



MODEL TECHNICAL SPECIFICATIONS FOR PROCUREMENT OF LED LUMINAIRES IN CANADA

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INTRODUCTION

LED technology offers significant benefits for outdoor luminaire applications in streets, roads and parking areas, and garages, including energy savings, maintenance savings and improved visual clarity and safety. Performance verification combined with luminaire price declines, have increased interest in scaling up installations. This Guide is intended to make designing the procurement process for LED luminaires for outdoor applications easier, with special relevance to LED street, roadway, and parking area luminaires. Using this Guide in combination with other procurement resources should allow you to select the most appropriate products available from manufacturers active in the Canadian market.

In many ways procuring LED luminaires is different from purchasing lamps, ballasts, and conventional luminaires. Since an LED luminaire is an integrated electronic, mechanical, and thermal system, the weakest component part will compromise the performance of the whole. Another factor is that due to its directionality, LED based lighting exhibits quite different photometric characteristics than traditional lamps. LED performance, therefore, needs to be measured and evaluated differently, and a variety of parameters needs to be considered in assessing products. Finally, long-term lumen output remains an issue. While the expectation is that outdoor LED luminaires may last 50,000 hours or more, there aren't any products yet that have actually been operating in outdoor applications for such a period to verify such longevity. Fortunately, a new practice recommended, TM-21, appeared, and products that have been tested for 6,000 hours or more using the TM-21 protocol for estimating long-term lumen maintenance, published in 2011 by the Illuminating Engineering Society of North America (IES), are now beginning to appear in the market.

USING THE GUIDE

The Guide focuses on LED performance and the electrical and mechanical criteria that support that performance. While there is a special focus on street and roadway LED luminaires, many of the provisions can be used for decorative, parking area, and garage luminaires. However, some adjustments may be required for these applications.

This Guide addresses selecting the appropriate equipment. It is to be used as a reference for developing specific language and compliance features relevant to the local situation. Both local conditions and experience will govern some specific requirements, such as corrosion resistance, light level expectations and networking design, but the Guide outlines the process for selecting them. Legal considerations will also vary by location. These are not covered in this document.

Installation, maintenance procurement procedures and financing are not part of this Guide. Cities can do these activities internally or outsource them as they see fit. Some luminaire suppliers offer some or all of them as part of their package.

The Guide is modular, with criteria listed in tabular form, so lighting managers can select those provisions most useful and relevant to them. In addition, annex templates are provided that give a simple way for manufacturers to indicate their compliance with specific criteria.

Rather than be prescriptive in all criteria, some key provisions are performance based, which requires the bidder to submit documentation verifying such performance. This puts more onus on the evaluation process to identify the best products among competing proposal bids that will meet local needs.

As this Guide is a living document and will be upgraded periodically, please send your suggestions for improvement to: Lightsavers@canurb.org.

RELATED REFERENCE MATERIALS

1. The LightSavers Adaptive Controls Primer (link) addresses criteria to use in procuring adaptive controls for LED luminaire.
2. The Product Qualified Products List from the Designlights Consortium is a useful industry resource developed for procurement:
http://temp.designlights.org/solidstate.about.QualifiedProductsList_Publicv2.php.
The Designlights Consortium (DLC) is a collaboration of utility companies and regional energy efficiency organizations funded by its members, including Natural Resources Canada, BC Hydro, and Hydro Québec. The list covers products designed for 30 commercial LED applications, including outdoor area, roadway, and decorative applications. Keep in mind the potential lag time between the introduction of new products by manufacturers and their evaluation by DLC.
3. Technical requirements for qualification for all LED products are listed here:
<http://www.designlights.org/solidstate.manufacturer.requirements.php>. Manufacturers must submit both IESNA LM- 79 and LM-80 data from qualified laboratories in order for DLC to evaluate their products. So the availability of this data in the DLC's QPL enables quick comparisons among various products using some fundamental specifications listed in this guide, such as electrical characteristics, luminous efficacy, and correlated colour temperature. Note, however, that more comprehensive photometric data, such as horizontal flux distribution and candela plots typically included in LM-79 reports, are not reported by the QPL. Such photometric data can be useful in determining whether a proposed product will meet local roadway lighting standards.
4. The U.S. Department of Energy (DOE) Municipal Solid State Lighting Consortium's (MSSLC) Model Specification for LED Roadway Luminaires, Version 1.0 (October 2011) is available here:
<http://www1.eere.energy.gov/buildings/ssl/specification.html>.
5. Procurement documents from Canadian municipalities and provinces are also available to serve as references. LightSavers Canada will endeavor to post many of these documents on its website at www.lightsavers.ca to accompany this guide.
6. In developing a procurement document, lighting managers may wish to consult Canada's National Master Specification (NMS) text base, administered by the National Master Secretariat of Public Works and Government Canada. It is intended for use by the federal government, other public organizations and the private sector in the preparation of construction and renovation contract documents. Information is here:
<https://www.raic.org/raic/national-master-specification-nms>

