

Model Lighting Ordinance (MLO)

Developed by the International Dark-Sky Association (IDA) and
the Illuminating Engineering Society (IES)

60% Public Review

NOT FOR ADOPTION OR USE

February 7, 2009

Modifications Published March 2, 2009

- Added “-“ to page 1: International Dark-Sky Association
- Added Reference to page 21 of text/22 of PDF “Addendum A for IESNA TM-15-07: Backlight, Uplight, and Glare (BUG) Ratings <http://www.iesna.org/PDF/Erratas/TM-15-07BUGRatingsAddendum.pdf>”
- Change to page 23 of text/24 PDF two references to "Table E" changed to "Appendix A: Table A"
- Added to page 24 of text/25 of PDF "Appendix A: Table A –" to Skyglow Multiplier of Exitant Lumens (interpreted from Baddiley)
- Added to page 25 of text/26 of PDF "Appendix A: Table B –" to Maximum Line of Sight Illuminance at Any Vertical Plane Boundary
- Added to page 25 of text/26 of PDF "Appendix A: Table C –" to Minimum Modified DeBoer Rating Viewed from Any Boundary

1 **IDA-IESNA Model Lighting Ordinance (MLO)**

2
3 **FOR PUBLIC REVIEW**

4 **NOT INTENDED FOR PUBLIC ADOPTION AT THIS TIME**

5 **Contents**

6 **I. Preamble..... 2**

7 **II. Definitions..... 3**

8 **III. General Requirements for All Outdoor Lighting 6**

9 A. Conformance with All Applicable Codes 6

10 B. Applicability 6

11 C. Use of Lighting Zones..... 7

12 D. Lighting Controls and Curfews 8

13 **IV. Requirements for Non-Residential Outdoor Lighting..... 10**

14 A. Prescriptive Method 10

15 B. Performance Method 10

16 **V. Requirements for Residential Outdoor Lighting 11**

17 **VI. Lighting by Special Use Permit Only 12**

18 A. High Intensity and Special Purpose Lighting..... 12

19 B. Complex and Non-Conforming Uses..... 12

20 **VII. Existing Lighting 14**

21 A. Amortization..... 14

22 B. New Uses or Structures, or Change of Use..... 14

23 C. Additions or Alterations 14

24 **VIII. Enforcement and Penalties (Reserved) 16**

25 **IX. Tables 17**

26 **Appendix “A” Performance Method 23**

27
28

1 **i. Preamble**

2 The purpose of this Ordinance is to provide regulations for outdoor lighting
3 that will:

4 Permit reasonable uses of outdoor lighting for night-time safety, utility,
5 security, productivity, enjoyment and commerce.

6 a. Conserve energy and resources to the greatest extent possible.

7 b. Minimize adverse offsite impacts including, light trespass, and
8 obtrusive light.

9 c. Curtail light pollution and preserve the nighttime environment.

10 d. Help preserve the dark night sky for astronomy and enjoyment.

11 e. Help protect the natural environment from the adverse effects of night
12 lighting from electric sources.

13

1 II. Definitions

<i>Authority</i>	The adopting municipality, agency or other governing entity having jurisdiction.
<i>Astronomic Time Switch</i>	An automatic lighting control device that operates as an on/off switch for outdoor lighting relative to time of solar day with time of year correction.
<i>Adjacent Grade</i>	Grade directly below luminaire on a plumb line or, nearest grade thereto.
<i>Backlight</i>	For an exterior luminaire, light emitted in the quarter sphere below horizontal and in the opposite direction of the intended orientation of the luminaire. For luminaires with symmetric distribution, backlight will be the same as frontlight.
<i>BUG</i>	A luminaire classification system that is used in the Prescriptive method for evaluating optical distribution of outdoor luminaires that denotes levels of backlight (B), uplight (U) and glare (G).
<i>Canopy</i>	A covered, unconditioned structure with at least one side open for pedestrian and/or vehicular access..
<i>Common Outdoor Areas</i>	One or more of the following: a common parking lot for three or more domiciles or buildings; a common parking garage or covering entrance intended to be used by three or more domicile or buildings; a common entrance for three or more domiciles or buildings.
<i>Curfew</i>	A time defined by the authority when outdoor lighting is reduced to a specified maximum level or extinguished.
<i>Emergency conditions</i>	Loss of electrical power, fire, security alarm, or other situation requiring uninterrupted illumination for the path of egress.
<i>Fully Shielded Luminaire</i>	A residential luminaire with opaque top and sides, capable of only emitting light in the lower photometric hemisphere as installed.
<i>Frontlight</i>	For an exterior luminaire, light emitted in the quarter sphere below horizontal and in the direction of the intended orientation of the luminaire.
<i>Glare</i>	Light entering the eye directly from luminaires that causes visual discomfort or reduced visibility.
<i>Hardscape</i>	Permanent improvements to a site, including but not limited to parking lots, drives, entrances, curbs, ramps, stairs, steps, and similar construction.
<i>Hardscape Area</i>	Area in square feet of all hardscape including any medians, walkways, landscape areas 10 feet or less in width within the hardscape area used to calculate complete site method allowed lumens.
<i>Hardscape Perimeter</i>	Perimeter in linear feet of all hardscape outside perimeter plus perimeter around buildings and structures greater than 10 feet in width used to calculate complete site method allowed lumens.
<i>IDA</i>	International Dark-Sky Association, Tucson, AZ USA
<i>IES</i>	Illuminating Engineering Society, New York, NY USA
<i>Illuminated area</i>	An exterior area for which lighting of reasonable uniformity and illumination is provided; not incidentally lighted or partially lighted.
<i>Improved area</i>	The area of a specific use, measured in plan view.
<i>Initial Lamp Lumens</i>	Lumen rating of a lamp when the lamp is new and has not depreciated in light output (rated lamp lumens) Lamp lumen depreciation equals 1.0.

