



Calgary

City Auditor's Office

Streetlight Maintenance & Repair Operations Audit

May 14, 2024



Table of Contents

Audit Objective	3
Why it Matters	3
What We Concluded	3
Background	4
Scope & Approach.....	4
Results	5
Observations & Recommendations	9
Acknowledgments.....	12

Audit Objective

The objective of this audit was to assess the efficiency and effectiveness of streetlight maintenance and repair operations.

Why it Matters

Given the significance of streetlighting for appropriate levels of lighting to support mobility, crime prevention, and safety, an effective and efficient operation of streetlight maintenance and repair services is essential to meet objectives and manage risks effectively.

The City of Calgary (The City) has 105,288 streetlight luminaires with asset replacement value of approximately \$1.9B (March 2024).

What We Concluded

The streetlight maintenance and repair processes are partially effective to mitigate key risks and support service delivery.

The City awarded a service contract to a new vendor effective November 2022, and underlying structures to support effective contract management such as contract obligations and key performance indicators (KPIs) have been established. Performance obligations are defined in the Service Level Agreement (SLA) and monitored by the Street Light team. Monitoring and control processes established for preventive maintenance are generally effective, for example, as-built design reviews by the Street Light team. The Street Light team has engaged in benchmarking and other related industry connections to support on-going service delivery improvement.

However, our audit identified changes that are required to better support contract management, particularly timely corrective maintenance and monitoring of associated variable costs. During the audit period, actual response times for corrective maintenance exceeded contractual KPIs by over 400%, which impacts risk mitigation and service delivery. We identified the need for a dedicated contract compliance monitoring process to best support on-going contract management. The current service delivery prioritization and escalation processes do not support timely repairs of the most urgent outages and require review. We additionally identified that the Work Management System (WMS) does not contain sufficient data to support effective repair operations and contract management. Enhancing the completeness of available data and implementing a data review process will better support efficient and effective service delivery and variable costs management by providing The City with enhanced data analytical capabilities and the opportunity for data driven insights.

The Street Light team agrees with the recommendations and has developed action plans to implement process changes by December 1, 2025.

Background

The Street Light team within the Mobility Operations service area of the Mobility Business Unit manages streetlight maintenance and repair operations. Mobility Operations is responsible for designing and operating all traffic control devices including street lighting, while Traffic Operations is responsible for their installation and ongoing maintenance. The team responsible for streetlight repairs and maintenance is known as the Street Light team.

Streetlight maintenance and repair operations include preventive and corrective maintenance of streetlights, lifecycle upgrades, and asset management, including signage and streetlighting coordination. The operating budget for these operations is approximately \$23 million, with maintenance and repair costs representing around 35% of the budget. The performance goals for streetlight maintenance and repair operations are as follows:

- Deliver provision of appropriate levels of lighting within Calgary’s public spaces between dusk and dawn to support crime prevention, vehicle collision reduction and enhance security for pedestrians and communities.
- Maintain an overall infrastructure status of “Good”; with 50% of assets in “Good or Very Good” condition.

As of February 2024, The City has around 105,288 streetlight luminaires with asset replacement value of around \$1.9B. The table below sets out the key performance indicator (KPI) results for 2023:

S#	Description	Results
1	Up Time	99.65%
2	Annual Work Requests	8,686
3	Maintenance Response Time (Average days to repair)	61 days
4	Work Request Escalations	2,508

The City awarded a service contract to a new vendor effective November 2022. The Street Light team indicated that the average response time has improved during the contract, and shared with us that the average response time was 44.5 days in July 2022 (start of the audit period), 61 days in June 2023 (end of the audit period) and 10.3 days by mid-April 2024.

Scope & Approach

The audit focused on the streetlight maintenance and repair operations during the period July 2022 – June 2023.

The audit approach included the assessment of the design and operation of the controls to address risks including:

- Reputational risks arising from non-compliance with contractual obligations and issues in timely service delivery.
- Financial risk due to an increase in variable repair and maintenance costs.
- Governance risk due to inefficiencies in preventive and corrective monitoring and control activities.

