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MEMORANDUM

TO: Mark Thiel, Assistant Public Works Director

FROM: Jason Hoskinson, BG Consultants, Inc.

CC: David Cronin, City Engineer

DATE: May 20, 2015

RE: Investigation of Solar Powered Street Light Feasibility
23rd Street Lighting Project
BG Project #14-1320L

Background:

The City of Lawrence is currently pursuing a project that will replace the existing wood pole street lights on the north side of 23rd Street (Iowa to Alabama) with decorative street light poles and LED luminaires. The installation will be similar to the street lighting improvements installed on the 23rd and Iowa reconstruction project last year. The purpose of this memo is to describe an option to use solar powered street lights on the project in lieu of the conventional hard wired design connected to the Lawrence electrical grid.

Current Design for Street Lighting (*Wired Design Option*):

The design for the 23rd Street Lighting Project, described as the *Wired Design Option*, includes the installation of 2 metered street light cabinets, 16 new street lights, and underground conduits and wire. The Westar power source will enter the City's street light system at the meter cabinets. Power then branches out to the street lights via wiring in underground conduits. Each street light assembly will include a footing, pole, luminaire arm, and LED luminaire.

Alternative Design for Street Lighting (*Solar Powered Design Option*):

Solar power as the sole source of electrical power to a street light was investigated as an alternative design solution. This concept makes use of a solar collector panel and a battery cabinet mounted on each street light pole. The solar collector panel recharges the batteries when solar conditions allow and the batteries provide a low voltage power source to the LED luminaire. This option, if feasible, could eliminate the need for the metered, street light controller cabinet and the underground conduits and wires. It would also eliminate annual power consumption costs paid to Westar.

The following is a summary of key advantages/disadvantages associated with solar powered street lights as compared to the conventional wired design for street lighting. This list may not be all inclusive and focuses primarily on the advantages/disadvantages associated directly with the application of solar powered street lights on the 23rd Street Lighting Project.

Advantages of Solar Powered Street Lights:

- Provides an element of "green" design to the City's infrastructure.
- Reduced energy consumption costs.
- Underground conduit/wiring installation is not required.
- A meter control cabinet is not required.

Disadvantages of Solar Powered Street Lights:

- The application of this technology to the street lighting market is still fairly new and as a result, the initial equipment costs are relatively high.
- Under the best operating conditions, the light output (lumens) of the solar powered street light assembly package is about one-half (8,650 lumens) the amount of light output of the specified wired design (16,600 lumens) for the specified lights. The quantity of solar powered street lights to be purchased will need to be increased to achieve similar lighting levels as the wired design.
- The batteries in the solar power unit have a limited service life and require periodic replacement.
- There may be days when weather conditions do not allow for a full re-charge of the batteries. The solar powered street lights may be dim or completely off during night-time hours on those days.

Because of the intricacies involved with providing a solar power source to a light pole, the street light assembly (pole, arm, LED luminaire, and solar power unit) will need to be purchased as a packaged product. Add-on or after-market solar power units will void the UL listing and warranty of the lighting components if not assembled and supplied as a packaged product. Additionally, aftermarket solar panel units operate at different voltages than the wired LED luminaire fixtures, requiring additional field wiring to complete the installation.

There are two maintenance items to be considered for the *Solar Power Design Option*. One item is in regards to the battery life. The batteries in the solar power unit will have a shorter service life than the LED luminaire. Depending on the size and type provided, the service life will range from 7-10 years. For comparison purposes, the batteries on the City's traffic signal infrastructure typically provide service for 7-8 years and currently cost about $1,000 to replace.

A second item in the *Solar Power Design Option* to consider is the maintenance efforts and eventual replacement cost of the solar panel itself. Solar panels, while durable and made for these installations, will require City Staff to monitor the panel for cracks, weather-tight seals, and eventual replacement. Costs for staff time, traffic control efforts, and potential replacement, although not quantified in the analysis below, are a factor to be considered when deciding if solar power lighting is a feasible solution.

<u>Benefit-Cost Analysis:</u>

A benefit-cost analysis was performed for the 23rd Street Lighting Project to determine if the use of a Solar Powered Design Option is feasible. The analysis included the estimated initial investment costs and basic operation and maintenance costs for a 15-year anticipated service

life of the LED luminaire. For the Solar Powered Design Option, batteries were assumed to be replaced twice during the 15-year service life.

Initial investment costs:

a. Based on recent bid prices, the estimated cost for initial infrastructure investments for the *Wired Design Option* is $233,345.
b. The estimated cost for initial infrastructure investments for the *Solar Power Design Option* using the same quantity of light poles as the wired design is approximately $285,345. Adding the additional solar powered street lights required to achieve a similar level of light output as the wire design increases the initial infrastructure investments costs of the *Solar Power Design Option* to $525,345.
c. Changing from the *Wired Design Option* to the *Solar Powered Design Option* results in a net increase of $292,000 for initial investment costs.

Operation and Maintenance (O&M) Costs (15-year service life):

a. O&M costs unique to the *Wired Design Option* consist primarily of power consumption costs. The new street lights will consume an estimated 14,000 kW-hrs. per year. The current annual power cost is estimated to be $1,780 assuming the unit cost for power is $0.11 per kW-hr. with a $20 monthly service fee. Over the 15-year life expectancy of the LED luminaire, this equates to a present day value of approximately $21,250.
b. O&M costs unique to the *Solar Power Design Option* consist of replacing the batteries. The batteries are expected to be replaced twice during the 15-year service life which equates to a present day value of approximately $48,000 in material costs.
c. Changing from the *Wired Design Option* to the *Solar Powered Design Option* results in a net increase of $26,750 for O&M costs.

Conclusion:

To achieve a similar level of light output under ideal operating conditions, the present day cost of the project will be approximately $318,750 higher if the *Solar Powered Design Option* is pursued for the 23rd Street Lighting Project. The key factor affecting the cost differential is the inability of currently available solar powered street light assemblies to deliver a similar level of light output as compared to the specified equipment in the *Wired Design Option*. An increased number of solar powered street light assemblies are required to achieve appropriate levels of lighting.

As described previously in this memo, there are other, non-monetary concerns with the *Solar Power Design Option* related to maintenance efforts and street light performance/reliability. Depending on the configuration of the solar power street light assembly, City Staff may have to temporarily restrict traffic on 23rd Street to monitor the condition of the solar power units, replace batteries, and/or reseal or replace the solar panel. The *Solar Power Design Option* also introduces a risk of having lower levels of light output or potentially no light output, particularly during winter months or an extended period of cloudy weather.