CITY OF KIRKLAND
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DEPARTMENT OF PUBLIC WORKS
PRE-APPROVED PLANS POLICY

Policy R-40: Street Lighting Design Guidelines

III APPENDIXES

APPENDIX A

APPENDIX B

Materials and Installation (Electrical, Poles, Luminaires)

I INTRODUCTION

1 PURPOSE

Street lighting refers to illumination that is provided for arterial, collector, and residential streets where vehicles, pedestrians, and bicyclists may be present during hours of darkness. Diminished visibility is a significant contributing factor to nighttime crashes. Therefore, the primary purpose of street lighting is to provide a visual environment that allows comfortable visibility and accurate identification of hazards at night, both on and adjacent to the street, so drivers, pedestrians and cyclists can appropriately take action ahead of time thereby reducing the incidence of nighttime crashes.

An enhanced visual environment affects safety-related driver behavior, adds a sense of personal security and increases the visibility of businesses, which may lead to an increase in commercial activity.

These guidelines establish procedures for the preparation and review of street lighting design pertaining to private and public development projects located at/within the vicinity of Kirkland's arterial, collector, and residential streets. These guidelines also apply to the design of lighting improvements at walkways, pedestrian crosswalks, associated bikeways, intersections, and roundabouts.

Additionally, this document provides the Design Engineer with sufficient information to prepare the plans for City review and approval.

The requirements of this document pertain to street lighting systems in the public right-of-way within the City of Kirkland including those owned and maintained by Puget Sound Energy (PSE). The requirements of this document do not apply to lighting systems located within transportation facilities under WSDOT's or other agencies' jurisdiction.

2 DESIGN GOALS

Street lighting design should strive to achieve the following goals:

- Improve visual quality for all users including drivers, pedestrians, and cyclists.
- Provide quality light and increased contrast for detecting hazards.
- Illuminate high conflict areas such as intersections, roundabouts, midblock crosswalks, and driveways.
- Minimize the environmental impacts of lights during nighttime.
- Minimize impacts such as light trespass and excessive glare to adjacent areas.
- Implement lighting systems that optimize energy usage and are easy to maintain.

3 STANDARD PRACTICE

The Design Engineer shall be a registered Civil or Electrical Professional Engineer. Plans and special provisions shall be sealed and signed by the Design Engineer.

The Design Engineer preparing plans for a roadway lighting system shall comply with the requirements of these guidelines as well as the following publications:

- City of Kirkland Pre-Approved Plans (Standard Details and Policies).
- Current edition of the *Standard Specifications for Road, Bridge, and Municipal Construction* published by the Washington State Department of Transportation (WSDOT), including all Amendments.
- Current edition of the Standard Plans for Road, Bridge, and Municipal Construction published by WSDOT.
- Applicable requirements of the State of Washington Department of Labor and Industries (L&I).
- NFPA 70, the National Electric Code, as adopted and modified by the State of Washington.
- Design of Roadway Facility Lighting ANSI/IES RP-8-22.
- *The Lighting Handbook* published by the Illuminating Engineering Society.
- AASHTO Roadside Barriers Design Guidelines.

II DESIGN GUIDELINES

4 DESIGN AND REVIEW PROCESS

All street lighting systems installed in the City of Kirkland shall meet the requirements established in these guidelines.

The project owner (development applicant, City Capital project, etc.) or PSE shall be responsible for submitting materials to the City for review and approval of the proposed lighting system. If PSE will own and maintain the lighting system upon project completion, the project owner shall work in coordination with PSE to receive approval from the City for the design and installation of the system.

The following steps describe the typical process for the design review of street lighting systems. For questions on the City of Kirkland's street lighting review process or technical requirements, please contact Rochelle Starrett, rstarrett@kirklandwa.gov.

- The Design Engineer shall identify applicable City of Kirkland's lighting system and lighting level requirements (based on street functional classification and pedestrian activity) and standards. These are included in Appendixes A and B.
- If a new service is required, the Design Engineer shall work with PSE to identify the 120/240 single phase service power location and specific connection requirements.
- The Design Engineer shall confirm with the City if a street lighting design analysis report is required as part of the project submittals. Projects requiring a street lighting design analysis report typically include large capital transportation projects involving significant street reconfiguration (widening, etc.), construction or reconstruction of arterial and collector streets, construction of new shared pedestrian/bicyclist pathways; and private development projects with significant frontage along arterial or collector streets. In addition to the submittal requirements described in this section, the street lighting design analysis report shall include narrative to document the design methodology, design alternatives evaluated, recommendations, and the results of photometric and electrical design analyses.
- Lighting analysis and evaluation must be performed using AGi32 Software for all projects that meet the requirements described in Section 5A(2) below.
- Submittals: At least two submittals, the Preliminary and the Final may be required by the City. Each submittal shall include one (1) copy of the drawings, an AGi summary report, and other required data. Plan sheets shall be submitted as part of the complete civil design package for the project. The civil design package intake may not be accepted for review unless a complete submittal, as detailed below, is included. Failure to provide a complete civil design package may require additional submittals for review.
- **Preliminary submittal for review.** The Design Engineer shall provide the following:
    - Project description
    - Site plan (streets and project address labeled)

  - Vicinity map
  - Existing and proposed roadway and sidewalk geometry for reference
  - Information on existing and/or future illumination system ownership
  - Proposed illumination system layout including luminaire locations with labels for: luminaire model number, wattage, color temperature, mounting height, pole material, and mast arm length. This information may be included in table format for clarity.
  - Lighting level summary table comparing proposed average maintained illuminance (footcandles) and uniformity ratio (avg/min) to target levels.
  - Supporting calculations document with AGi32 analysis outputs, including luminaire definitions, calculation summary, and Figure showing calculation area limits and individual calculation points.
  - Identification of potential conflicts with utilities or other features and specific areas that may require potholing.
- **Final submittal after review.** Final Submittal shall include all of the above and responses to initial review comments. In addition, a temporary illumination design submittal as part of the submittal package is required if existing illumination cannot be maintained or is to be removed.

