The Corporate Project Management Framework

Project Business Case

e2 Energy Efficient Street Lighting Program

THE CITY OF CALGARY TRANSPORTATION

The City of Calgary Project Management Framework

Roads, Traffic Engineering; and Corporate Energy Management Office (EMO)	**Canace Bain, Sr Leader Traffic Design, Traffic Engineering; and Arsheel Hirji, Leader, Sustainable Infrastructure**	**Jun 15, 2014**
Author contact information	Document author name	Document date
Lifecycle & Asset Management	**City-Wide LED Street Lighting Project**	**N/A**
Budget Program name	Project name	Record #
Program 128	**432200 Streetlight Upgrade Mtce**	**10701**
Budget Program #	Project #	Dept ID

1. OVERVIEW

Business Unit (BU) / division responsible	Roads, Traffic Engineering Division
Project Manager (PM)	Michael Gray, Senior Engineer, Street Light Design
PM Contact	Michael.Gray@calgary.ca
Executive summary	The Roads Traffic Engineering Division continuously investigates new technologies to ensure that Calgary's street light system is efficient and effective. There are almost 90,000 fixtures which make up Calgary's street light inventory, consuming more than 90 million kWhs of energy per year at a cost of over $12.5 million. In 2013, Council approved a recommendation for Administration to develop a business case and implementation plan for a street light energy efficiency program as part of the 2015 to 2018 business plan cycle (TT2013-0798). Roads, with the support of the Corporate Energy Management Office, has extensively researched the advancements in light emitting diode (LED) technologies and trials in multiple Calgary communities for 2500 fixtures are underway. Roads has developed detailed specifications to support the procurement of LED fixtures. Based on this work, Roads is confident that recent advancements in LED technologies have improved their reliability and applicability to Calgary's roadways. In comparison to other technologies evaluated (i.e. induction, light emitting plasma, and electronic ballasts,) the use of LED technologies will better enable The City to reduce operating costs related to electricity and maintenance, while reducing light wastage and potentially improving the ability for drivers and pedestrians to see and be seen. The following business case has been developed in support of a recommendation for a proposed city-wide LED street lighting project with an estimated total cost of $32 million. This four year project will enable The City to reduce operating costs by an anticipated $50 million over a ten year period, demonstrating a simple payback period of approximately six years. The associated benefits exceed the preliminary estimates completed in 2012. Three funding options have been identified to address the capital costs of the project. Combined with a variety of mitigation measures, Capital funding is recommended as it is associated with the lowest overall risk in comparison to utilizing third-party funding

	agents.
Project location	City-Wide
Location identifier	**M (Multiple Sector)**

	2015 / NW	2016 / NE	2017 / SE	2018 / SW
Approximate Quantity of Fixtures	25,000	15,000	20,000	20,000
Total Fixture Count:				Approximately 80,000

Project type	**U - Upgrade**

Form modified by / contact info.	Changes made	Date modified
Arsheel Hirji, EMO	Draft Version 1.0	Jun 09, 2014
Canace Bain, Roads	Draft Version 2.0	Jun 24, 2014
Michael Gray, Roads	Final Draft	Jun 24, 2014
		Click here to enter a date.

2. OPPORTUNITY

Strategic policy alignment	The 2015 to 2018 Transportation Action Plan will include multiple strategies, performance measures and targets related to transportation system efficiency, energy management, and asset management. The recommended scope of the LED street lighting program will significantly contribute towards achieving many of the objectives of Transportation's Action Plan, in addition to the Calgary Transportation Plan (CTP), Municipal Development Plan (MDP), 2020 Sustainability Direction (SD), and imagineCalgary (iC) goals, including: • **CTP Goal #6:** Advance environmental sustainability to reduce the impact of travel on the environment by reducing energy consumption and greenhouse gases. • **CTP Goal #7:** Ensure transportation infrastructure is well managed to promote efficiency, preservation, value and a healthy environment. • **MDP Goal:** Conserve, protect and restore the natural environment by optimizing infrastructure to reduce the demand for non-renewable energy resources. • **2020 SD Goal:** Sustainable Environment: The protection of air, land and water is recognized as critical for achieving health ecosystems within Calgary and this understanding is applied to the way we grow and operate as a city. • **iC Target 67:** By 2036, energy consumption is reduced by 30% based on 1999 use
Scope statement	In order to address the increasing cost to operate Calgary's street lighting system, a citywide LED street lighting conversion program is proposed for the 2015 to 2018 Action Plan. This program will address up to 80,000 non-decorative, cobra head mounted, high pressure sodium street lights ranging from 100W to 400W. Current LED technologies are best suited to address these specific fixtures.
Expected benefits	• Alignment with strategic policies, targets and goals (see above); • Reductions in electricity consumption and associated costs; • Reductions in preventative maintenance costs; • Potential improvements in lighting levels and quality, thereby improving the ability for citizens to see and be seen; and a • Reduction in light wastage through trespass and uplight, thereby reducing light pollution.