<i>Intended manner</i>	The manner of use of the product generally as listed, advertised and/or per manufacturer's standard installation instructions.
<i>Lamp</i>	A generic term for a source created to produce optical radiation (i.e. "light"), often called a bulb or tube.
<i>Lamp Watts</i>	The rated watts of the lamp, not including the watts of external auxiliaries.
<i>Landscape Lighting</i>	Lighting not mounted to poles or buildings, for the purpose of illuminating trees, shrubbery and other natural external elements.
<i>Light Pollution</i>	Light scattered by the atmosphere that interferes with the appreciation or observation of night skies
<i>Light Trespass</i>	Unwanted light that falls on neighboring properties or produces glare or distraction for observers away from the area for which the light is intended (also called "nuisance glare")
<i>Lighting</i>	Light produced by man-made sources, including electric lamps, gas lamps, and similar sources.
<i>Lighting Equipment</i>	Equipment specifically intended to provide electric illumination, including but not limited to, luminaire(s), poles, posts, and related structures, electrical wiring, and other necessary or auxiliary components.
<i>Lighting System</i>	On a site, all exterior man-made lighting sources, associated infrastructure and controls.
<i>Low Voltage Landscape Lighting</i>	Electric lighting powered at less than 15 volts and limited to lamps of 50 watts or less, not mounted to poles or buildings, for the purpose of illuminating trees, shrubbery and other natural external elements.
<i>Lumens (lm)</i>	International unit of luminous flux; light power corrected for V_{λ} , the human photopic sensitivity function.
<i>Lighting Zone (LZ)</i>	A designation assigned by the Authority for specified parcels, areas or districts within its jurisdictional boundaries defining allowable ambient lighting levels, operational characteristics and other control criteria.
<i>Luminaire</i>	The complete lighting unit assembly (fixture), consisting of a lamp, or lamps and ballast(s) (when applicable), together with the parts designed to distribute the light (reflector, lens, diffuser), to position and protect the lamps, and to connect the lamps to the power supply.
<i>Mounting height</i>	The height of a luminaire above grade level. The horizontal spacing of poles is often measured in units of "mounting height". Example: "The luminaires can be spaced up to 4 mounting heights apart."
<i>New lighting</i>	Lighting for areas not previously illuminated; newly installed lighting of any type except for replacement lighting or lighting repairs.
<i>Obtrusive light</i>	Light that produces sky glow, light trespass, glare or other undesirable environmental impacts.
<i>Opaque</i>	A solid material allowing no light to pass through.
<i>Ornamental lighting</i>	Lighting that is not a sign and does not impact the function and safety of an area but is purely decorative, or used to illuminate architecture and/or landscaping, and installed for aesthetic effect.
<i>Partly Shielded Luminaire</i>	A residential luminaire in which the lamp is shielded by a translucent shade so as to prevent light from being directly emitted by the lamp or reflector into the upper photometric hemisphere

