure sodium (HPS) lights utilizing a 4,000K color correlated temperature (CCT) range. This industry standard for LED streetlighting was established based on longevity of LED fixtures available at the time; scientific research on driver and pedestrian reaction time and response to street lighting[6]; and public perception of the appearance of lighting.

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[1] City Council Action Agenda, April 13, 2015.

[2] City of Bellingham Climate Action Plan, 2007

[3] Seattle LED Adaptive Lighting Study NEEA, May 29, 2014 Northwest Energy Efficiency Alliance Report #E14-286, Clanton & Associates.

[4] https://www.wsdot.wa.gov/Design/Traffic/ledluminaires.htm

[5] Municipal Solid State Street Lighting Specification for LED Roadway Luminaires, July 2014, https://www.energy.gov/eere/ssl/model-specification-led-roadway-luminaires

[6] Visual Performance as a Function of Spectral Power Distribution of Light Sources at luminances used for General Outdoor lighting, Alan L. Lewis Michigan College of Optometry, Journal of the Illuminating Engineering Society, Winter 1999.

With rapid adoption by many municipalities across the United States, LED streetlights have curried both fans and detractors. Mainstream media outlets reported on fears related to health concerns, wildlife impacts, dark sky impacts and aesthetics[7]. Many of the reports conflate street lighting with interior lighting and reduce complex issues to short internet friendly, attention grabbing statements resonating in all corners of the internet echo chamber. Independent and academic research by the Federal Highway Administration[8], the US Department of Energy[9],[10], the Illuminating Engineering Society[11,12] and the Pacific Northwest National Laboratory[13] has added to the factual knowledge base on the use of LEDs for street lighting. Additional research has been conducted on how the wavelength spectrum generated from LED streetlight is processed by the human eye. This research has led to new industry guidelines for specifying and manufacturing LED fixtures[14]. Further advances in LED manufacturing technology have increased the efficiency and longevity of LED fixtures in a wider range of options.[15]

In addition to changing the lights from high pressure sodium (HPS) to solid state lighting technology the project also added an adaptive, smart streetlight communication and control system. The control system was intended to further reduce power consumption through adaptive dimming of the lights when not needed.

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[7] Council on Science and Public Health, CSAPH Report 2-A-16 & American Medical Association Health Policy H-135.927 2016.

[8] Evaluation of the Impact of Spectral Power Distribution on Driver Performance, FHWA publication No. FHWA-HRT-15-047m August 2015

[9] Solid State lighting Technology Fact Sheet, US Department of Energy

[10] Street Lighting and Blue Light, Frequently Asked Questions, US Department of Energy February 2017

[11] Illuminating Engineering Society Board Position on the 2016 AMA Policy H-135.927

[12] IES TM-30-18 ES Method for Evaluating Light Source Color Rendition

[13] An Investigation of LED Street Lightings's Impact on Sky Glow, US Department of Energy, Kinzey, Perrin, Miller, Kocifaj, Aube, Lamphar, Contract DE-AC05-76RL01830, April 2017

[14] IES TM-30-18 ES Method for Evaluating Light Source Color Rendition

[15] Narrow Band Spectra and Options- Opportunities and Challenges, CREE, Paul Fini November 2017.

Connections to the City's computer network would have been through a combination of radio frequency and power line communications. The control system was also intended to provide information on the status of each individual light streamlining maintenance and operations.

CURRENT STATUS

All City owned streetlights were retrofit with LED technology by 2016. All new streetlights installed since then have used LED technology. In addition, the City is paying PSE to convert PSE owned streetlights to LED technology. With the addition of the LED streetlights, the power consumption for street lighting was reduced by nearly 40% and has contributed significantly to the City's efforts to reduce its climate footprint.

The control system was installed concurrently with the LED retrofit but has not met expectations. From the outset, the control system has had continuing issues related to communications. Many of the fixtures could not communicate with the lighting network. The contractor attempted repeatedly to fix issues, but after several years has not been able to provide a working product to the City as promised. Citizens have repeatedly observed streetlights turned on during daylight hours. This is a direct result of the failed control system which defaults to "on" when communications are lost. In addition, the hardware for the control system has significant reliability and longevity issues. The company that supplied the control system was recently acquired by a larger corporation who announced it was discontinuing the product line. This means the City would not be able to expand the controls to new street light systems and would have limited if any product support moving forward. Based on this information, the City notified the contractor that the system did not meet the contract specifications and requested a correction. The correction is to remove the control system and install a standard photocell on each light.

NEXT STEPS

The contractor is responding to the City's request. Making the change presents possible options for the City.

Installing photocells eliminates the ability to dim streetlights which will not be an operational issue for the majority of standard street lights (e.g. cobra heads, shoeboxes). The change involves replacing the control module with a standard photocell. The change will not affect the LED's in any way.

Removing the control system from roughly 350 decorative fixtures requires additional work. The decorative fixtures have the control system integrated with the LEDs. Removing the controls means a custom installation of a driver on each fixture. Modifying the fixture voids future warranty protections.

When the LED retrofits were installed, the decorative fixtures proved problematic with noticeable glare. This was not observed to be a problem using the HPS lamps as the light produced was in a very narrow wavelength band and produced a low illuminance. Many nearby residents expressed concern about the perceived color and requested a lower temperature light. The problem is related to several factors and not solely the LED CCT rating. Staff acquired a lower temperature LED (3000K) test retrofit, however the perceived color difference made no difference in the glare largely due to the decorative housing itself. The decorative fixtures also do not provide effective light at street level and do not have internal cutoff or shielding capabilities. This results in unnecessary light pollution and perceptions of glare or excessive brightness.

It is possible to replace the LED fixture entirely rather than removing the controls and installing custom modifications. Replacing the LED fixture will be more expensive to the City than installation of a custom driver. Replacing the LED fixture entirely facilitates using a lower temperature LED (approx. 2700k).

The decorative fixtures are considered pedestrian scale lighting in the Fairhaven and Downtown business districts. Many of the decorative fixtures are installed on residential streets with low pedestrian traffic and do not provide the illuminance level meeting arterial street lighting standards and are considered purely decorative. While adding aesthetic ambience, they do little to provide street lighting for pedestrian or vehicle safety. Since the primary goal of the project is to reduce energy consumption, removal of unnecessary lights may be worth considering.

The contractor has responded to the City's notice of default on the control system with a contract change order proposal with options summarized as follows:

Option #1 – Remove control system, install photocells on all streetlights. No change to existing conditions. Decorative fixtures remain at current light output and 4000K CCT. NO WARRANTY on 350 decorative fixtures. Net refund of approximately $250,000 – No change to climate impacts

-Or-

Option #2 – Remove control system, install photocells on all streetlights, CONVERT 350 decorative fixtures to a retro-fit LED kit with warmer color 2,700K CCT, full cut-off light distribution and 10 yr. warranty. Net Refund of approximately $50,000) – No change to climate impacts

-Or-

Option #3 – Option #2 plus explore removal of any decorative fixtures on low volume vehicle/pedestrian residential streets. (refund and costs are unknown) --Removal of unnecessary decorative streetlights results in less power consumption and less maintenance – minor benefit to climate impacts.

Direction from the Council is needed on which of the three options best meets the goals of the City related to Climate Action and budget. Staff recommend proceeding with Option #2.