<table>
<tr><td>Preliminary stakeholder identification</td><td>
<table>
<tr><th>Stakeholder Group</th><th>Roles & Contributions</th></tr>
<tr><td>Transportation GM's Office</td><td>Review and approve project business case and project plan; and
Review and approve all project update reports to Council</td></tr>
<tr><td>Roads Director's Office</td><td>Review and approve project business case and project plan; and
Review all project update reports to Council.</td></tr>
<tr><td>Manager, Roads, Traffic Engineering Division</td><td>Review and approve project business case and project plan;
Review all project update reports to Council; and
Review and approve project Communications Plan.</td></tr>
<tr><td>The Project Team, including:
Sr. Leader, Traffic Design (Sponsor)
Sr. Engineer, Streetlight Design
Project Manager
Street Lighting Technologist(s)</td><td>Complete all required project initiation and execution documents (including Project Charters, Business Cases, Project Plans, Progress Reporting, etc…)
Coordinate project activities including the preparation of requirements specifications; and detailed designs and material procurement;
Select and manage 3rd party services including material suppliers and construction contractors;
Prepare Committee/Council reports; and
Provide information and updates to management team, Council, and members of the public.</td></tr>
<tr><td>Corporate Energy Mgmt. Office</td><td>Complete billing adjustments and tracking of electricity savings (consumption savings and cost); and
Provide continued technical support to the Project Team where required.</td></tr>
<tr><td>Suppliers/ Contractors (TBD)</td><td>Provision of LED luminaires and all associated hardware (Supplier)
Receiving of LED luminaires;
Scheduling and coordination of installations; and
Management and provision of data regarding installations and field inventory of luminaires.</td></tr>
<tr><td>City Council</td><td>Review project business case and project plan and accept/reject recommendation;</td></tr>
<tr><td>Public</td><td>Participate in public information session and provide comments on LED street lighting in Phase 1 conversion areas.</td></tr>
</table>
</td></tr>
<tr><td>Proposed start date</td><td>January 2, 2015</td></tr>
<tr><td>Estimated duration</td><td>2015 through 2018 (4 years)</td></tr>
<tr><td>New resources required (number of FTE's)</td><td>Potentially up to 1 FTE as a project manager</td></tr>
<tr><td>Change in City owned asset</td><td>This project adds TCA assets in the following category: 3RNSTLLMZZ Engineered Structures - Road Network Street Lights Luminaries and Lamps; This project will also retire TCA assets in the same category.</td></tr>
<tr><td>Impact on Tangible Capital Assets (TCA)</td><td>Increase in the total value of the assets</td></tr>
<tr><td>Project history</td><td>In 2012, Council approved a recommendation for Administration to develop a business case</td></tr>
</table>

	and implementation plan for an energy efficient street lighting project in the 2015 to 2018 business plan cycle (TT2012-0343). Although a specific energy efficient technology was not recommended at this point, the recommendation was informed through an initial small-scale trial of LED street lights in the neighbourhood of Brentwood. In 2013, Administration delivered a project update (TT2013-0798) specifically identifying LED technologies as the most feasible technology to achieve the greatest energy and maintenance cost savings. This report also outlined the detailed design approach to be undertaken to support achieving targeted levels of illumination on roadways and sidewalks. Over 2014, the Project Team developed and issued an RFP for LED street lighting. These fixtures are in the process of being installed in a number of Calgary communities (over 2,500 fixtures across all quadrants).
Business need	In addition to addressing Calgary's longer-term vision for an efficient and sustainable transportation system, the potential to reduce the cost to operate Calgary's street light system is the primary driver behind introducing more efficient technologies to light Calgary's roads. In 2013, City street lights consumed over 90 million kWh of electricity at a cost of $12.5 million. By 2020, consumption is estimated to increase compounded by increasing costs per unit. The total electricity costs to operate Calgary's street lighting system are forecast to increase to over $16 million per year by 2020. In addition, annual preventative maintenance programs addressing the 8-year life cycle of high-pressure sodium bulbs are associated with a $600 thousand annual capital cost.
Economic	Estimated total savings of over $50 million (over 10 years).
Social	Potential increases in the levels and quality of light on Calgary's roads and sidewalks
Environmental	Decrease in trespass of light into private properties; Decrease in light wastage (uplight), helping darken Calgary's skies.