<i>Photoelectric Switch</i>	A control device employing a photocell or photodiode to detect daylight and automatically switch lights off by day.
<i>Project</i>	Installation of a lighting system under a single electrical permit or for a specific construction project, multiple permits when required for phased construction.
<i>Property line</i>	The edges of the legally-defined extent of privately owned property
<i>Public Right of Way</i>	Any sidewalk, planting strip, alley, street, or pathway, improved or unimproved, that is dedicated to public use.
<i>Radiosity</i>	A method for calculating lighting system performance that accounts for direct and reflected light by using Fourier coefficients to describe the transfer of radiative energy from sources to surfaces and among surfaces.
<i>Ray Tracing</i>	A method for calculating lighting system performance that accounts for direct and reflected light by tracing each ray from sources to surfaces and among surfaces until dissipated.
<i>Replacement Lighting</i>	Lighting installed specifically to replace existing lighting equipment that is sufficiently inoperable to be beyond repair(s).
<i>Repair(s)</i>	The reconstruction or renewal of any part of an existing luminaire for the purpose of its on-going operation, including but not limited to relamping or replacement of components such as; capacitor, ballast or photoelectric control.
<i>Residential Luminaire</i>	Luminaires used solely for compliance with Section V.
<i>Sales area</i>	Uncovered area used for sales of retail goods and materials, including but not limited to automobiles, boats, tractors and other farm equipment, building supplies, and gardening and nursery products.
<i>Seasonal lighting</i>	Temporary lighting installed and operated in connection with holidays, community celebrations or traditions.
<i>Service yard</i>	Uncovered hardscape specifically used for vehicular, marine or aviation service or for outdoor storage and/or loading of goods and materials
<i>Shielded Directional Luminaire</i>	A fully shielded residential luminaire with an adjustable mounting device allowing aiming in a direction other than straight downward.
<i>Sign</i>	Advertising, directional or other signs (governed by the sign ordinance)
<i>Site</i>	A geographic area within the jurisdiction of the Authority delineated by specific dimensions and coordinates or a complete land parcel defined by designated property boundaries as recorded by the Authority..
<i>Skyglow</i>	The illumination of clouds, moisture and airborne matter by lighting
<i>Temporary lighting</i>	Lighting installed and operated for periods not to exceed 60 days, completely removed and not operated again for at least 30 days.
<i>Third Party</i>	A party contracted to provide lighting, such as a utility company.
<i>Time Switch</i>	An automatic lighting control device that operates as an on/off switch for outdoor lighting according to time of day.
<i>Translucent</i>	A material allowing light to pass through while obscuring or diffusing the lamp.
<i>Uplight</i>	For an exterior luminaire, light emitted in the hemisphere at or above the horizontal plane.
<i>Urban Park</i>	A publicly accessible park in or near a town or city and not specified as a wildlife refuge or nature preserve.

1 **III. General Requirements for All Outdoor Lighting**

2 **A. Conformance with All Applicable Codes**

3 All outdoor lighting shall be installed in conformance with the provisions of
4 this Ordinance, applicable Electrical and Energy Codes, and applicable
5 sections of the Building Code.

6 **B. Applicability**

7 Except as described below, all outdoor lighting installed after the effective
8 date of this Ordinance shall comply with these requirements. This includes,
9 but is not limited to, new lighting, replacement lighting, or any other lighting
10 whether attached to structures, poles, the earth, or any other location,
11 including lighting installed by any third party.

12 *Exemptions to III.(B.)* The following are not regulated by this
13 Ordinance:

- 14 a. Lighting equipment within public right-of-way or easement for
15 the principal purpose of illuminating streets, roadways and/or
16 other areas open to public transport by vehicle or pedestrian
17 traffic. No exemption shall apply to any lighting equipment
18 within the public right of way or easement when the purpose of
19 the luminaire is to illuminate areas outside the public right of way
20 or easement.
- 21 b. Lighting equipment for roadway rest areas without gas stations,
22 restaurants or retail stores.
- 23 c. Lighting equipment for public monuments and statuary.
- 24 d. Lighting equipment solely for signs, (as this lighting is regulated
25 by the Sign Ordinance).
- 26 e. Repairs to existing lighting equipment.
- 27 f. Temporary lighting equipment for theatrical, television,
28 performance areas and construction sites.
- 29 g. Lighting equipment in swimming pools and other water features.
- 30 h. Temporary lighting equipment and seasonal lighting equipment
31 provided that individual lamps are 10 watts or less.
- 32 i. Lighting equipment that is only used during emergency
33 conditions.

1 j. Lighting equipment used solely for security and controlled by a
2 motion sensor with photoelectric switch.

3 k. In Lighting Zones 2, 3 and 4, low voltage landscape lighting
4 equipment controlled by a photoelectric switch or programmable
5 time switch.

6 ***Exceptions to III. (B.)*** When the requirements herein conflict with
7 specific lighting provisions of any of the following, only those
8 specific provisions shall take precedence and all other requirements
9 herein shall remain in force:

10 a. Lighting equipment specified or identified in a specific special
11 use permit.

12 b. Lighting equipment required by laws and/or regulation of a
13 government, authority or entity having applicable jurisdiction.

14 **C. Use of Lighting Zones**

15 The Authority shall establish Lighting Zones (LZ) within its jurisdictional
16 boundaries. The Lighting Zone shall define the limitations for outdoor
17 lighting as specified in this ordinance. The descriptive criteria for each
18 Lighting Zone shall be as follows:

19 **LZ0: No ambient lighting**

20 Areas where the natural environment will be seriously and adversely
21 affected by lighting. Impacts include disturbing the biological cycles
22 of flora and fauna and/or detracting from human enjoyment and
23 appreciation of the natural environment. Human activity is
24 subordinate in importance to nature. The vision of human residents
25 and users is adapted to the total darkness, and they expect to see little
26 or no lighting. When not needed, lighting should be extinguished.