LightSavers Canada
Canadian Urban Institute
Toronto, Ontario
March, 2015

1.0 LUMINAIRE PHYSICAL CHARACTERISTICS

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
1.1	Housing	<p>Made of die cast or extruded aluminum:</p> <ul style="list-style-type: none"> • Integrated heat sink; • Two exterior finish options: <ul style="list-style-type: none"> (a) raw, unpainted aluminum; (b) coated – typically light grey or silver color. <p>Housing to be easily opened and closed without a tool.</p> <p>The wiring compartment to have adequate space for third-party adaptive controls.</p> <p>Obtain cost to provide an ANSI C136.41 5-prong receptacle with the housing to accept dimming controllers from a variety of vendors in the future.</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i> 	<p>Paint must be maintained over time, so consider this in finish options.</p> <p>Other considerations:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Investigate type of finish, i.e., some such as polyester powder coatings are more corrosion resistant,; <input type="checkbox"/> See paint finish requirements in Leotek report part 6
1.2	Dimensions	<p>Specific dimensions of luminaire (outer) and mounting arm to suit existing pole infrastructure.</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i> 	<p>May want to be flexible on luminaire dimensions to allow a greater variety of products to be considered, unless specific conditions limit the size.</p>
1.3	Allowable Weight and Wind Resistance	<p>Specify maximum [## option] kilo- grams and [## option] total Effective Projected Area (EPA) capacities appropriate for the pole capacity and wind zone.</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i> 	<p>The EPA of a fixture is the area “visible” by the wind at a particular angle.</p> <p>Allow for increased weight of LED luminaire over the existing luminaire.</p> <p>Typical values are: maximum weight of 16 kg (35 lbs.) and</p>

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
1.4	Ingress Protection	Housing: CUL rated for wet locations Optical chamber: IP-66 rated. Driver chamber: IP-66 rated recommended.	<ul style="list-style-type: none"> • Description of item in the proposal submitted by bidder; • Certification report by an independent, third party laboratory attached to signed and dated form: <i>Annex II: Ingress Protection.</i> 	When the driver is in an IP66 chamber, it protects the connections to light engine to discourage corrosion and failure at those connection points. Luminaires with drivers in an open wiring chamber are also more prone to icicle build-up.
1.5	Minimum Vibration Resistance	Conform to ANSI C136.31 Vibration Rating A more rigorous option is the ANSI C136.31 3G rating which should at least be required in locations where there is significant vibration, such as on bridges.	<ul style="list-style-type: none"> <input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i> 	The major manufacturers comply with 3G so requiring it could weed out some weak quality products.
1.6	Modularity	Luminaires should be designed for ease of component replacement, including LED engines/modules, drivers, surge devices, and they should accommodate end-of-life disassembly.	<ul style="list-style-type: none"> <input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i> 	Product modularity provides an opportunity for product upgrading at end of life to save instead of having to procure new luminaires. Integrated components may reduce first procurement costs, but will likely lead to higher maintenance/replacement
1.7	Samples	Bidder shall provide a minimum of 4 of each proposed luminaire for inspection and testing.		If resources are available, the bidder should verify the proponents' modeling results in a field trial of the samples to ensure that they meet the specified requirements in the street layout(s) designated for modeling in the RFP.

2.0 LUMINAIRE PHYSICAL CHARACTERISTICS

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
2.1	Safety and Electrical Characteristics	Luminaires shall comply with applicable Canadian Codes and standards, and pass required testing by a certification body approved by the local authority having jurisdiction.	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i>	Testing laboratory should be certified as a Testing Authority in Canada by the Standards Council of Canada or by provincial certifying agencies, for example, the Electrical Safety Authority of Ontario.
2.2	Wiring	Wiring and insulation shall comply with applicable codes and standards, for example, the Canadian Electrical Code and/ or provincial code.	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i>	Use of terminal blocks for connections makes it easier to replace individual electrical components should they fail.
2.21	Grounding	Specify grounded or un-grounded in accordance with local system. If grounded, then comply with applicable Codes and standards.	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i>	Not including this can cause significant problems if the luminaires purchased don't match the local electrical system.
2.22	Operating Voltage	[Specify the requirements to meet local supply] Fluctuation tolerance $\pm 10\%$.	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i>	<p>Most common options are: 120V/50&60Hz 120-240V/50&60Hz</p> <p>If local conditions require it: 277V/50&60Hz 347V/60Hz 480V/60Hz</p>
2.23	Operating Current	<i>LED drive current should be equal to or less than 50% of the maximum LED chip design.</i>		