Resubmittal and Approval: If outstanding design issues still exist, the City will require the Design Engineer to submit a new set of Plans for further review and comment prior to approval.

5 STREET LIGHTING DESIGN REQUIREMENTS

A. Lighting Analysis and Evaluation

(1) Objectives

The main objective of street lighting analysis and evaluation is to identify the lighting improvements required to meet Kirkland's recommended lighting levels and standards. Recommended lighting improvements may include any of the following:

i. Installation of new or upgrade to existing street and pedestrian lighting systems located within the vicinity of private developments, or on streets included within the limits of CIP (Capital Improvement Program) projects.
ii. Installation of continuous street and pedestrian lighting systems on new and widened public streets, or on City-owned street frontage of private developments.
iii. Installation of street lighting system at new signalized intersections.
iv. Installation of street lighting at existing signalized and un-signalized intersections.
v. Installation of street lighting at new uncontrolled marked midblock crosswalks.
vi. Installation of street lighting at existing uncontrolled marked midblock crosswalks.

vii. One on one luminaire / pole replacement at a single location.
viii. Upgrade existing luminaire to LED, add new LED luminaire on an existing PSE pole.

(2) Lighting Analysis and Evaluation Tools/AGi32 Software Use

The City of Kirkland has identified AGi32 (Lighting Analysts, LLC c/o Revalize Software) as the industry standard software tool for the calculation of accurate photometric predictions. AGi32 Software must be used to perform the lighting analysis and evaluation for projects of **any size** that meet the following criteria:

a. The project has frontage on or at an intersection located on a street designated as arterial or collector as defined in Figure 1 on Appendix A.
b. The project is located on a local street along a school walk route as depicted in the Kirkland School Walk Routes Map on Transportation Strategic Plan, formerly known as the Transportation Master Plan (TMP). See Map on Page 29 of 2015 TMP (https://www.kirklandwa.gov/files/sharedassets/public/v/2/public-works/city-of-kirkland-transportation-master-plan.pdf)
c. The project has frontage on or is within 50 feet of any street intersection with a marked crosswalk. Lighting analysis shall be required at the intersection as defined by the calculation area identified in these guidelines in addition to the subject project frontage.
d. The project has frontage on or is within 50 feet of any street with a marked midblock crosswalk. Lighting analysis shall be required on the midblock crosswalk as defined by the calculation area identified in these guidelines in addition to the subject project frontage.
e. The project is located on an area of major pedestrian sidewalks, pedestrian oriented streets, or through-block pathways as defined in Kirkland Zoning Code, Chapter 180, Plate 34 Series. (https://www.codepublishing.com/WA/Kirkland/html/KirklandZ180/KirklandZ180.html#Plate34A)

Use of AGi32 Software for lighting analysis is not required for residential developments of fewer than four units if **all** of the following conditions apply:

i. Located on a local street; and,
ii. Not in area that has experienced one or more of fatal, severe injury, fixed object, or pedestrian- or cyclist-involved crashes during the past five years; and,
iii. Not defined as part of a school walk route as defined above; and,
iv. Not defined as a Kirkland Neighborhood Greenways as defined above; and,
v. No other public street exists within the development other than the frontage; and,
vi. Not within 50 feet of an intersection with another public or private street.

If all the above conditions are met and use of AGi32 software for lighting analysis is not required, the proposed lighting improvements shall be limited to the following, as directed by Public Works:

1. One-to-one luminaire and/or pole replacement
2. Upgrading an existing luminaire to a comparable new LED luminaire fixture
3. Adding a new LED luminaire on an existing PSE pole

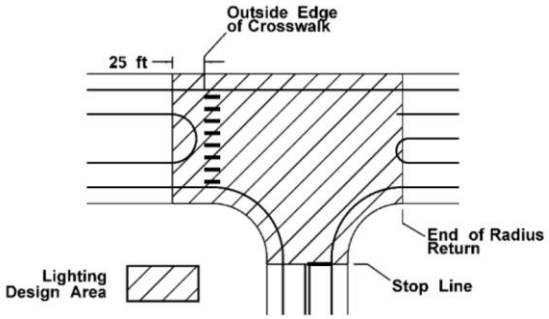
(3) Additional Considerations

a. Facility Evaluation Extent: Where a half-street improvement is required in conjunction with a development, the roadway width to be used in the lighting analysis for illumination design purposes will be the actual full width of the roadway at the time of design and not half of the ultimate width. Lighting levels shall be brought up to current standards for the whole width of the roadway adjacent to a new development. This may include installation of new streetlights on the opposite side of the street from the development to bring lighting levels to current standards. Existing light levels shall be evaluated for the length of the project frontage unless a modified evaluation extent is permitted in coordination with City staff.