27 **LZ1: Low ambient lighting**

28 Areas where lighting might adversely affect flora and fauna or disturb
29 the character of the area. The vision of human residents and users is
30 adapted to low light levels. Lighting may be used for safety, security
31 and/or convenience but it is not necessarily uniform or continuous.
32 After curfew, most lighting should be extinguished or reduced as
33 activity levels decline.

34

1 **LZ2: Moderate ambient lighting**

2 Areas of human activity where the vision of human residents and
3 users is adapted to moderate light levels. Lighting may typically be
4 used for safety, security and/or convenience but it is not necessarily
5 uniform or continuous. After curfew, lighting may be extinguished or
6 reduced as activity levels decline.

7 **LZ3: Moderately high ambient lighting**

8 Areas of human activity where the vision of human residents and
9 users is adapted to moderately high light levels. Lighting is generally
10 desired for safety, security and/or convenience and it is often uniform
11 and/or continuous. After curfew, lighting may be extinguished or
12 reduced in most areas as activity levels decline.

13 **LZ4: High ambient lighting**

14 Areas of human activity where the vision of human residents and
15 users is adapted to high light levels. Lighting is generally considered
16 necessary for safety, security and/or convenience and it is mostly
17 uniform and/or continuous. After curfew, lighting may be
18 extinguished or reduced in some areas as activity levels decline.
19

20 **D. Lighting Controls and Curfews**

21 1. Automatic Control Requirements

22 Controls shall be provided that automatically extinguish all outdoor
23 lighting by day using a switching device such as a photoelectric
24 switch, astronomic time switch or a control system such as a
25 programmable lighting controller, building automation system,
26 lighting energy management system or equivalent.

27 *Exceptions to III.(D.) 1.* Automatic lighting controls are not
28 required for the following:

- 29 a. Lighting under canopies.
- 30 b. Lighting for tunnels, parking garages, garage entrances, and
31 similar conditions.
32

1 2. Curfews and Automatic Lighting Reduction Requirements

2 The Authority shall establish curfew time(s) specific to each
3 Lighting Zone designation after which the total outdoor lighting
4 lumens shall either be extinguished or at a minimum reduced by
5 30%.

6 *Exceptions to III.(D.) 2.* Lighting reductions are not required for
7 any of the following:

- 8 a. When there is only one (1) conforming luminaire on the
9 property.
- 10 b. Code required lighting for steps, stairs, walkways, and points
11 of ingress and egress to building and other facilities.
- 12 c. When in the opinion of the Authority, lighting levels must be
13 maintained.
- 14 d. Motion activated lighting.
- 15 e. Lighting governed by special use permit in which times of
16 operation are specifically identified.
- 17 f. Residential lighting
- 18

1 **IV. Requirements for Non-Residential Outdoor**
2 **Lighting**

3 For all non-residential properties, and for multiple residential properties
4 having common outdoor areas, all outdoor lighting shall comply either with
5 Part A or Part B of this section.

6 **A. Prescriptive Method**

7 An outdoor lighting system for applications in this section shall comply with
8 this Ordinance if it meets the requirements as defined in subsections 1 and 2,
9 below.

10 1. Total Site Lumen Limit

11 The total installed initial lamp lumens of all outdoor lighting on the
12 site shall not exceed the total site lumen limit. The total site lumen
13 limit shall be determined using any one of the three methods listed
14 in Table A, (Allowed Total Lumens per Site for Non-residential
15 Outdoor Lighting). Only one method shall be used per permit
16 application. For sites with existing lighting, the existing lighting
17 shall be included in the calculation of total installed lumens.

18 2. Limits to Off Site Impacts

19 All luminaires shall be rated and installed according to Table C,
20 (Maximum Allowable Backlight, Uplight and Glare (BUG)
21 Ratings).

22 **B. Performance Method**

23 An outdoor lighting system for applications in this section shall comply with
24 this Ordinance if when analyzed by the appropriate software it meets the
25 specifications in Appendix A.

1 **v. Requirements for Residential Outdoor Lighting**

2 For all residential properties including multiple residential properties not
3 having common areas, all outdoor lighting shall comply with Table D,
4 (Residential Lighting Total Wattage Limits). Lighting not listed in Table D
5 shall not be permitted unless exempt according to Section III (B.).

6 *Exceptions to Section IV and Table D.*

7 a. Open flame gas lights (without mantle) are exempt.

8 b. If located more than 75 feet from **all property lines**, a fully shielded
9 luminaire may be mounted up to 25 feet above adjacent grade.