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2.3	Electrical Immunity	Luminaires shall contain a separate, easily accessible and replaceable, surge protection device (SPD) compliant with ANSI/ IEEE, <i>Surge Voltages in Low Voltage AC Power Circuits</i> , C62.41.2-2002 Rating Category C-High operation.	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Certification report by an independent, third party laboratory attached to signed and dated form: <i>Annex III: Surge Protection</i> .	<input type="checkbox"/> The SPD should protect all electronic components from harmful line transient voltage surges as a result of utility line switching, lightning strikes, etc.
2.5	Total Harmonic Distortion	$\leq 20\%$	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist</i> .	
2.6	Power Factor	≥ 0.9	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist</i> .	
2.7	Operating Temperature Range	-40°C to +40°C for all electrical components in the luminaire, including LED engines/modules, drivers, and surge devices.	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist</i> .	

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
2.8	Power Supply/Driver	<ul style="list-style-type: none"> • Power factor $\geq 90\%$; • Tolerates input voltage fluctuations of $\pm 10\%$; • To last 80,000 hours; • Reliable operation up to 40°C; • Integrated dimming control capability utilizing an external 0-10 VDC control signal. • Minimum 3 yr. OEM warranty. 	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i>	The quality of the driver is often the primary determinant of lifecycle. A simple measure of confidence in driver reliability is the warranty provided by the OEM of the driver to the luminaire manufacturer.
2.9	Photoelectric Controller	<p>Shall conform to ANSI C136.10-1996 with a NEMA 3-prong type twist-lock rated connection. Socket shall be free to reorient the geographic directional orientation without the use of tools.</p> <p>Provide option for C136.41 receptacles to support adaptive control modules from different manufacturers.</p>	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i>	Photoelectric controllers may be provided for all luminaires. Controls warranty should be coordinated with the luminaire warranty.
3.0	Luminaire LED Performance			
3.1	Minimum Luminaire Efficacy	70 lumens/watt per IESNA LM-79.	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> IESNA LM-79 Report, “ <i>Electric and Photometric Measurements of Solid State Lighting Products,</i> ” from a LED Lighting Facts [®] Approved Laboratory, attached to signed and dated form: <i>Annex IV: IESNA LM-79.</i>	Consider assigning extra points during the evaluation of bids if luminaire efficacy exceeds 70 lumens/watt.

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
3.2	Correlated Colour Temperature (CCT).	3,500K - 5,000K, with nominal CCT tolerances in accordance with ANSI C78.377.	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> IESNA LM-79 Report, “ <i>Electric and Photometric Measurements of Solid State Lighting Products,</i> ” from a LED Lighting Facts [®] Approved Laboratory, attached to signed and dated form: <i>Annex IV: IESNA LM-79.</i>	<p>Field or lab testing of luminaires during the procurement process is essential to verifying CCT.</p> <p>Field-testing in Seattle demonstrated that the 4100K test areas, including the asymmetric test area, outperformed all of the other test areas in terms of detection distance. See: Clanton & Associates, Seattle LED Adaptive Lighting Study, Report # E14-286, (2014) here: http://neea.org/docs/default-source/reports/seattle-led-adaptive-lighting-study.pdf?sfvrsn=4h ## more here on blue light</p>
3.3	Minimum Colour Rendering Index (CRI)	65	<input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> IESNA LM-79 Report, “ <i>Electric and Photometric Measurements of Solid State Lighting Products,</i> ” from a LED Lighting Facts [®] Approved Laboratory, attached to signed and dated form: <i>Annex IV: IESNA LM-79.</i>	The minimum Design Lights Consortium (DLC) criteria for streetlights is 65.

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
3.5	Luminaire Cut-off	Two options: <ul style="list-style-type: none"> • Option 1: Compliant with Dark Skies or; • Option 2: Uplight (90° above nadir) zonal distribution BUG rating shall be 0. 	<ul style="list-style-type: none"> • Dark Skies option: certification by the International Dark Skies Association, with signed and dated form: <i>Annex VIII: Dark Skies Compliance</i> or; <input type="checkbox"/> BUG option: ratings provided in IESNA LM-79 Report, “<i>Electric and Photometric Measurements of Solid State Lighting Products,</i>” from a LED Lighting Facts® Approved Laboratory, attached to signed and dated form: <i>Annex IV: IESNA LM-79.</i> 	
3.6	Lumen Maintenance (LM)	Minimum of 50,000 hour lifetime required, using extrapolation method provided by IESNA TM-21, based on lab test results of the LED devices according to IESNA LM-80 testing protocol, Manufacturer to provide lighting calculations performed by a Professional Engineer.	<ul style="list-style-type: none"> <input type="checkbox"/> Description of item in the proposal submitted by bidder; <input type="checkbox"/> <i>Statement of Lumen Maintenance</i> to be submitted by bidder verifying that the proposed luminaire is on the Designlights Consortium’s <i>Qualified Products List</i>. If the product has not yet been evaluated, then include calculations and supporting test data per <i>DLC’s Qualification Criteria</i>, attached to the signed and dated form: <i>Annex V: Statement of Luminaire Lumen Maintenance</i>. The IESNA LM-80 report, “<i>Measuring Lumen Maintenance of LED Light Sources</i>” from a 	The Design Lights Consortium requires and also verifies TM-21 tests for 50,000 hours for all LED streetlights certified in its Qualified Products List, so DLC approval is a simple compliance path. If it is desired to go beyond 50,000 hours minimum lifetime to, say, 80,000 hours, it is suggested that IESNA TM- 21 calculations be supplied by the manufacturer. Note that some manufacturers have tested their LED devices of as long as 15,000 hours in the lab.