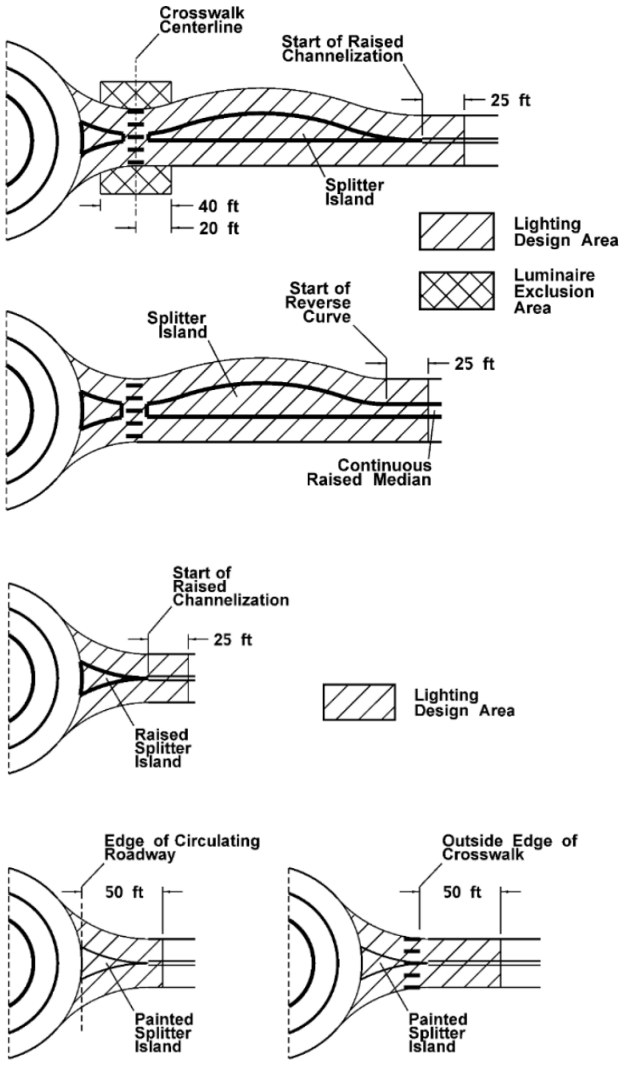
b. System Evaluation: When using AGi32 software in the analysis and evaluation of lighting improvements the following calculation criteria must be input into the program.
   i. Light Loss Factor (LLF): 0.85 is to be used for LED luminaire fixtures. Existing High Pressure Sodium (HPS) luminaire fixtures shall use a LLF of 0.62.
   ii. Initial Lumens Values: Typically included in the IES file provided by the manufacturer. For the latest IES file of the identified fixture, visit the manufacturer website or contact the manufacturer.
   iii. Analysis Method: Luminance and/or Illuminance method can be used. Horizontal illuminance method is required for intersections and curved section of streets.
   iv. Default Drive Current: 530mA. Confirm with City.
   v. Color Temperature: Warmer/softer light is preferred. 2700k is required on residential local and collector streets. On arterial streets 3000k is preferred, but 4000k may be considered on a case-by-case base.
   vi. Calculation areas shall be laid out on a 5-foot by 5-foot grid as follows:

- **Intersections**: The intersection and roundabout calculation area is required for the entirety of the intersection area, extends to face-of-curb or edge of pavement, and includes marked crosswalk areas.

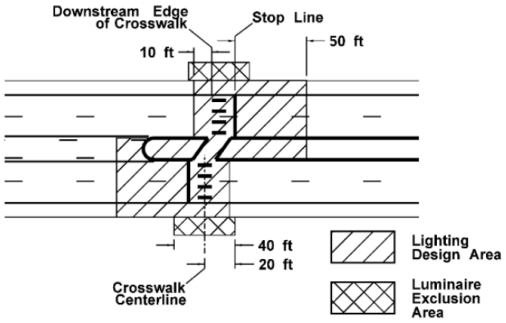
The calculation area for a typical non-roundabout intersection shall extend to the stop line or yield line, or to 25 feet beyond the outside edge of the marked crosswalk, whichever is furthest from the center of the intersection. If no stop or yield line exist and there is no marked crosswalk, the intersection area shall extend to the end of the radius return.



The calculation area for a roundabout may exclude the central island and truck apron. For safety and visibility, luminaire poles should not be placed within 20 feet of the centerline of any crosswalk. The calculation area shall extend to 25 feet before the start of either the raised channelization or the start of the reverse curve approach, 50 feet before the outside edge of the crosswalk, or 50 feet from the edge of the circulating roadway, whichever is furthest from the center of the intersection.



- **Roadway segments**: The roadway area extends to the face-of-curb or edge of pavement, and includes raised median islands, bicycle lanes, bicycle lane buffer areas, on-street bicycle/pedestrian shared paths and related buffer areas.
- **Midblock marked crosswalks**: regardless of control type, the analysis area extends 50 feet in advance of the stop line for the crosswalk, if present, and 10 feet beyond the downstream edge of the crosswalk for each approach direction. The analysis area also includes the curb ramps. If pedestrian refuge islands are present, they should be included in the analysis area. For safety and visibility, luminaire poles should not be placed within 20 feet of the centerline of any crosswalk. Luminaire poles should be installed upstream of the crossing on each side of the roadway, such that there is positive lighting of any pedestrian in the crosswalk, to the maximum extent possible.