3. DECISION

Assumptions	Cost of materials will not increase over the 4 year project period; Cost of labour will increase by 3.5% per year over the 4 year project period; Qualified installation contractors will be available to complete the specified work annually; Forecast for transmission/distribution cost increases are accurate, thereby ensuring benefits per kWh of electricity saved is also accurate.
Options analysis	**The following options analysis has been determined based on a 10-year cash flow analysis. Recommended Options are identified with an asterisk (*)**

Description	Assessment of Project/Program Benefits	Cost Implications
1. Do-Nothing Further *Suspension of any further conversions of street lights to LED technologies*	No new funds are required	Operating budget for street lighting will continue to increase due to an annual increase in consumption, the electricity costs per unit, and increases in the

		cost of preventative maintenance programs. Costs for energy will increase to over $16 million by 2020.
2. Status-Quo Scenario *Completing approximately 2,000 fixtures per year using the existing base budget.*	No new funds are required	Electricity cost savings realized due to the installation of up to 20,000 fixtures by 2024, preventative maintenance programs on HPS fixtures continue. $9 million in estimated energy savings over 10 years
3. City-Wide Implementation Scenario* *Conversion of up to 80,000 street lights with LED technologies over the 4 year Action Plan period.*	An estimated $31 million in new funds are required over the period spanning 2015 through 2018	Electricity and preventative maintenance cost savings realized due to full-scale conversion program. Over $50 million in cumulative estimated savings over 10 years.

Three options are available to fund a citywide conversion program and are described below.

Financing through the capital budget for 2015-2018 budget cycle is recommended as this option would not require repayment and the City would immediately realize operating cost savings. These savings will offset both the growth in the amount of fixtures in The City and the potential increase in electricity costs over the project. In addition, the operating savings realized would be used to fund much needed upgrades to the existing streetlight system, included critical pole replacement and underground fault repairs.

Funding sources such as gas tax transfers and Green Trip funding have also been excluded due to the ineligibility of street lighting related expenses under these programs.

Administration is continuously seeking other incentives and grant opportunities through the provincial and federal governments.

External financing options, including manufacturer assisted financing were considered but are not recommended as The City is approaching the Council approved debt ceiling. In addition these financing options entail higher costs in comparison to internal financing options.

Internal project financing, with the potential operating cost savings associated with a

citywide LED street lighting program being used to repay the capital borrowed, could be considered as well as reallocating capital funds from other sources.

Risk analysis of Recommended Options

Option	Risk Description	Risk Severity	Risk Likelihood
1: Do Nothing	Reputational risk associated with the increasing costs of operating Calgary's street lighting system and the associated tax rate impacts.	High – Due to the unmitigated increase in costs.	Medium
2: Status Quo		Medium – due to the partial mitigation of costs through a smaller scale project.	Medium
Mitigation Strategy:	A larger scale, city-wide LED conversion program is recommended to mitigate the rising costs of operating Calgary's street lighting system.		
3. City-wide LED implementation	Reduced night-time power usage could create an increase in the commodity price for the Corporation	Medium	Medium
	Some additional retrofitting will be required, including rewiring, as installations are being undertaken.	Low	Medium – based on City of Edmonton Experience
	Construction cost escalation over time	Low	High
Mitigation strategy: reduced night-time power usage could create an increase in the commodity price for the corporation	The cost of electricity is impacted by factors that are partially within the control of The City and external factors under the jurisdiction of regulatory agencies. The City's electricity commodity price is contracted through an Electricity Services Agreement. The contracted rate may be impacted as the consumption of lesser expensive, "off-peak" electricity is reduced. This can be mitigated through a corporate approach of load shaping, where, reductions in off-peak electricity are balanced with reductions in peak consumption. The proposed Corporate Energy Strategy and the Transportation Energy Management have identified opportunities that will contribute towards load shaping. Electricity distribution costs are regulated in Alberta and are not within the control of The City. In order to address the potential variability in pricing, the EMO, along with Intergovernmental Affairs have developed a forecast in consultation with regulatory agencies and ENMAX		
Mitigation	The cost of borrowing is also considered in the benefit cost analysis		