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
			LED Lighting Facts® Approved Laboratory should also be submitted if Option 1 is selected. <input type="checkbox"/> <i>TM-21 based luminaire depreciation used in all RP-8 lighting calculations provided by the manufacturer</i>	
4.0	Luminaire Photometry			
4.1	IES RP-8	Luminaire shall meet IES RP-8 recommended values for the specific Location Parameters indicated in the appendix. A template is provided in Annex VI.	<ul style="list-style-type: none"> • Bidder shall submit analysis and diagrams derived from industry recognized lighting software that confirms compliance through point-by-point calculations graphically presented on the roadway, for illuminance, luminance, uniformity, and glare, attached to the signed and dated form: <i>Annex VI: Compliance with IESNA RP-8 Report;</i> • <i>Submission of reports and calculations based on sample roadways provided in Annex X</i> 	Professional lighting software available includes: <ul style="list-style-type: none"> <input type="checkbox"/> AGi32 v. 3.2; <input type="checkbox"/> AutoLux v. 8.0; <input type="checkbox"/> Lighting Reality PRO; <input type="checkbox"/> Photopia v. 3.0; <input type="checkbox"/> Visual Professional Edition; <input type="checkbox"/> Visual Roadway Tool. <input type="checkbox"/> SEAD Streetlight Evaluation Tool (also provides economic analysis).
4.2	Photometric Distribution	Luminaires must be available in IESNA outdoor luminaire intensity distribution classifications. Availability of Type II, III, and IV is preferred.	<ul style="list-style-type: none"> • <i>IESNA LM-79 Report, “Electric and Photometric Measurements of Solid State Lighting Products,”</i> from a LED Lighting Facts® Approved Laboratory, attached to signed and dated form: <i>Annex IV: IESNA LM-79.</i> 	

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
5.0	Environmental Characteristics			
5.1	No presence of Lead, Cadmium, or Mercury	Compliant with RoHS.	<ul style="list-style-type: none"> • Certification by an independent, third party laboratory, with signed and dated form: <i>Annex VII: RoHS Compliance.</i> 	
6.0	Warranty			
6.1	Period of warranty	10 years.	<ul style="list-style-type: none"> • Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i> 	
6.2	Coverage	<ul style="list-style-type: none"> • Upon failure within the warranted period, unit shall be replaced by the manufacturer; • Failure modes warranted include: negligible light output from more than 10% of the individual LED sources; luminaire housing, wiring, connections or drivers not sustaining specified performance. 	<ul style="list-style-type: none"> • Description of item in the proposal submitted by bidder; • Signed and dated copy of the attached form, <i>Annex I: General Compliance Statement and Checklist.</i> 	Includes on-site replacement material, fixture finish, and transportation.
7.0	Manufacturing			
7.1	ISO 9001	Facility that manufactures the LED luminaires shall be ISO 9001 certified.	<ul style="list-style-type: none"> • Signed and dated copy of <i>Annex IX: Manufacturing Compliance with ISO 9001.</i> 	

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
8.0	Proposal Evaluation			
<p>General Approach</p> <p>The evaluation process would assign a total of 100 possible points to the applicant’s proposal, comprising a different number of points (weighting) for each factor being considered. For some factors, such as light levels or colour, the requirement could be pass or fail, and fail may or may not mean disqualification . This should be made clear in the procurement documents.</p> <p>One scenario is that all of the performance requirements must be met, and the proposal with the lowest life cycle cost will be selected. However there are usually other factors that are not all or none – such as experience, warranty conditions, or GHG emissions reductions – that require weighting in the evaluation.</p>				
8.1	Experience	<p>Demonstrated experience of designing, manufacturing and implementing LED luminaires based on providing:</p> <ul style="list-style-type: none"> • Description of the applicant and manufacturer (if different) indicating the number of years in business, the number of years of manufacturing LED luminaires, the associated volume of installed luminaires in those years. • Information on a minimum of 3 other projects of similar scope; • Contact and project information for any other customers which have provided pre-approval of the same or similar luminaires as those proposed 	<p>Information requested for the evaluation process which was not submitted per Items 1.0 - 7.0 should be included in a separate appendix to the applicant’s proposal.</p>	<p>Consideration should be made in weighting experience to allow younger companies to compete without unreasonably increasing risk.</p>