10 c. Outdoor lighting for sports, agriculture and other uses/activities which
11 exceed the limits defined in this section shall only be permitted by a
12 special use permit.

13

1 **vi. Lighting by Special Use Permit Only**

2 **A. High Intensity and Special Purpose Lighting**

3 The following lighting systems are prohibited from being installed or used
4 except by special use permit:

- 5 1. Temporary lighting in which any single luminaire exceeds 250
6 watts or the total lighting load exceeds 2000 watts.
- 7 2. Aerial Lasers.
- 8 3. Searchlights.
- 9 4. Other very intense lighting defined as having a light source
10 exceeding 200,000 lumens or an intensity in any direction of more
11 than 2,000,000 candelas.

12 **B. Complex and Non-Conforming Uses**

13 Upon issuance of a special use permit by the Authority, lighting not
14 complying with the technical requirements of this ordinance but consistent
15 with its intent may be installed for complex sites/uses or special uses
16 including, but not limited to, the following applications:

- 17 1. Sports facilities, including but not limited to unconditioned rinks,
18 open courts, fields, and stadiums.
- 19 2. Construction lighting.
- 20 3. Lighting for industrial sites having special requirements, such as
21 petrochemical manufacturing or storage, shipping piers, etc.
- 22 4. Parking structures.
- 23 5. Bridges, public monuments, public buildings and urban parks.
- 24 6. Theme and amusement parks.

- 1 To obtain such a special use permit, applicants shall demonstrate that the
2 proposed lighting installation:
- 3 a. Has been analyzed using the Performance Method and for which
4 Sky Glow, Light Trespass and Glare values have been calculated.
 - 5 b. Has sustained every reasonable effort to mitigate Sky Glow, Light
6 Trespass and Offensive Glare supported by a signed statement
7 describing the mitigation measures. Such statement shall be
8 accompanied by computer calculations indicating the light trespass
9 levels (horizontal and vertical at ground level) at the property line.
 - 10 c. Employs lighting controls to reduce lighting at a Project Specific
11 Curfew (“Curfew”) time to be established in the special use permit.
 - 12 d. Complies with the Prescriptive or Performance Method after
13 Curfew.
- 14 The Authority shall review each such special use permit application. A
15 special use permit may be granted if, upon review, the Authority believes
16 that the proposed lighting will not create unwarranted glare, sky glow, or
17 light trespass.
- 18

1 VII. Existing Lighting

2 Lighting installed prior to the effective date of this ordinance shall comply
3 with the following.

4 A. Amortization

5 On or before [amortization date], all outdoor lighting shall comply with this
6 Code.

7 B. New Uses or Structures, or Change of Use

8 Whenever there is a new use of a property (zoning or variance change) or
9 the use on the property is changed, all outdoor lighting on the property shall
10 be brought into compliance with this Ordinance before the new or changed
11 use commences.

12 C. Additions or Alterations

13 1. Major Additions.

14 If a major addition occurs on a property, lighting for the entire
15 property shall comply with the requirements of this Code. For
16 purposes of this section, the following are considered to be major
17 additions:

- 18 a. Additions of 50 percent or more in terms of additional
19 dwelling units, gross floor area, seating capacity, or parking
20 spaces, either with a single addition or with cumulative
21 additions after the effective date of this Ordinance.
- 22 b. Single or cumulative additions, modification or replacement
23 of 50 percent or more of installed outdoor lighting
24 luminaires existing as of the effective date of this Ordinance.

25 2. Minor Modifications, Additions, or New Luminaires for Non- 26 residential and Multiple Dwellings

27 For non-residential and multiple dwellings, all additions,
28 modifications, or replacement of less than 50 percent of outdoor
29 luminaires existing as of the effective date of this Ordinance shall
30 require the submission of a complete inventory and site plan
31 detailing all existing and any proposed new outdoor lighting.

32 Any new lighting shall meet the requirements of this Ordinance.

- 1 3. Resumption of Use after Abandonment
- 2 If a property with non-conforming lighting is abandoned for a
- 3 period of six months or more, then all outdoor lighting shall be
- 4 brought into compliance with this Ordinance before any further use
- 5 of the property occurs.
- 6

PUBLIC REVIEW ONLY

1 **viii. Enforcement and Penalties (Reserved)**

2
3
4

PUBLIC REVIEW ONLY

1 **ix. Tables**

2

3 **Non-Residential Prescriptive Method**

4 Table A - Non-residential Outdoor Lighting Prescriptive Method - Allowed
5 Total Lumens per Site.....18

6 Table B - Additional Lumen Allowance for Specific Applications.....19

7 Table C Prescriptive Method - Maximum Allowable Backlight, Uplight and
8 Glare (BUG) Ratings.....21

9

10 **Residential Lighting**

11 Table D - Residential Lighting Total Wattage and Lumen Limits for each
12 Luminaire.....22

13

14

15

1 **Table A - Non-residential Outdoor Lighting Prescriptive Method -**
 2 **Allowed Total Lumens per Site**