	strategy: Cost escalation of fixture and constructions	in addition to appropriate capital contingencies (10% of capital costs) thereby ensuring the benefit cost analysis is more accurate. Implementing an annual RFP approach to procurement may also contribute to higher rates of return due to anticipated lower material costs achieved through increased buying power.
	Mitigation strategy: Risk poor condition of existing infrastructure	Retrofitting of existing infrastructure is included in the business case based on the City of Edmonton's experience .
Municipality benchmark analysis	Not Applicable. It is important to note that municipalities across Canada and the United States have began implementing LED technologies in larger quantities (due to the technologies recent maturity) as a means by which to reduce the costs of operating municipal street lighting networks.	
Cross-dependencies	Dependency of other Roads/City projects including major projects impacts the same resources. This will be partially mitigated by the addition of a full time staff member to manage the proposed project. The operating cost savings enabled by implementing LED street lighting technologies will also assist Roads in off-setting growth over the 2015 to 2018 business cycle	
Success criteria	100% of suitable luminaires are completed in 4 years. The payback period of 10 years or less for the project is achieved. Replacement of poor condition poles occurs in conjunction with luminaire replacement where "Critical Pole" replacement budget allows.	
Recommendations	To proceed with a citywide implementation of LED technologies on applicable poles over the 2015 to 2018 business cycle, funded through the capital budget for the 2015-2018 budget cycle.	
Constraints	**1. Performance:** Roadway lighting levels will achieve Transportation Association of Canada (TAC) recommended lighting levels for the road classification if possible. Alternately lighting levels will be equivalent or better than existing levels. **2. Time:** The project should be completed within the 4 year business cycle to avoid the loss of potential savings. Also, there are dependencies on other Roads/City projects which impact the same resources. Workload of all project types often exceeds resources. Timing of projects with other BU's and Capital projects in order to minimize disruption and eliminate open cuts in new pavement are also considered in scheduling these projects. **3. Cost**: The budget has been determined through a smaller scale RFP; additional cost savings may be realized due to the size of the procurement.	

Provide details (below in $000's)

$32,310
CLASS 2 - DETAILED DESIGN (Expected veriance -15% to + 20%)
Using the contingency classification tool, this project was determined to have a score of 17, therefore a contingency of 15% has been applied.

G	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
	Provide details below ($000's)										Total
	$ 1,210	$ 725	$ 1,055	$ 1,105							$ 4,095
	$ 7,000	$ 4,300	$ 6,000	$ 6,000							$ 23,300
	$ 5	$ 5	$ 5	$ 5							$ 20
	$ 5	$ 5	$ 5	$ 5							$ 20
t	$ 190	$ 190	$ 190	$ 190							$ 760
	$ 1,245	$ 750	$ 1,065	$ 1,055							$ 4,115
n)	$ 9,655	$ 5,975	$ 8,320	$ 8,360	$ -	$ -	$ -	$ -	$ -	$ -	**$ 32,310**
	1	1	1	1							

ATT

An estimated range of operations and maintenance (O&M) cost savings associated with the LED conversion program are summarized in the table below. These savings were estimated as follows:

Potential electricity savings (kWh): Based on the results of an RFP for LED street lighting, the average energy consumption ratings for LED fixtures that would replace high pressure sodium fixtures ranging from 100W to 400W were determined. The City's geospatial database was referenced to determine the quantities of fixtures eligible for conversion to LED. The annual amount of electricity consumed by these eligible fixtures was determined (baseline scenario) for each year, starting in 2015. The annual amount of electricity that would be consumed if these fixtures were converted to LED, based on the proposed installation schedule was then determined (project scenario). By taking the difference of these two scenarios, the annual electricity savings potential was determined.