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
8.2	Product Compliance	Compliance with technical requirements in items 1 to 7. Verification and evaluation of luminaire photometric performance and useful in-situ operating life expectations based upon the following documents: LM-79 photometric test reports; Expected lumen maintenance using IES LM-80 and TM-21 documents; List other documents here for other components of the luminaire, such as driver performance, depending on the procurement officer's preferences.	<ul style="list-style-type: none"> • LED luminaire technical product information; • LED driver technical product information, including utilized driver output wattage(s); • LED driver dimming control interface description and associated wiring schematics; • Surge protection device technical product description; <input type="checkbox"/> Information requested for the evaluation process which was not submitted per Items 1.0 - 7.0 should be included in a separate appendix to the applicant's proposal. 	The municipality may wish to seek bidders' compliance with the bid document in several ways: <ul style="list-style-type: none"> • Require certain verification documents to be submitted, and the entire bid to be deemed pass/fail based on the response; • Assign evaluation points based on a weighting of different documents. • Combination of the above two options. For example, if the bidder does not submit the basic LM-79 and TM-21 documents, the bid could be deemed to fail. Submission of other documents, such as surge protection description and certification, could be weighted in assigning evaluation points.

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
8.3	Ease of installation and suitability of long-term in-situ maintenance requirements	Luminaire installation instructions and sample; Written description of recommended maintenance requirements and associated maintenance schedules.	Evaluation of ease of installation, by purchaser's field staff, using sample and submitted information. Confirmation from owners of existing installations of the installation and maintenance performance	
8.4	Luminaire Energy Savings	Calculation of predicted energy savings, simple payback, return on investment, and internal rate of return based on analysis conducted per Section 9.	Information requested for the evaluation process which was not submitted per Items 1.0 - 7.0 should be included in a separate appendix to the applicant's proposal.	Maximum points would be awarded to the lowest energy consumption proposed (W) while meeting required light levels. Those offers not meeting required light levels would be deducted points as appropriate.
8.5	Product Reliability	Level of effort required by the owner to achieve acceptable replacement rate over time (after warranty expiry).	Submit a summary of reliability testing applicable to the luminaires, as a minimum including the LEDs and LED drivers. Information requested for the evaluation process which was not submitted per Items 1.0 - 7.0 should be included in a separate appendix to the applicant's proposal.	This factor represents one of the higher risk elements and should be weighted accordingly.
8.6	Submission of Samples for Field Evaluation	Bidder shall submit a minimum of three sample luminaires for testing for one or more of the Location Parameters described in <i>Annex VI: Compliance with IESNA RP- 8 Report</i> (see Item 4.1).	Field crews will evaluate how easy it is to install the products on existing poles and arms.	Purchaser needs to decide how they want to verify installation requirements – as part of initial or final selection, how the performance testing is done and how costs are covered. Note: manufacturers may not be able to provide samples in a timely fashion, due to high demand & supply constraints, so adjustments may need to be made accordingly.

ITEM	SPECIFICATION	PERFORMANCE REQUIRED	EVIDENCE OF COMPLIANCE	COMMENTS
9.0	Luminaire Pricing and Lifecycle Costing			
9.1	Luminaire Pricing and Lifecycle Costing	<p>The bid shall contain the following information:</p> <ul style="list-style-type: none"> •prices for fixtures for location parameters specified •Additional equipment cost associated with changing or modifying mounting arms and poles, miscellaneous wiring, etc. • Installation cost if the manufacturer is expected to undertake this service; • Length of warranty (or other measure of length of time the fixture will operate successfully until its output reaches 70% of its original flux (L70), based on lumen maintenance above; • Calculate net present value (NPV) and return on investment (ROI) for capital outlay using the Energy cost (\$/kWh) ; labour inflation rate (%/year), energy cost inflation rate (%/yr); discount rate provided by the owner. 		<p>Maximum points would be awarded to the lowest lifecycle cost as calculated in Annex X. <u>All other cost quotations to be scored relative to this based on a formula to be consistent with procurement process.</u></p> <p>The economic evaluation should strive to evaluate luminaire economics on an even playing field. Simple payback analysis, for instance, is useful in determining how fast the municipality will get back its return on investment, but tends to devalue the return on investment over time.</p> <p>It may be appropriate to use a uniform lifetime for all products in the analysis, say 15 or 20 years, unless there is reliable evidence to differentiate expected lifespans.</p>