This audit did not include a technical assessment i.e., an assessment of physical conditions of streetlight poles or electrical components, design, technology, materials choices etc. or assess the technical quality of repairs and maintenance conducted.

Results

The results of the audit assessment for the efficiency and effectiveness of streetlight repair and maintenance operations and relevant risks-mitigating controls are summarized in the following key areas:

- Contractual Obligations
- Corrective Maintenance
 - Timely Service Delivery
 - Variable Costs
- Preventive Maintenance
- Benchmarking

Contractual Obligations

We assessed the processes in operation to support compliance with contractual obligations related to safety, quality, and reputation. Overall, the contractor adhered to relevant contract terms such as insurance coverage, hazard assessment reports, project site operational health and safety inspections, and progress meetings.

However, non-compliance with contract obligations were noted in project scheduling, mitigation, recovery planning, and notice-to-proceed requirements. These gaps originate from the absence of dedicated compliance monitoring processes (Recommendation 2).

Corrective Maintenance

The monitoring and control activities for corrective maintenance are partially effective in supporting timely service delivery and managing variable costs. Performance obligations are defined in the SLA and monitored by the Street Light team using weekly and monthly reports, progress meetings, random inspections, and as-built design review during payment processing. However, information collected in WMS on repairs is limited, and contract management and monitoring processes also need enhancements to more fully support effective and efficient corrective maintenance.

Timely Service Delivery

We assessed the design and operating effectiveness of processes to ensure timely service delivery.

For the design effectiveness, we reviewed the supplier contract and identified existence of KPIs related to response times for different issue categories, urgency levels, and penalties including performance bond and deductions for deficiencies and delays.

For the operating effectiveness, we reviewed the effectiveness and compliance of KPIs monitoring and control processes. The actual response times exceeded contractual KPIs by over 400%, and penalties were not enforced due to monitoring and accountability challenges. For example, actual average repair time for urgent pedestrian-related (many streetlights out) was 77 days versus a service level agreement of 14 days, exceeding the agreement by 450%.

The Street Light team primarily relies on weekly and monthly reports to track average response time for various categories and issues.

We noted inconsistencies between the service contract and the KPI monitoring reports, such as the absence of percentage response time achievement and differences between repair and response times (Recommendation 2).

We reviewed the current practices for work order prioritization considering the risk factors relevant to the performance goal for provision of appropriate lighting. We noted that the work order scheduling follows a first-in, first-out (FIFO) and geographical approach, with escalations advised by the Street Light team. We observed that the field crew does not differentiate initial escalations from routine work due to high volume of escalations (averaging 37% of work requests from Q4 2022 to Q3 2023). Given the potential negative impact of significant service delays in customer satisfaction, we reviewed the current practices for customer satisfaction concerns and escalation management. The escalation process for delayed work orders could be initiated through 311, the web portal, and internal team communication. However, there are inconsistencies in the available escalation choices. We recommended defining the work order prioritization criteria using customer-centered considerations; and reviewing the escalation and management response processes across all channels. (Recommendation 1)

We identified and verbally communicated with the Street Light team opportunities to review the repair time in service level agreement for possible efficiencies and cost effectiveness (i.e., reduce energy costs by reviewing the agreed repair time for streetlights on during daytime), and to differentiate response time reported in the monitoring reports for routine work and outliers (i.e., customized lights requiring special materials and resourcing).

Variable Costs

As the repair operations are primarily incident-driven due to the nature of services, nearly all the operating costs are variable (i.e., hourly contract rates, materials, equipment, and supplies). We assessed the effectiveness of managing the variable costs by reviewing the processes for operating budget monitoring, variance analysis, contractor invoice review and approval, and trend analysis for repair and maintenance-related key variable cost factors.

We noted that the operating budget monitoring practices are effective. The Calgary Management Accounting Reporting Tool is used to monitor the expenses using activity codes for both operating and capital budgets. A year-on-year financial update including budget, actuals, variance, and explanation is prepared at the Business Unit level.