- **Sidewalks:** When required, the calculation area extends from face of curb to back of sidewalk, including any planting strip or furnishing zone, and is evaluated for the entire length of the project A project requires a sidewalk lighting evaluation when pedestrian scale lighting is required as part of the project.

B. Design Inputs

The list below includes the factors that must be considered for street lighting design**:**

(1) Road Geometrics

This refers to the number and width of travel lanes, size and location of medians, islands, bridge structures, culverts, utilities, location of driveways, crosswalks and intersections, presence of parking lanes, sidewalks, and bicycle lanes. This information may be obtained upon request from Kirkland's internal GIS browser via the project's Public Works contact.

(2) Street Functional Classification

Streets are classified as principal and minor arterial, collector and local streets. Figure 1 in Appendix A depicts Kirkland's Street Functional Classification Map. This figure corresponds to Figure 3-11, Existing Roadway Network, in Kirkland's 2024 Transportation Strategic Plan.

(3) Adjacent Area Land Use

This refers to specifically designated pedestrian circulation areas within the vicinity of the project where both pedestrian and street lighting are required. These are shown in Kirkland Zoning Code Chapter 180 and include the CBD (Central Business District) in Downtown Kirkland, Totem Lake Business District, NE 85th Street Station Area, Juanita Business District, and North Rose Hill Business District, among other areas.

The area of the Finn Hill Neighborhood within the boundaries of Juanita Drive and Holmes Point Drive may require installation of pedestrian lighting in lieu of street lighting on streets designated as local.

(4) Nighttime Pedestrian Activity

The level of nighttime pedestrian activity is a key element in the design of street lighting systems. Areas with high nighttime pedestrian activity require street lighting systems that increase the visibility of pedestrians. Figure 2 in Appendix A depicts areas with high, medium and low nighttime pedestrian activity in Kirkland. However, the presence of schools and parks in some areas require consideration of higher pedestrian activity than those shown in Figure 2.

Areas with medium to high nighttime pedestrian activity are typically located in designated pedestrian circulation areas which may require both street and pedestrian scale luminaires/poles to meet lighting level requirements.

(5) Pavement Classification Type

Most common pavements are grouped according to their light reflectance characteristics (which vary from mostly specular to mostly diffuse) and this information is used in the calculation of pavement luminance (amount of light reflected from it) and Small Target Visibility (STV).

(6) Other Design Inputs

a. Light Output: This refers to the quality and total quantity of light emanating from a light source in all directions, and it is measured in Lumens.
b. Light Loss Factor: A Light loss factor should be applied to any luminaire considered to ensure that the maintained light levels will meet the target criteria.
c. BUG Ratings: The luminaire BUG (Backlight-Uplight -Glare) rating system provides a numerical rating of the luminaire light distribution as it applies to light trespass, uplight, and glare.

(7) Lighting Level Requirements

a. General: Lighting level requirements, in general, depend upon the type of roadway facility under consideration (street segment, intersection, midblock crosswalk, roundabout, pedestrian walkways, shared use path), street functional classification and nighttime pedestrian activity. Tables A.1, A.2, A.3, and A.4 in Appendix A summarize recommended lighting levels based on the illuminance and luminance lighting design methods.
b. The Illuminance method determines the amount of light incident upon the road surface or a vertical surface from the roadway lighting system. Horizontal and vertical illuminance criteria are recommended for pedestrian facilities and horizontal illuminance for intersections and curved segments of roads and streets.
c. The luminance method approximates the brightness of road surface as perceived by the driver. It is the recommended method for straight road/street segments.
d. Design criteria include:

i. Average Illuminance: It is the average of the roadway surface illuminance at all grid points. It is measured in foot candles.
ii. Average Luminance (AL): It is the average of the roadway surface luminance at all grid points. It is measured in candelas per square meter.
iii. Veiling Luminance (Lv): It is used to evaluate disability glare as experienced by the driver.
iv. Veiling Luminance Ratio: It is the veiling luminance maximum divided by the average luminance of the road.
v. Average Uniformity Ratio: it is the ratio of the average value of either Luminance or Illuminance to the minimum value.

e. Lighting level for intersection, sidewalks and marked crosswalks shall be as follow:
   i. Intersections: Intersections shall have a minimum average light level equal to 1.5 times the average light level requirement of the intersecting street with the highest functional classification. Average maintained light levels at intersections shall be no less than those shown in Tables A.3 and A.4 in Appendix A. Intersection uniformity shall be less than or equal to the uniformity ratio of the intersecting street with the highest functional classification.
   ii. Sidewalks and Pedestrian Crossings: Recommended lighting level within pedestrian facilities is shown on Table A.5 in Appendix A

C. Street Lighting Design Elements

This section provides recommendations for street lighting design elements including pole spacing and placement, pole mounting height, arm length and pole offset, pole materials and pole foundation; luminaire design elements include type and wattage, light output, light distribution type, and color temperature.