ANNEX I: GENERAL COMPLIANCE STATEMENT & CHECKLIST

ITEM REF.	SPECIFICATION & PERFORMANCE REQUIRED	YES	NO	LOCATION OF SUPPORTING DOC. IN BID
1.0	Luminaire Physical Characteristics			
1.1	Housing is made of die cast or extruded aluminum, includes an integrated heat sink, and is unpainted, light gray, or silver color. Housing can be opened without a tool. There is room for future adaptive controls.			
1.2	Dimensions of the luminaire are provided.			
1.3	Weight and the EPA of the luminaire are provided.			
1.5	Luminaire's minimum vibration resistance conforms to ANSI C136.31 for 3G vibration for normal applications.			
1.6	The luminaire is modular and is designed for ease of component replacement.			
2.0	Luminaire Electrical Characteristics			
2.1	Luminaire's safety and electrical characteristics comply with applicable codes and standards (certification attached).			
2.2	Wiring and insulation comply with applicable codes and standards (certification attached).			
2.21	If grounded, the luminaire complies with applicable codes and standards (certification attached).			
2.22	Voltage fluctuation tolerance is $\pm 10\%$.			
2.5	Total harmonic distortion is $\leq 20\%$.			
2.6	Power factor is ≥ 0.9 .			
2.7	Operating temperature is -40°C to $+40^{\circ}\text{C}$.			
2.8	Power supply driver is dimmable and will operate as follows: <ul style="list-style-type: none"> <input type="checkbox"/> Designed for reliable operation up to 40°C; <input type="checkbox"/> Will last 80,000 hours <input type="checkbox"/> Driver housing IP66 rated if the housing is air cooled; <input type="checkbox"/> Integrated dimming control capability utilizing an external 0-10 VDC control signal pre-wired to optional ANSI C136.41 receptacle. 			

2.9	Conforms to ANSI C136.10-1996 with a NEMA 3-prong type twist-lock rated connection. Socket shall be free to reorient the geographic directional orientation without the use of tools. Optional ANSI C136.41 receptacle for pre-wired dimming			
6.0	Warranty			
6.1	Period of the warranty is 10 years.			
6.2	<p>Warranty covers luminaire integrity and functionality:</p> <ul style="list-style-type: none"> · Luminaire housing, wiring, and connections; · LED light source(s)—negligible light output from more than 10% of the LED sources constitutes luminaire failure; · LED driver(s) · Acts of God, excepting damage that is insured by Quezon City, which includes typhoon, traffic accidents, theft, etc. <p>Warranty compliance includes on-site replacement material, fixture finish, transportation, removal and labour costs of installation.</p>			
7.0	Product Cost			
6.1	Cost of proposal shall be evaluated			

Please attach a sheet explaining why you have answered NO to any of the above item requirements.

I hereby confirm the above Yes/No statements to be true and legitimate:

Name

Title/Position

Phone Number

Date

ANNEX II: INGRESS PROTECTION

The bidder's luminaire housing is CUL rated for wet locations (certificate attached). The luminaire's LED optical chamber complies with the rates and degrees of protection afforded by IP66, which include:

- No ingress of dust;
- Complete protection against contact;
- Protection against powerful water jets (12.5 mm nozzle) against the enclosure from any direction;
- Water volume: 100 litres per minute;
- Pressure: 100 kN/m³ at a distance of 3 metres.

Certificates from independent, third party laboratories are attached verifying that the bidder's proposed luminaire(s) are CUL rated for wet locations (housing) and IP66 (optical chamber).

I hereby confirm that attached report is true and legitimate:

Name

Title/Position

Phone Number

Date

ANNEX III: SURGE PROTECTION

The proposed luminaire(s) offers high capability surge protection that complies with ANSI/IEEE, Surge Voltages in Low Voltage AC Power Circuits, C62.41.2-2002 Rating Category 2 for 10kV/5kA location.

I hereby confirm that the proposed luminaire complies with the above ANSI/IEEE standard:

Name

Title/Position

Phone Number

Date

ANNEX IV: IESNALM-79

The bidder attaches an IESNA LM-79 report for the proposed luminaire(s), tested by a LED Lighting Facts[®] Approved Laboratory, listed here: <http://lightingfacts.com/approvedlabs>. The report contains:

- Laboratory name;
- Report number;
- Date;
- Luminaire catalog number;
- Name and manufacturer's model number;
- Measured voltage and amps;
- Luminaire wattage;
- Total integrated flux or lumen output;
- Luminous efficacy;
- Correlated colour temperature (CCT);
- Colour rendering index (CRI);
- Iso-footcandle diagram;
- Power factor;
- Total harmonic distortion (THD);
- Documentation that specified standards and test methods were followed.