We noted that the contractor invoices are processed based on their face value, supported by documents and summaries provided by the contractor. The invoices are only reviewed and approved at the transaction level considering historical averages. There is no separate evaluation or periodic audit of the contractor invoice information.

There are various and complex cost drivers for repair and maintenance-related variable costs. For example, repair time rate, type of materials, nature and urgency of repairs, weather conditions. Therefore, effective resource utilization, monitoring,

and control require detailed analysis-driven decision-making. For that, we reviewed the effectiveness of practices to record and utilize periodic trend analysis information by selecting a sample of five monthly costs.

We noted that the details of relevant work orders are inconsistently captured, limiting the capability to analyze cost and time per work order or the nature of the work order. Only 1.68% of work orders have complication note entries, increasing to 4.42% for escalated statuses. Crew notes, intended for City use, are frequently lacking only 269 out of 1314 work requests had crew note entries. Insufficient information complicates effective cost analysis and resource management. (Recommendations 3 and 4)

We reviewed five data entry scenarios involving the 311 team, citizens, the Street Light team, and the contractor. While each scenario has different data entry methods and requirements, data entry guidelines are available for relevant user groups. There is an opportunity to use autofill, standardized drop-down lists, and preventive checks to ensure data completeness to enable detailed analysis (drilldowns), work order classifications (standard and customized), and customer-centered considerations (safety and escalations). These measures can improve analytic capabilities and inform resource allocations by the contractor. (Recommendations 3 and 4)

Preventive Maintenance

Monitoring and control processes for preventive maintenance are generally effective.

The design process and guidelines for streetlights are available online. Designs are reviewed for compliance, and any necessary corrective actions are directed through the workflow and Standard Operating Procedures (SOPs). Quadrant inspectors conduct site visits for design-related information. The findings from these inspections are discussed in monthly safety meetings. The contractor also conducts site inspections. The SLA with the contractor includes reporting updates on asset status and physical conditions.

Pole lifecycles vary based on materials and vendors. Information on pole lifespan, including condition at retirement, is available in the WMS. Preventive maintenance is managed through the Capital Program, utilizing system-based insights and data-driven inspections, outsourced to a third party. The streetlight inspection procedures manual guides these inspections.

Budget constraints currently limit critical pole replacements. Management aims to increase the reinvestment ratio to mitigate safety and reputational risks associated with fallen poles. A project plan/asset report card has been prepared by management, outlining the status, budget requirements, and associated risks in pole management. In 2023, no critical poles fell. The City recorded an average of five fallen poles annually. The following diagram shows the Streetlight poles owned by the Mobility Business Unit (formerly named Roads) ageing across The City.