3 Only one (1) method may be used for each project.

Per Parking Space Method					
	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
May only be applied to projects up to 12 parking spaces (including handicapped accessible spaces).	500 lm/space (lumens per parking space)	700 lm/space	900 lm/space	1200 lm/space	1500 lm/space

Simple Hardscape Method					
	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
May be used for any project	1.5 lm/ ft ² of hardscape*	2.5 lm/ ft ² of hardscape*	4.0 lm/ ft ² of hardscape*	8.0 lm/ ft ² of hardscape*	12.0 lm/ ft ² of hardscape*

Complete Site Method						
		Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
May be used for any project <i>The total allowance is the sum of each of the Basic, Perimeter, Area and Specific Use Allowances</i>	Basic Allowance	N/A	22,000 lm per site	33,000 lm per site	55,000 lm per site; plus	80,000 lm per site; plus
	Perimeter Allowance	10 lm per linear foot of hardscape perimeter	20 lm per linear foot of hardscape perimeter	30 lms per linear foot of hardscape perimeter	65 lm per linear foot of hardscape perimeter	100 lm per linear foot of hardscape perimeter
	Area Allowance	1 lm/ft ² of hardscape	2 lm/ft ² of hardscape	3 lm/ft ² of hardscape	7 lm/ft ² of hardscape	10 lm/ft ² of hardscape
	Specific Use Allowance	Reference Table B (LZ 0)	Reference Table B (LZ 1)	Reference Table B (LZ 2)	Reference Table B (LZ 3)	Reference Table B (LZ 4)

4 *When lighting intersections of site drives and public streets or roads the effective
 5 property line for the purpose of this section may be extended to the center line of the
 6 public right of way up to 5 times the width of the drive or site road on either side of the
 7 centerline of the intersecting drive or site road.

8

1 **Table B - Additional Lumen Allowance for Specific Applications**
 2 All of the following are “use it or lose it” allowances. All area and distance
 3 measurements in plan view unless otherwise noted.

Lighting Application	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Building Entrances or Exits. This allowance is per door. In order to use this allowance, luminaires must be within 20 feet of the door.	750 lm	2,000 lm	4,000 lm	6,000 lm	8,500 lm
Entrances at Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities. This allowance is lumens per primary entrance. To use this allowance, luminaire(s) must be installed within 100 feet of the entrance door.	N/A	4,000 lm	8,400 lm	12,000 lm	16,500 lm
Building Facades. This allowance is lumens per square foot of building façade that is illuminated. To use this allowance, luminaires must be aimed at the façade and capable of illuminating it without obstruction.	N/A	N/A	12 lm/ft ²	25 lm/ft ²	40 lm/ft ²
Outdoor Sales Lots. This allowance is lumens per square foot of uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale, and may not include driveways, parking or other non sales areas. To use this allowance, Luminaires must be within 10 mounting heights of the sales lot area.	N/A	10,000 lm plus 10 lm/ft ²	10,000 lm plus 40 lm/ft ²	15,000 lm plus 60 lm/ft ²	22,000 lm plus 125 lm/ft ²
Outdoor Sales Frontage. This allowance is for linear feet of sales frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. In order to use this allowance, luminaires must be located between the principal viewing location and the frontage outdoor sales area.	N/A	N/A	1,650 lm/ft	2,850 lm/ft	4,500 lm/ft
Hardscape Ornamental Lighting. This allowance is in lumens per square foot of the total illuminated hardscape area. In order to use this allowance, luminaires must be rated for 100 watts (3000 lumens) or less.	N/A	N/A	1.2 lm/ft ²	2.4 lm/ft ²	3.6 lm/ft ²
Drive Up Windows. This allowance is lumens per window. In order to use this allowance, luminaires must be within 2 mounting heights of the sill of the window.	N/A	2,700 lm	4,000 lm	8,000 lm	13,000 lm