I hereby confirm that the attached IESNA LM-79 report provides evidence that the bid complies with the technical requirements:

Name

Title/Position

Phone Number

Date

ANNEX V: STATEMENT OF LUMINAIRE LUMEN MAINTENANCE

The bidder attaches a report, *Statement of Luminaire Maintenance*, that verifies that the proposed LED luminaire is on the Designlights Consortium's (DLC) *Qualified Products List* and thus meets DLC's lumen maintenance technical requirements.

Alternatively, if the proposed LED luminaire has not yet been evaluated by DLC, the manufacturer may submit calculations and supporting test data indicating a minimum luminaire lifetime (L70) of 50,000 operating hours, based on one of two compliance pathways in accordance with Designlights Consortium's (DLC) Product Qualification Criteria: (<http://www.designlights.org/solidstate.manufacturer.requirements.php>).

- Option 1: LED device performance using the IESNA TM-21 protocols;
- Option 2: LED luminaire performance based on 6,000 hours of luminaire testing, using a pass/fail threshold for lumen maintenance compliance as established by the *Energy Star Manufacturer's Guide*, i.e., for 6,000 hours of test, LM = 95.8% assuming the luminaire lifetime is 50,000 hours.

Option 1: Compliance through Component Performance using TM-21 Calculations

Under *Option 1* the manufacturer will need to provide five documents:

- 1) A complete IESNA LM-80 report of the same LED device that is used in the luminaire (see *Annex V—LM-80*). Therefore, the LED package part number of the submitted luminaire must appear on this report. A complete LM-80 test report will include the relative light output over time, for at least 6,000 hours of continuous operation at three different temperatures measured at the LED package manufacturer-specified TMP. Following the LM-80 standard, the three TMP temperatures are 55°C, 85°C and a third temperature selected by the manufacturer.
- 2) The In Situ Temperature Measurement Test (ISTMT) report of the submitted luminaire including the measured temperature at the TMP of the hottest LED in the luminaire. The luminaire must have been tested under ANSI/UL 1598 and the report must contain the same model number of the submitted luminaire.
- 3) A photograph documenting the actual temperature measurement location such as a photograph of the luminaire with a thermo couple attached at the TMP point). For the validity of this document, it must contain the same model number of the submitted luminaire. This photograph can be incorporated in the ISTMT document.
- 4) A document with a schematic or photograph from the LED package manufacturer showing the specified TMP location. For the validity of this document, it must contain the same part number of the LED package used in the submitted luminaire.
- 5) Saved copy of completed ENERGY STAR TM-21 Calculator in a Microsoft Excel file format. Save the file, using the manufacturer's model number submitted with the bid, before uploading with other supporting documentation for Option 1 lumen maintenance. You can download the TM-21 calculator from the ENERGY STAR website at <http://www.energystar.gov/TM-21calculator>. Please be sure to download a new worksheet for each application. Instructions on how to use the calculator are included in the first page of the worksheet.

For products where the required lifetime is longer than the projection method allows, the necessary lumen maintenance minimums at the end of the allowable projection period are as follows. These percentages result from solving an exponential decay function for 35,000 and 50,000 hours.

TABLE 1: TM-21 PROJECTED LUMEN MAINTENANCE REQUIREMENTS

PROJECTION END POINT	REQUIRED LUMEN MAINTENANCE FOR 35,000 HOUR PRODUCTS	REQUIRED LUMEN MAINTENANCE FOR 50,000 HOUR PRODUCTS
33,000 hours	$\geq 71.44\%$	$\geq 79.03\%$
36,000 hours	$L_{70} \geq 35,000$	$\geq 77.35\%$
38,500 hours	$L_{70} \geq 35,000$	$\geq 75.98\%$
42,000 hours	$L_{70} \geq 35,000$	$\geq 74.11\%$
44,000 hours	$L_{70} \geq 35,000$	$\geq 73.06\%$
48,000 hours	$L_{70} \geq 35,000$	$\geq 71.01\%$
49,500 hours	$L_{70} \geq 35,000$	$\geq 70.25\%$
50,000 hours	$L_{70} \geq 35,000$	$\geq 70.00\%$

OR

When applying the lumen maintenance in accordance with these protocols, the DLC applies a tolerance of 5% to driver currents tested under LM-80.