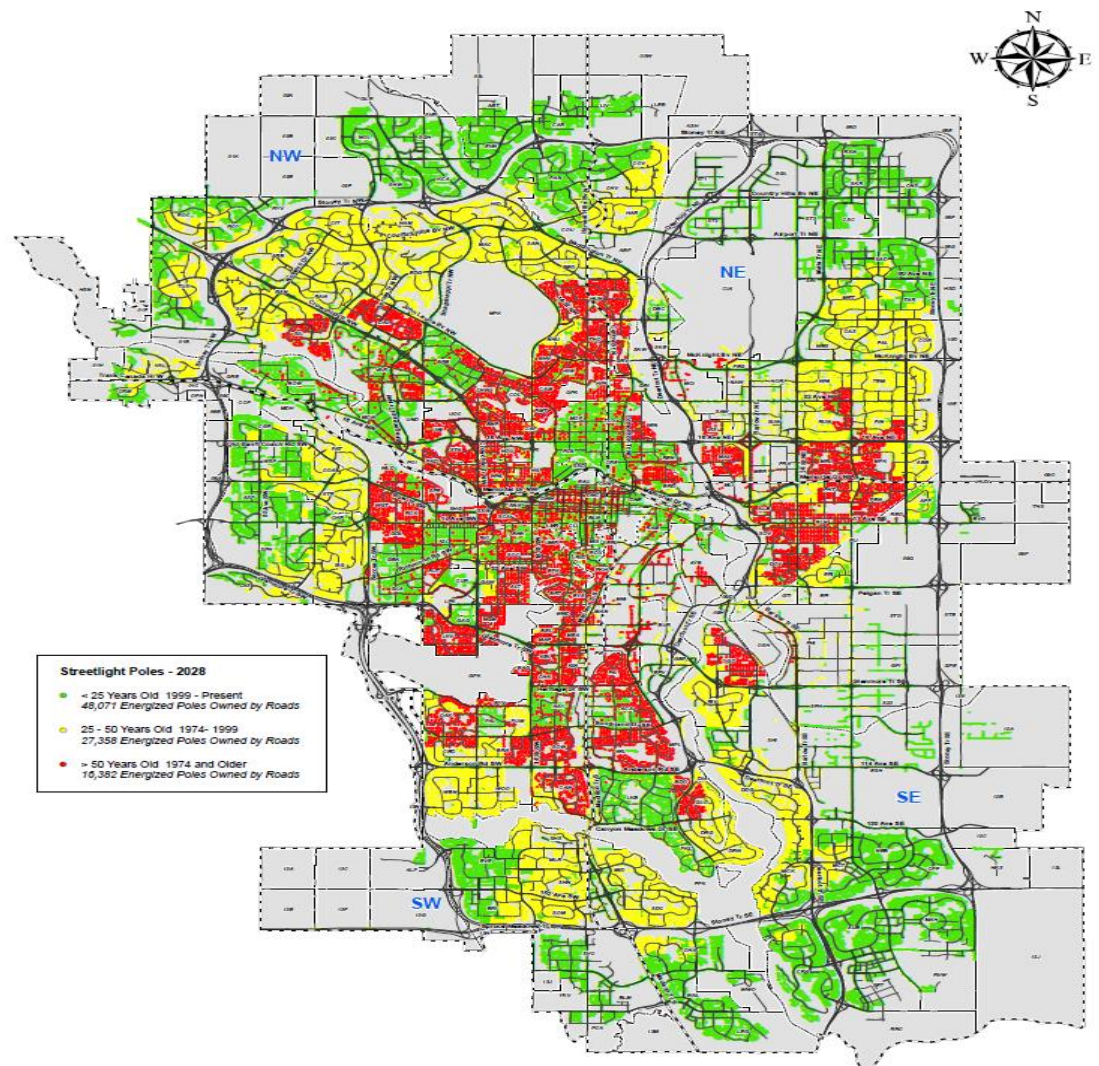


Diagram 1: Streetlight Poles Ageing – 2028

Benchmarking

We evaluated how the Street Light team utilized benchmarking to support risk mitigation and service excellence. The Street Light team effectively engages in benchmarking activities, although obtaining the required information can be challenging. Examples include maintaining a qualified team with membership in the Association of Professional Engineers and Geoscientists of Alberta (APEGA), participating in annual conferences, and collaborating on roadway lighting standards through the Transportation Association of Canada. Also, the City of Calgary is part of the Illuminating Engineering Society (IES). The City's Street Light team evaluates and applies the IES's recommended standards.