4

Guard Stations. This allowance is lumens per square foot of guardhouse area plus 2,000 sf per vehicle lane. In order to use this allowance, luminaires must be within 2 mounting heights of a vehicle lane or the guardhouse.	N/A	10 lm/ft ²	25 lm/ft ²	50 lm/ft ²	80 lm/ft ²
Outdoor Dining. This allowance is lumens per square foot for the total illuminated hardscape of outdoor dining area. In order to use this allowance, luminaires must be within 2 mounting heights of the hardscape area of outdoor dining.	N/A	1 lm/ft ²	10 lm/ft ²	15 lm/ft ²	25 lm/ft ²
Special Security Lighting for Retail Parking and Pedestrian Hardscape. This allowance is lumens per square foot for the total area of illuminated retail parking and pedestrian hardscape identified as having special security needs. This allowance shall be in addition to the building entrance or exit allowance.	N/A	0.2 lm/ft ²	2 lm/ft ²	3 lm/ft ²	N/A
Vehicle Service Station Hardscape. This allowance is lumens per square foot for the total illuminated hardscape area less any area of buildings, area under canopies, area off property, or areas obstructed by signs or structures. In order to use this allowance, luminaires must be illuminating the hardscape area and must not be within a building, below a canopy, beyond property lines, or obstructed by a sign or other structure.	N/A	5 lm/ft ²	10 lm/ft ²	25 lm/ft ²	40 lm/ft ²
Vehicle Service Station Canopies. This allowance is lumens per square foot for the total area within the drip line of the canopy. In order to use this allowance, luminaires must be located under the canopy.	N/A	30 lm/ft ²	60 lm/ft ²	80 lm/ft ²	150 lm/ft ²
Vehicle Service Station Uncovered Fuel Dispenser. This allowance is lumens per fueling side (2 max) per dispenser. In order to use this allowance, luminaires shall be within 2 mounting heights of the dispenser.	N/A	7,500 lm	15,000 lm	20,000 lm	40,000 lm
All Other Sales Canopies. This allowance is lumens per square foot for the total area within the drip line of the canopy. In order to qualify for this allowance, luminaires must be located under the canopy.	N/A	10 lm/ft ²	40 lm/ft ²	65 lm/ft ²	100 lm/ft ²
Non-sales Canopies. This allowance is lumens per square foot for the total area within the drip line of the canopy. In order to qualify for this allowance, luminaires must be located under the canopy.	N/A	5 lm/ft ²	12 lm/ft ²	25 lm/ft ²	45 lm/ft ²

1 **Table C Prescriptive Method - Maximum Allowable Backlight, Uplight**
 2 **and Glare (BUG) Ratings**

3
 4
 5
 6
 7
 8
 9

A luminaire may be used if it is rated as follows according to the Lighting Zone of the Site. If the luminaire is installed in other than the intended manner, the rating shall be determined to account for the actual photometric geometry. Luminaires equipped with adjustable mounting devices permitting alteration of luminaire aiming in the field shall not be permitted.

	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Backlight Rating					
>2 mounting heights from property line	B0	B1	B2	B3	B4
1 to 2 mounting heights from property line and properly oriented*	B0	B1	B2	B3	B3
0.5 to 1 mounting height to property line and properly oriented*	B0	B0	B1	B2	B2
<0.5 mounting height to property line adjacent to a street and properly oriented*	B0	B0	B1	B2	B2
<0.5 mounting height to property line and properly oriented*	B0	B0	B0	B1	B2
Allowed Uplight Rating	U0	U1	U2	U3	U4
Allowed Glare Rating	G0	G1	G2	G3	G4

10
 11
 12
 13
 14

** The luminaire must be mounted with backlight towards the property line.*

Note: Backlight, Uplight, and Glare ratings are defined based on specific lumen limits for IESNA TM-15-07 solid angles.

Addendum A for IESNA TM-15-07: Backlight, Uplight, and Glare (BUG)

Ratings <http://www.iesna.org/PDF/Erratas/TM-15-07BUGRatingsAddendum.pdf>

1 **Table D - Residential Lighting Total Wattage and Lumen Limits for**
 2 **each Luminaire**

3 Each luminaire shall not exceed the lower of either the allowed Watts or
 4 Lumens.

Allowable Lamp Wattages	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Total Lamp Watts or Lumens for General Exterior Lighting**	25 watts plus .05 watts per ft ² of site structures*	75 watts plus .05 watts per ft ² of site structures*	150 watts plus .05 watts per ft ² of site structures*	200 watts plus .05 watts per ft ² of site structures*	200 watts plus .05 watts per ft ² of site structures*
	750 lumens plus 0.45 lumens per ft ²	2250 lumens plus 0.45 lumens per ft ²	4500 lumens plus 0.45 lumens per ft ²	6000 lumens plus 0.45 lumens per ft ²	6000 lumens plus 0.45 lumens per ft ²
Maximum Allowed Lamp Watts or Lumens Each for Fully Shielded Luminaires	25W	40W	60W	100W	100W
	750 lumens	1200 lumens	1800 lumens	3000 lumens	3000 lumens
Maximum Lamp Watts or Lumens Each for Partly Shielded Luminaires	N/A	15W	40W	40W	40W
	N/A	450 lumens	1200 lumens	1200 lumens	1200 lumens
Maximum Lamp Watts or Lumens each for Low Voltage Landscape Lighting	N/A	N/A	50W	50W	50W
	N/A	N/A	1500 lumens	1500 lumens	1500 lumens
Maximum Watts or lumens each for Shielded Directional Flood Lighting	N/A	N/A	60W	100W	100W
	N/A	N/A	1800 lumens	3000 lumens	3000 lumens