Specific street lighting design requirements are listed below:

(1) Pole Spacing and Placement, Pole Foundation and Materials

a. Recommended pole material type for various street functional classifications and designated land use areas are included in Tables B.2a, B.2b and B.2c in Appendix B.
b. Pole Spacing/Placement: The Design Engineer shall determine the optimum pole spacing to achieve required illumination levels. Poles should be carefully placed to support a lighting system that provides the required level of illumination and uniformity for the facility under design. Pole placement issues that need to be addressed during the design process include presence of trees, driveways and clear zone requirements. Once optimum pole spacing is established, it shall be adjusted so that:

i. No pole should be placed closer than 10 feet to a driveway measure from the outside wing. Poles should ideally be placed such that driveways are not located at the darkest point between luminaires.
ii. At least one pole should be placed at the approximate Point of Curvature/Point of Tangency (PC/PT) at a corner at unsignalized intersections.
iii. One pole should be placed at each corner of a signalized intersection. New luminaires shall be provided on signal poles.
iv. At midblock marked crosswalks located on arterials with three or more travel lanes, there should be at least two luminaires, each one located at least 20 feet in advance of the crosswalk for positive contrast. This helps avoid a silhouetting effect that reduces drivers' ability to perceive pedestrians in the crosswalk during hours of darkness.
v. To the maximum extent feasible, a luminaire pole should be located such that the centerline to centerline spacing between any adjacent existing or proposed trees and the light pole shall be greater than or equal to the mounting height of the light pole. The minimum spacing of any street light or pedestrian light pole to the center of an adjacent tree is 20 feet.
vi. Pole locations shall be adjusted between these control points to provide uniform spacing.

c. Pole lateral placement: Where sidewalk is present, luminaire poles shall be located at the back of sidewalk wherever practical. A minimum distance of 3 feet shall be maintained from the face of pole to the face-of-curb. In some cases, sidewalk widening may be required to provide required clearance along the pedestrian access route around the pole per PROWAG standards. If no curb is present, the face of the pole shall be located at least 10 feet from the edge of traveled way. Breakaway or slip bases should be considered anytime a pole is placed closer than 10 feet from either the edge of traveled way or face-of-curb.
d. Pole mounting height: The selection of pole mounting height shall be based on roadway width, adjacent area type and type of pole placement (staggered, single sided, or opposite). The selection of pole mounting height for residential areas needs to consider the impacts of spill over light and glare impacts resulting from taller poles. The values depicted in Tables B2.a, B2.b and B2.c in Appendix B are intended as general guidelines for the selection of mounting heights.
e. Pole foundations shall follow City of Kirkland pre-approved plans and shall be confirmed by the City. Soils analysis may be required in some cases. Should unsuitable soils be encountered, the Design Engineer shall provide an

alternate design based on a soils analysis. WSDOT Standard Plans and Specifications shall be followed if over-excavation becomes necessary.

f. Mast arm length recommended values range from 6 to 12 feet. In all cases with luminaire mast arms, the mast arm should provide a minimum luminaire overhang of approximately 2 feet from face of curb, unless a lighting analysis can show light level requirements are being met regardless of surrounding trees and other infrastructure.

(2) Luminaire Type and Materials

The luminaires' main function is to position and control, both electrically and optically, a light producing source such as LED (Light Emitting Diodes).

The two agencies who own and maintain street and pedestrian lighting systems in Kirkland are the City of Kirkland and PSE. As of the publishing date of this document, the current preferred LED luminaires are:

- City of Kirkland owned and maintained
  - Roadway luminaires: Leotek GreenCobra Series LED
  - Pedestrian luminaires: pole and luminaire styles vary depending upon the specific land use designation of the area under consideration.
  - Tables B2.a, B2.b and B2.c in Appendix B depict recommended pole/luminaire styles for various areas in Kirkland.
- PSE owned and maintained
  - Roadway luminaires: GE Evolve LED (Types II and III distribution only) – ***Design Engineer is responsible for requesting latest list of allowable luminaire fixture models from PSE at time of design.*** Projects shall only propose luminaire fixtures that PSE stocks for replacement.
  - Pedestrian luminaires: Cooper Traditionaire LED post-top

(3) Type of System/System Layout -Configuration

Kirkland is transitioning to all Light-Emitting Diode (LED) street lighting systems; therefore, LED systems shall be installed for all new and retrofit designs. Even if the photometric values are met, LED replacement is still required for each light that contributes to light levels along the frontage.

a. The preferred system layout/configuration shall be staggered. However, single-sided systems may be used if poles cannot be installed on the opposite side of the roadway due to overhead or underground utility conflicts or other obstructions.
b. Opposite system layout may be specified on wider roadways or to match existing facilities.

(4) Temporary Illumination (More than 48 Hours)

a. Temporary Illumination may be required for construction projects in the following cases:

   - Replacement of existing illumination systems
   - Complex roadway realignment or channelization
   - Multi-lane split around obstructions
   - Temporary traffic signals
   - All intersections with low lighting level as determined by the City with traffic control in place

b. Existing illumination shall not be removed until a temporary system has been approved by the City and is fully operational
c. All components of a temporary illumination system shall be crashworthy with breakaway features, outside the clear zone, or protected from traffic.
d. The temporary lighting shall satisfy the greater of the "construction lanes and detours" light level and uniformity ratios in accordance with WSDOT *Design Manual* Chapter 1040 or the specific intersection light level and uniformity ratios, as defined in this chapter under Calculation Areas.
e. All temporary lighting shall be connected to grid power.