Observations & Recommendations

#1: Work Order Prioritization, Resource Optimization and Escalation Process																				
OBSERVATION	RECOMMENDATION																			
<p>The current service delivery prioritization and escalation processes do not support timely repairs of the most urgent outages. Actual repair times significantly exceed the SLA timelines across all types of repairs based on our audit sample:</p> <table border="1"> <thead> <tr> <th>Description (Work Order)</th> <th>SLA Standard Time (Days)</th> <th>Actual Average Time (Days)</th> </tr> </thead> <tbody> <tr> <td>Medium Many Out - Minor Roads</td> <td>21</td> <td>88</td> </tr> <tr> <td>High Many Out - Major Roads</td> <td>14</td> <td>110</td> </tr> <tr> <td>Urgent Many Out - Pedestrian Related</td> <td>14</td> <td>77</td> </tr> <tr> <td>Normal Single Out</td> <td>30</td> <td>83</td> </tr> <tr> <td>High Single Out – Pedestrian Related</td> <td>14</td> <td>76</td> </tr> </tbody> </table> <p>Source: Standard Vs. Actual Average Repair Time – 5 months 2023 (Audit Sample)</p> <p>The contractor relies on a first-in-first-out (FIFO) and geography-based approach to prioritize work order scheduling. The Work Management System (WMS) has work order prioritization capabilities, but defined prioritization criteria have not been developed, instead case by case prioritization is completed by the Street Light team leading to inconsistencies and omissions.</p> <p>Inconsistencies in the escalation process also impact timely issue resolution. The escalation choices across the service request initiation channels varies, i.e., there are three levels of escalations with automated email notification to different levels of management through 311; however, there is only first level of escalation through web portal which only updates the work order status to "Escalated" and does not trigger any additional notifications for attention of the Street Light team. First-level escalations are not generally prioritized, while escalations beyond the first level are handled on a case-by-case basis. From Q4-2022 to Q3-2023, an average of 37% of work requests were escalated or deemed complicated (highest 79% in Q4-2022).</p>	Description (Work Order)	SLA Standard Time (Days)	Actual Average Time (Days)	Medium Many Out - Minor Roads	21	88	High Many Out - Major Roads	14	110	Urgent Many Out - Pedestrian Related	14	77	Normal Single Out	30	83	High Single Out – Pedestrian Related	14	76	<p>1a) The Streetlight Design Leader define the work order prioritization criteria using customer-centered considerations; and</p> <p>1b) Review the escalation and management response processes across all channels.</p> <p>MANAGEMENT RESPONSE</p> <p>Agreed.</p> <p>a) The work order descriptions will be monitored by management to determine where resources should be allocated, and this will be developed into a Standard of Practice. The contractor should have clear direction and work where efficient to avoid unnecessary travel time between sites. A Standard of Practice will be developed for monitoring developer choice projects to push these projects to repair streetlights in a timely manner on job sites where the Street Light team is not the prime contractor. Additionally, a review of the internal organizational structure of the Street Light team will be conducted by the Mobility Operations Manager to identify the resource requirements needed to meet the increasing demands.</p> <p>LEAD Streetlight Design Leader, Supervisor, Street Light Operations</p> <p>SUPPORT: Manager, Mobility Operations</p> <p>COMMITMENT DATE September 1, 2024</p> <p>b) A revised prioritization, scheduling, and escalation management strategy will be developed. This escalation management strategy will incorporate the type of roadway, adjacent land use, pedestrian levels, and special events.</p> <p>LEAD Streetlight Design Leader, Supervisor, Street Light Operations</p>	
Description (Work Order)	SLA Standard Time (Days)	Actual Average Time (Days)																		
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<p>Prioritization and escalation aligned to SLAs better support timely repairs, which in turn support the relevant performance goals of crime prevention, vehicle collision reduction, and security enhancement.</p>	<p>SUPPORT: Manager, Mobility Operations</p> <p>COMMITMENT DATE September 1, 2024</p>
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<p>#2: Contract Compliance Monitoring</p>	
<p>OBSERVATION</p>	<p>RECOMMENDATION</p>
<p>Contract monitoring controls do not fully align to the requirements of the contract.</p> <p>Contractual obligations regarding response time achievement percentages are not included in monitoring reports, which limits the ability of the Street Light team to assess whether response times are being met.</p> <p>Our sample review of contractual obligations identified that the contract requires the contractor to submit a project schedule to support monitoring of substantial performance. However, as the work completed is operational in nature, the Street Light team are instead monitoring the number of work orders completed and holding informal progress meetings (which are not formally documented) with the contractor.</p> <p>Our sample review of contractual obligations also identified that the contract states that should The City determine inadequate progress by the contractor in meeting key milestones or completing the work within specified time limits, The City can demand a detailed recovery and mitigation plan outlining how the contractor will address delays and comply with the schedule. Due to the operational nature of the work, this is not being implemented.</p> <p>Informal monitoring of contractual obligations may lead to slower identification and remediation of delays in delivery, or other contract quality requirements, impacting the effectiveness of the service.</p>	<p>2. The Streetlight Design Leader design and implement a contract monitoring process to identify applicable compliance requirements, implement results monitoring, and timely reporting and escalation processes.</p> <p>MANAGEMENT RESPONSE Agreed.</p> <p>Contractual obligations will be reviewed by the Leader, Administration to identify compliance requirements, implement results monitoring and its timely reporting and escalation processes to ensure compliance with SLA requirements and mitigate the reputational risk.</p> <p>LEAD Streetlight Design Leader, Supervisor, Leader, Administration</p> <p>SUPPORT: Manager, Mobility Operations, Director, Mobility</p> <p>COMMITMENT DATE June 1, 2024</p>