Electricity unit price ($/kWh): A range in potential electricity unit costs over a 10 year period was provided by the Corporate Energy Management Office. Although electricity is procured under contract through an Electricity Services Agreement (2009), transmission/distribution charges are regulated in Alberta. With the Province's commitment to expanding Alberta's electricity transmission infrastructure, there is a high likelihood of annual increases in the cost of electricity to consumers across the province. Therefore, a range in unit costs was determined by no annual increases in transmission/distribution related costs for a conservative estimate. The higher end of the range was determined by forecasting the potential increase in electricity transmission/distribution costs

Annual preventative maintenance savings: Other savings include the discontinuation of a preventative maintenance program that addresses bulk street light bulb replacements (10,000 + units per annum).

Load shape adjustment factors: Introduced in the risk analysis section above, there is a potential that business units across The City may bare increased utility costs due to the proposed project. This is due to the impact on electricity costs as a result of a significant change in the amount of electricity that will be consumed during typically lesser expensive, off-peak hours. The City's Electricity Services Agreement specifies "load-shape adjustment factors" to the electricity commodity rate as changes occur in the quantity of electricity consumed and the time at which it is consumed. Load shape adjustments are determined at the beginning of the each calendar year and are determined by evaluating a number of factors in comparison to the terms specified in the Agreement. These factors include how much electricity was consumed in the previous year, when electricity was consumed, and what the market price of electricity was in comparison to the contracted rate. This adjustment approach is used as a means by which to address risks associated with forecasting electricity consumption and ensures that lower commodity prices are paid up front as the risk of inaccurate forecasting is insured.

A preliminary estimate of this adjustment indicates that the corporation could experience up to a $2 million increase in annual electricity costs (by 2019) as an adjustment to a significant change in load shape. This annual adjustment is an estimate and is directly related to the impact on electricity demand associated with the growth in service, new infrastructure, and energy efficiency measures approved in the 2015 to 2018 business plan and budget.

Associated O&M Savings & Costs	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
	(000's)										Total
Electricity (Conservative Rates)	$ 1,540	$ 2,430	$ 3,730	$ 5,040	$ 5,570	$ 5,630	$ 5,700	$ 5,700	$ 5,750	$ 5,770	$ 46,860
Electricity (Forecasted Rates)	$ 1,620	$ 2,620	$ 4,120	$ 5,680	$ 6,360	$ 6,580	$ 6,800	$ 6,920	$ 7,060	$ 7,180	$ 54,940
Avoided Group Rebulbing	$ 400	$ 400	$ 400	$ 400	$ 400	$ 400	$ 400	$ 400			$ 3,200
Annual Load Shape Rate Adjustment (Estimated)	-	$ (400)	$ (1,100)	$ (1,600)	$ (2,000)	$ (2,000)	$ (2,000)	$ (2,000)	$ (2,000)	$ (2,000)	$ (15,100)
Total Potential Savings (conservative electricity rate estimates, with load shape adjustment)	$ 1,940	$ 2,430	$ 3,030	$ 3,840	$ 3,970	$ 4,030	$ 4,100	$ 4,100	$ 3,750	$ 3,770	**$ 34,960**
Total Potential Savings (forecasted electricity rate estimates, with load shape adjustment)	$ 2,020	$ 2,620	$ 3,420	$ 4,480	$ 4,760	$ 4,980	$ 5,200	$ 5,320	$ 5,060	$ 5,180	**$ 43,040**
Total Potential Savings (conservative electricity rate estimates - no load shape adjustments)	$ 1,940	$ 2,830	$ 4,130	$ 5,440	$ 5,970	$ 6,030	$ 6,100	$ 6,100	$ 5,750	$ 5,770	**$ 50,060**
Total Potential Savings (forecasted electricity rate estimates - no load shape adjustments)	$ 2,020	$ 3,020	$ 4,520	$ 6,080	$ 6,760	$ 6,980	$ 7,200	$ 7,320	$ 7,060	$ 7,180	**$ 58,140**

The simple payback associated with a city-wide LED streetlight conversion program ranges from 5.6 to 9.2 years, depending on the unit cost of electricity and the extent of the load shape adjustment. Streetlight system growth of approximately 2,500 units each year causes an estimated $360 thousand energy cost increase and is not included in the current Action Plan 2015-2018.