(5) Transit Stops

The Design Engineer shall coordinate with transit agencies when any bus stops, park & ride facilities, or light rail stations are to be illuminated as part of any proposed system. Refer to King County Metro Transportation Facility Design Guidelines and Sound Transit Design Standards and Guidelines for Sound Transit Projects: Sounder & ST Express Passenger Facilities, Chapter 12 to obtain information on specific design requirements.

(6) Installation and Material Requirements

The information included in these guidelines is intended to provide guidance as to the type of materials and installation procedures to be used. Appendix B includes information on material and installation requirements for conduit, wiring, junction boxes and service cabinets.

Following the complete installation of public street lights, it is the responsibility of the Owner and/or Permit Holder to contact PSE to initiate the billing account transfer process. After the request has been initiated by the Owner and/or Permit Holder, PSE will reach out to Public Works for verification and complete account transfer process.

APPENDIX A

MAP AND FIGURES
Figure 1: Functional Classification Map
Figure 2: Pedestrian Activity Map

LIGHTING LEVEL REQUIREMENTS
Table A.1 Street Lighting- Luminance Criteria
Table A.2 Street Lighting- Illuminance Criteria
Table A.3 Full Intersection and Roundabout - Illuminance Criteria
Table A.4 Pedestrian Facilities- Illuminance Criteria

Table A.1 Street Lighting – Luminance Criteria

Street Classification	Pedestrian Activity Classification	Average Luminance **L**avg (cd/m^2)	Average Uniformity Ratio **L**avg/**L**min	Maximum Uniformity Ratio **L**max/**L**min	Maximum Veiling Luminance Ratio **L**vmax/**L**avg
Arterial	High	1.2	3.0	5.0	0.3
	Medium	0.9	3.0	5.0	0.3
	Low	0.6	3.5	6.0	0.3
Collector	High	0.8	3.0	5.0	0.4
	Medium	0.6	3.5	6.0	0.4
	Low	0.4	4.0	8.0	0.4
Local	High	0.6	6.0	10.0	0.4
	Medium	0.5	6.0	10.0	0.4
	Low	0.3	6.0	10.0	0.4

Table A.2 Street Lighting –Illuminance Criteria

Street Classification	Pedestrian Activity Classification	Average Illuminance (Footcandles)	Average Uniformity Ratio Eavg/Emin	Maximum Uniformity Ratio Emax/Emin	Maximum Veiling Luminance Ratio Evmax/Eavg
Arterial	High	1.7	3.0	5.0	0.3
	Medium	1.3	3.0	5.0	0.3
	Low	0.9	3.0	6.0	0.3
Collector	High	1.2	4.0	5.0	0.4
	Medium	0.9	4.0	6.0	0.4
	Low	0.6	4.0	8.0	0.4
Local	High	0.9	6.0	10.0	0.4
	Medium	0.7	6.0	10.0	0.4
	Low	0.4	6.0	10.0	0.4

Table A.3 - Full Intersection and Roundabout- Illuminance Criteria (lux/fc)

Functional Classification	Pedestrian Activity Level			Uniformity Ratio Eavg/Emin
	High	Medium	Low	
Principal/Principal (*)	34/3.2	26/2.4	18/1.7	3.0
Principal/Collector	29/2.7	22/2.2	15/1.4	3.0
Principal/Residential	26/2.4	20/1.9	13/1.2	3.0
Collector/Collector	24/2.2	18/1.7	12/1.1	4.0
Collector/Residential	21/2.0	16/1.5	10/0.9	4.0
Residential/Residential	18/1.7	14/1.3	8/0.7	6.0

(*) Also referred to as Major

Table A.4 Pedestrian Facilities – Illuminance Criteria

Pedestrian Facility	**Target Maintained Average. (fc)**	**Uniformity Ratio (Avg/Min)**
Marked Mid-block Crossing including curb ramps	1.5x adjacent intersection/corridor	3:1
Marked or Unmarked Crosswalk at Intersection	Same as adjacent Intersection	
Sidewalk (*): *All other sidewalk areas* *Residential*	0.7x adjacent roadway	4:1 6:1
Trails and multiuse paths other than sidewalks	0.7x adjacent roadway	4:1

(*) A project requires a sidewalk lighting analysis when pedestrian lighting is required

APPENDIX B
Applicable City Policies and Standards

MATERIALS AND INSTALLATION REQUIREMENTS

Design Engineer shall refer to the City of Kirkland Pre-Approved Plans and Policies, Sections 8-20 and 9-29 of the WSDOT Standard Specifications, and the WSDOT Standard Plans for complete material and installation requirements.

1. Pole Foundations:

Pole foundations shall follow City of Kirkland Standard Plan CK-R47 and shall be confirmed by the City. Where unsuitable soils are encountered, as determined by the City of Kirkland, the Design Engineer shall provide an alternate design based on a soils analysis. Foundations shall be placed against undisturbed earth. WSDOT Standard Plans and Specifications shall be followed if over-excavation becomes necessary.