#3. Work Management System Data	
OBSERVATION	RECOMMENDATION
<p>The WMS does not contain sufficient accurate data to support effective repair operations and contract management.</p> <p>WMS data accuracy and completeness is limited due to:</p> <ul style="list-style-type: none"> • Lack of integration of data: 311 Service Request numbers and dates are not recorded in the WMS. WMS dates therefore may not reflect when the Service Request was raised, impacting the accuracy of the repair time information. • Inconsistent utilization of data fields where data is entered directly into WMS e.g., work order details. • Unavailable information: information is not routinely collected in WMS on repair time rates, recurring work orders, and the nature and urgency of repair and maintenance activities. Corrective maintenance for damage related service requests is not managed through WMS. • A lack of review of data: citizen entries directly populate the outage map without the Street Light team review, and the entries made by the Street Light team are not reviewed for accuracy. <p>Inaccurate/incomplete information limits the ability to analyze costs, repair time rates, or prioritize maintenance activities, and can limit analytic capabilities that support informed decision making.</p>	<p>3. The Streetlight Design Leader to identify and implement opportunities to enhance WMS data completeness and accuracy including:</p> <ul style="list-style-type: none"> • Identifying key data sets and relevant sources of data that are required to support effective operations and contract management; • Reviewing the integration between the 311 system and WMS; • Evaluating the implementation of data validation and verification mechanisms to ensure consistency and completeness of key data; and • WMS reporting functionality may facilitate analysis of time spent per work order and applicable rates, and standard materials at authorized rates to support supplier invoices and track cost per work request. <p>MANAGEMENT RESPONSE</p> <p>Agreed.</p> <p>Actions taken will be:</p> <ol style="list-style-type: none"> a) Defining the scope of work for WMS enhancements and development. b) Project charter signoff. c) Implementation of system features identified in the scope. <p>LEAD Streetlight Design Leader, Street Light Engineer</p> <p>SUPPORT: Manager, Mobility Operations</p> <p>COMMITMENT DATE</p> <ol style="list-style-type: none"> a) November 1, 2024 b) December 1, 2024 c) December 1, 2025 <p>4. The Streetlight Design Leader to establish a WMS data review process to support data accuracy of key data sets.</p> <p>MANAGEMENT RESPONSE</p> <p>Agreed.</p>

	<p>We will utilize the WMS data validation and verification mechanisms identified and implemented as part of Recommendation 3 to act as a data review process.</p> <p>LEAD Streetlight Design Leader, Street Light Engineer</p> <p>SUPPORT: Manager, Mobility Operations</p> <p>COMMITMENT DATE December 1, 2025</p>
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Acknowledgments

The City Auditor’s Office conducts projects, including this audit, in conformance with the International Standards for the Professional Practice of Internal Auditing. The City Auditor’s Office would like to thank the Street Light Team for their cooperation and support during this audit.