5 * *The sum of the land area of residential buildings on the site including*
 6 *habitable structures, garages, recreational buildings, and storage and*
 7 *equipment structures.*

8 ** *For sites exceeding one acre, an additional allowance of 100 watts per*
 9 *acre is allowed.*

10

1 **Appendix “A” Performance Method**

2 The Performance Method requires the use of computer software that
3 employs either radiative transfer (radiosity) and/or ray tracing methods to
4 predict lighting system performance. Such software is typically used for
5 lighting design and illuminating engineering, and most current programs
6 include CAD interfaces to enable rapid and accurate data input. For the
7 purposes of this analysis, input data shall include all buildings, structures
8 and significant topography and may, at the option of the analyst, include
9 trees and minor topography.

10 The software must be modified to perform the following tests and then
11 return a “pass” rating only if all three tests are passed for the Lighting Zone
12 of the Project. In addition, the software should provide the analyst with
13 feedback to aid in interpreting the results and correcting deficiencies.

14 **Test 1: Analysis of Off-site Lumen Impact (or “Light Pollution” or** 15 **“Skyglow”)**

- 16 1. Calculate the *allowed* offsite lumens as follows:
 - 17 a. Determine the total allowed on-site lumens using the
18 “Complete Site Method” under the Prescriptive Method
19 (Section IV (A.))
 - 20 b. Multiply by 0.1. This is the allowed offsite lumens.
- 21 2. Calculate the *relative skyglow* produced by off-site lumens as follows:
 - 22 a. Establish the worst-case condition: Multiply the allowed offsite
23 lumens calculated in step 1b by the skyglow multiplier for the
24 90-100° range of exitant angles from Appendix A–Table A. This
25 is the *maximum relative average sky luminance* that would be
26 produced by the allowed offsite lumens.
 - 27 b. (This calculation includes direct and reflected light.) Determine
28 the amount and exitant angles of all lumens leaving the site
29 using the vertical angular increments in the following Table.
30 Multiply the lumens leaving the site in each of these angular
31 zones by the corresponding multiplier from Appendix A–Table A.
32 These products are the *relative average sky luminance* produced by
33 the lumens leaving the site. Lumens that are emitted downward
34 and not blocked (that is between 0° and 90°) are counted only if
35 they leave the site. All lumens emitted upward and not blocked
36 are counted.

(NOTE: the reference document (B.)(1.) below shall be consulted as shall new data from this and other sources. At such time as additional data warrants, the table shall be modified to account for location, climate and other conditions.)

- c. Add the relative average sky luminances from all solid angles. This is the total relative average sky luminance (“skyglow”) produced by all the offsite lumens.

Appendix A: Table A – Skyglow Multiplier of Exitant Lumens
(interpreted from Baddiley)

Vertical exitant angles	Skyglow Multiplier
0-10°	0.002
10-20°	0.002
20-30°	0.003
30-40°	0.003
40-50°	0.005
50-60°	0.009
60-70°	0.015
70-80°	0.029
80-90°	0.337
90-100°	1.000
100-110°	0.774
110-120°	0.587
120-130°	0.436
130-140°	0.236
140-150°	0.170
150-160°	0.134
160-170°	0.102
170-180°	0.033

- 3. The design passes Test 1 if the ratio of the total relative average sky luminance produced by all the offsite lumens calculated in step 2b is less than or equal to *****TBD***%** of the worst case relative average sky luminance calculated in step 2a.

Test 2: Analysis of Light Trespass Impact

Calculate line of sight illuminance at or above grade on a vertical plane at the property line, up to the highest point of structures or luminaires. Calculate the direct light from individual luminaires and light reflected from all solid surfaces on the site. Assume the reflecting surfaces are diffuse. If no point illuminance exceeds defined threshold values for each lighting zone, then the design passes Test 2.

Appendix A: Table B – Maximum Line of Sight Illuminance at Any Vertical Plane Boundary

Maximum Illuminance	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
	0.5 lux (0.05 fc)	1.0 lux (0.10 fc)	3.0 lux (0.30 fc)	8.0 lux (0.8 fc)	15.0 lux (1.5 fc)

Test 3: Analysis of Glare Impact

Calculate the modified DeBoer glare rating according to the reference document (B.)(2.) below for E_l and E_s at or above grade (within 55 degrees above horizontal and 75 degrees below horizontal) on a vertical plane at the property line, up to the highest point of structures or luminaires within the site. The design passes if the rating is higher than or equal to the following ratings:

Appendix A: Table C Minimum Modified DeBoer Rating Viewed from Any Boundary

	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
	TBD	TBD	TBD	TBD	TBD

Minimum DeBoer Rating

Reference Papers

1. Skyglow Impact (Reserved for Baddiley paper)
2. Modified DeBoer Method for Rating Glare (Reserved for LRC Paper)