2. Conduit:

a. Conduit placed above ground or between the service point (power pole or vault) and the service cabinet shall be hot dip galvanized, rigid steel.
b. Conduit beneath the roadway or shoulder area shall be Schedule 80 rigid Polyvinyl Chloride (PVC). Conduit placed elsewhere shall be Schedule 40 rigid PVC.
c. A minimum of two conduits shall be installed along frontage improvements and roadway crossings. Conduit shall be extended from property line to property line and terminate in a junction box. If property line ends in a driveway or other obstruction, the conduit must be further extended to clear the obstruction or driveway.
d. Minimum size conduit shall be 2 inches for power and 3 inches for communication. No half sizes shall be used.
e. Illumination wires shall not be placed in the same conduit as signal, detection, or communication wires.
f. Maximum conduit fill shall be 26 percent for new installations and 40 percent for retrofit installations. See Table III-2 for conduit fill requirements for various trade sizes. Conduit fill shall be based on the total area of the circuit wires within the conduit. Wire size to calculate conduit fill shall be as follows:
    - No. 8 Wire: 0.056 sq. in.
    - No. 6 Wire: 0.073 sq. in.
    - No. 4 Wire: 0.097 sq. in.
    - No. 2 Wire: 0.133 sq. in.

Table B.1. CONDUIT FILL

Trade Size	Schedule 40		Schedule 80	
	26 Percent Fill	40 Percent Fill	26 Percent Fill	40 Percent Fill
2″	0.856 sq. in.	1.316 sq. in.	0.747sq. in.	1.150sq. in.
3″	1.890 sq. in.	2.907 sq. in.	1.675 sq. in.	2.577 sq. in.
4″	3.264 sq. in.	5.022 sq. in.	2.927 sq. in.	4.503 sq. in.

3. Junction Boxes:

a. Junction box installation shall conform to the City of Kirkland Standard Plans and WSDOT Standard Plans.
b. A junction box shall be placed within 10 feet of each luminaire pole as well as adjacent to the service cabinet.
c. Junction boxes shall be placed so that no conduit run is greater than 500 linear feet.
d. Junction boxes shall be placed at all locations where the conduit turns 90 degrees or more horizontally.
e. All large junction boxes shall be Type 8, dual lid units.
f. Junction boxes shall not be located within the traveled way, pedestrian ramps, or driveways. Junction boxes located in sidewalk or any other Pedestrian Accessible Route shall have non-slip frames and lids.
g. The size of the junction box shall be determined by the total of the conduit diameters entering the box as follows:
    - Type 1 Junction Box: Maximum of 6 inches
    - Type 2 Junction Box: Maximum of 12 inches
    - Type 8 Junction Box: Maximum of 24 inches
h. Conduit containing illumination circuits shall not be routed through junction boxes containing conduit for signal, detection, and/or communication conduits, except where junction box serves type 3 signal pole.
i. Traceable mule tape must be installed in all empty conduit

4. Wiring:

a. Main circuit wires shall be sized to provide a maximum of 4 percent voltage drop at the end of each branch circuit.
b. Minimum wire size shall be No. 8.
c. A ground wire shall be included in all illumination runs and shall be equal in size to the largest conductor.
d. Circuits from different services shall not enter the same junction box.
e. Main and branch circuit wire shall be USE rated. Wire beyond fusing shall be NEC wet rated and sized accordingly to fixture and fuse ampacity.

f. Splices and Disconnect Kits: Splices in the junction box to connect the individual luminaires to the main circuit shall be made with a mechanical C-Tap with 3M 2200 Mastic and 3m 88 Tape. A fused quick disconnect kit shall be provided in each pole base, and shall be made with a SEC Connector Company model 1791-SF.
g. Fuse kits shall be in the j-box for pedestrian luminaries.
h. All fixtures shall have a shunt in place of the photoelectric control.

5. Service Cabinets:

a. Service cabinets shall conform to City of Kirkland Standard Plan CK.TS.05A, B and C. Where a signalized intersection is being constructed in conjunction with the illumination system, the illumination system may be energized from the service cabinet at the signal.
b. Where the service cabinet is installed to service only an illumination system, it shall be located near the midpoint of the system to minimize voltage drops.
c. Service cabinets shall power illumination, ITS Devices and traffic signals only.
d. All services shall be metered.
e. Services shall be 120/240 volt single phase and have a twist lock photoelectric control inside a 6”X6” wire mesh guard, mounted on top of the cabinet.
f. Minimum (1) spare 2” conduit shall be placed between the j-boxes
g. Photoelectric Control

6. Luminaires:

Approved City of Kirkland standards luminaires are Light-Emitting Diode (LED), cobra-head type with IESNA Type II (local and collector streets) and Type III (on arterial streets) distribution patterns. Recommended Nominal Color Temperature ranges from 2700K for local street and collectors and 3000 to 4000K for Arterial Streets. Recommended luminaires standards are summarized in Tables B2.a, B2.b and B2.c.