I hereby confirm that the attached report to be true and legitimate:

Name

Title/Position

Phone Number

Date

ANNEX VI: COMPLIANCE WITH IESNA RP-8

The bidder attaches a report, *Compliance with IES RP-8* which was created with lighting industry acceptable design software such as AGi32 (<http://www.agi32.com>), *Visual Roadway Lighting* (www.visual-3d.com/Default.aspx), or *Lighting Reality* (<http://www.lightingreality.com/>) using the template shown below (courtesy City of Hamilton, ON). The report shows point-by-point calculations graphically presented on the roadway, providing modeling evidence that the bidder's luminaire product will meet IES RP-8 recommended values for illuminance or luminance, uniformity, etc. The software analysis will determine the luminaire wattage and integrated luminous flux of the luminaire proposed herein needed in its initial lumen output to exceed RP-8 recommended values by 30%, thus allowing for lumen depreciation over 80,000 hours while maintaining compliance with the value.

In addition, the bidder commits to providing a minimum of three LED luminaire samples on a timely basis for one or more of the Location Parameters described herein for field evaluations.

I hereby confirm that the attached report to be true and legitimate:

Name

Title/Position

Phone Number

Date

ANNEX VII: ROHS COMPLIANCE

The proposed luminaire(s) complies with the directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment 2002/95/EC, otherwise known as RoHS. RoHS restricts the use of the following six substances:

1. Lead (Pb);
2. Mercury (Hg);
3. Cadmium (Cd);
4. Hexavalent chromium (Cr⁶⁺);
5. Polybrominated biphenyls (PBB);
6. Polybrominated diphenyls ether (PBDE).

I hereby confirm that the attached report from an independent laboratory certifies RoHS compliance:

Name

Title/Position

Phone Number

Date

ANNEX VIII: DARK SKIES COMPLIANCE

The proposed luminaire(s) meets the International Dark Skies Association’s standards for being dark sky friendly, meaning no light emissions above 90 degrees. (See <http://www.darksky.org>).

I hereby confirm that the attached Seal of Approval from the International Dark Skies Association certifies Dark Sky compliance:

Name

Title/Position

Phone Number

Date

ANNEX IX: MANUFACTURING COMPLIANCE WITH ISO 9001

The proposed luminaire(s) was manufactured in a facility that uses a quality management system that conforms to ISO 9001.

I hereby confirm that the attached report from an independent ISO certified auditor verifies ISO 9001 compliance:

Name

Title/Position

Phone Number

Date

ANNEX X: LIGHTING REQUIREMENTS AND LIFECYCLE COSTING

Vendors must submit computer simulations of the roadway lighting proposed, using AGi32 or Lighting Reality software according to the roadway parameters in the table below. Vendors must use a light loss factor (LLF) based on Illuminating Engineering Society (IES) Publication TM-21 (Projecting Long Term Lumen Maintenance of LED Light Sources) and show their calculations. Scotopic or mesopic factors will not be allowed.

Existing Luminaire	Mount height (m)	Pole Spacing (m)	# of Lanes	Lane Width (m)	Pole Set-back (m)	Arm Length (m)	Roadway class / Pedestrian Conflict	Single Sided or Double, Median Mounted	Minimum average illuminance (lux)	Uniformity Ratio (avg:min) (Maximum allowed)
70W HPS	9.0	50	2	4.5	1	0.6	Local/Low	Single Sided	4.0	6.0
100W HPS	9.0	50	2	3.5	1	0.6	Local/Medium	Single Sided	7.0	6.0
150W HPS	9.0	47	2	3.5	1	1.2	Collector/Medium	Single Sided	9.0	4.0
250W HPS	10.5	47	4	3.5	1	1.5	Major/Medium	Double, Median Mounted	13.0	3.0

Note 1: Assume R3 for pavement classification for all layouts

Note 2: For double, median mounted, assume 2 meter median width

Note 3: Calculation grids must be designed in accordance with IESNA RP-8 guidelines

**VENDOR RESPONSE TABLE:
 ENTER RESULTS INTO THE FOLLOWING CHART (AND PROVIDE LAYOUTS)**

	A	B	C	D	E	F = B x E	G	H = A x F x G	I	J = H + (Ix A)
EXISTING LUMINAIRE	NUMBER OF LUMINAIRES	LED LUMINAIRE WATTAGE	ROADWAY AVG (LUX)	ROADWAY AVG:MIN (LUX)	HOUR OF OPERATION (20 YRS)	20 YEAR ENERGY USAGE (KWH)	ENERGY COST PER KWH	ENERGY COSTS	FIXTURE COST	TOTAL COST
70W HPS	INSERT QTY				87,600		\$0.13			
100W HPS	INSERT QTY				87,600		\$0.13			
150W HPS	INSERT QTY				87,600		\$0.13			
250W HPS	INSERT QTY				87,600		\$0.13			
Total Lifecycle Cost (total of all Column J's)										

Note: There are a wide variety of road types and requirements that are not included in this chart. These layouts will be used for benchmarking energy savings across suppliers. Further lighting design will be conducted during the implementation phase of the LED conversion project to ensure the appropriate luminaires are being provided for the vast array of road types.