Tables B2.a, B2.b and B2.c (attached)

Appendix B

Table B2.a Recommended Street and Pedestrian Lighting Standards for Arterial Streets

Street Classification	Designated Land Use (LU) Areas	Land Use Pre-Approved Plan	Max Pole Spacing (*) (Ft)		Mounting Height (*) (Ft)		Arm Length (*) (Ft)	Max. Wattage(*)		Pre-Approved Luminaire and Pole Standards			
			Street Light	Pedestrian Light	Street Light	Pedestrian Light	Street Light	Street Light	Pedestrian Light	Street Light		Pedestrian Light	
ARTERIAL	Central Business District	CK-R.47D	200	60	30-35	12	8-12	112	90	LED Cobra Head	CK -TS.08, J- Series Round Steel Fiber Glass Octagonal Concrete Tapered	Candela Series Cand1-1A, Aluminum Straight / Round Pole	CK-R47 CK-R.47A, CK-R. 47B CK-R.47C
	Totem Lake Center Neighborhood	CK-R.47F	200	60	30-40	12	8-12	112	65	LED Cobra Head	CK -TS.08 J -Series Round Steel Fiber Glass Octagonal Concrete Tapered	Candela Series Cand 2, Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R.47E CK-R.47M
	Juanita Business District	CK-R.47H	200	60	30-40	10	8-12	112	90	LED Cobra Head	CK -TS.08 J -Series Round Steel Fiber Glass Octagonal Concrete Tapered	Lumec Ancestra Series, Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R.47G CK-R.47I
	NE 85th Planned Area	Pending	200	60	30-40	12	8-12	112	90	LED Cobra Head	CK -TS.08 J -Series Round Steel Fiber Glass Octagonal Concrete Tapered	Domus Small Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R.47K CK-R.47L
	North Rose Hill	CK-R.47J	200	60	30-40	12	8-12	112	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	Candela Series Cand 2, Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R.47E CK-R.47M
	Rest of Kirkland		200	60-80	30-40	12-15	8-12	112	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	TBD	TBD

(*) These values may be modified depending on the specific design requirements of each project.

Table B.2b Recommended Street and Pedestrian Lighting Standards for Collector Streets

Street Classification			Max Pole Spacing (*) (Ft)		Mounting Height (*) (Ft)		Arm Length (*) (Ft)	Max. Wattage (*)		Pre-Approved Luminaire and Pole Standards			
	Designated Land Use (LU) Area	Land Use Pre-Approved Plan	Street	Pedestrian	Street	Pedestrian	Street	Street	Pedestrian	Street Light		Pedestrian Light	
COLLECTOR	Central Business District	CK-R.47D	200	60-80	25 - 30	12	8-10	84	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Concrete Octagonal Tapered	Candela Series Cand1-1A, Aluminum Straight / Round Pole	CK-R47 CK-R.47A, CK-R. 47B CK-R.47C
	Totem Lake Center/ Neighborhood	CK-R.47F	200	60-80	25 - 30	12	8-10	84	65	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	Candela Series Cand 2, Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R.47E CK-R.47M
	Juanita Business District	CK-R.47H	200	60-80	25 - 30	10	8-10	84	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	Lumec Ancestra Series, Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R. 47G CK-R.47I
	NE 85th Street Planned Area	Pending	200	60-80	25 - 30	12	8-10	84	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	Domus Small Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R. 47K CK-R.47L
	North Rose Hill District	CK-R.47J	200	60-80	25 - 30	12	8-10	84	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	Candela Series Cand 2, Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R.47E CK-R.47M
	Rest of Kirkland		150-200	60-80	25-30	NA	8-10	84	NA	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	NA	NA

(*) These values may be modified depending on the specific design requirements of each project.

Appendix B

Table B2.c Recommended Street and Pedestrian Lighting Standards for Local Streets

Street Classification	Designated Land Use (LU) Areas	Land Use Pre-Approved Plan	Max Pole Spacing (*) (Ft)		Mounting Height (*) (Ft)		Arm Length (*) (Ft)	Max. Wattage(*)		Pre-Approved Luminaire and Pole Standards			
			Street Light	Pedestrian Light	Street Light	Pedestrian Light	Street Light	Street Light	Pedestrian Light	Street Light		Pedestrian Light	
LOCAL	Central Business District	CK-R.47D	250	60-80	25	12	6-10	39	90-R	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	Candela Series Cand1-1A, Aluminum Straight / Round Pole	CK-R47 CK-R.47A, CK-R. 47B CK-R.47C
	Totem Lake Center Neighborhood	CK-R.47F	250	60-80	25	12	6-10	39	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	Candela Series Cand 2, Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R.47E CK-R.47M
	Juanita Business District	CK-R.47H	250	60-80	25	10	6-10	39	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	Lumec Ancestra Series, Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R. 47G CK-R.47I
	Ne 85th Street Planned Area	Pending	250	60-80	25	12	6-10	39	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Concrete Octagonal Tapered	Domus Small, Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R. 47K CK-R.47L
	North Rose Hill District	CK-R.47J	250	60-80	25	12	6-10	39	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	Candela Series Cand 2 Aluminum Straight / Round Pole	CK-R.47A CK-R.47B CK-R.47E CK-R.47M
	Rest of Kirkland (**)		250	60-80	25	12-15	6-10	39	90	LED Cobra Head	CK -TS.08 J-Series Round Steel Fiber Glass Octagonal Concrete Tapered	TBD	TBD

(*) These values may be modified depending on the specific design requirements of each project.

(**) The area of the Finn Hill Neighborhood west of Juanita Drive may install pedestrian lighting per PSE's recommended pedestrian pole/luminaires standards.