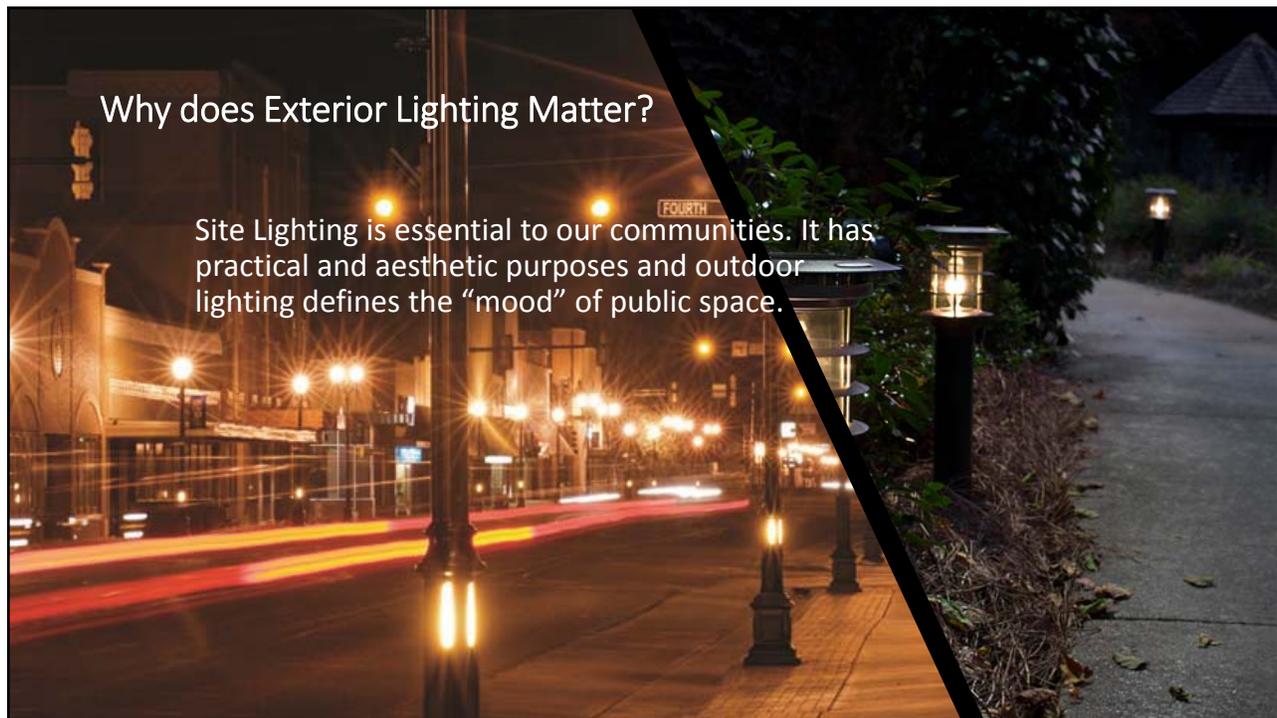


Illuminated! How to Plan for Site Lighting in Your Community

Michele R. Greig, AICP, Four Corners Planning LLC
Brandee K. Nelson, PE, LEEP AP, Tighe & Bond
Sarah Brown, Senior Planner, Fredrick P. Clark Associates

1



Why does Exterior Lighting Matter?

Site Lighting is essential to our communities. It has practical and aesthetic purposes and outdoor lighting defines the “mood” of public space.

2

Preserves Community Character



3

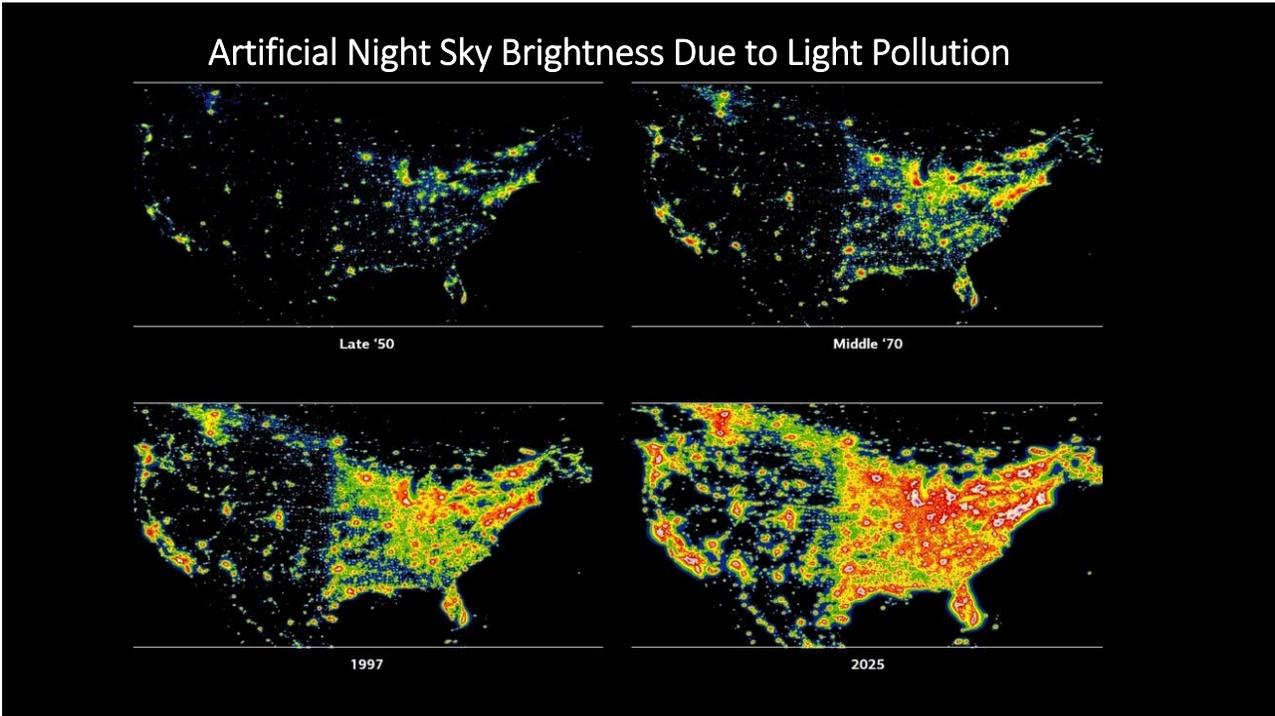
Enhances Safety and Security



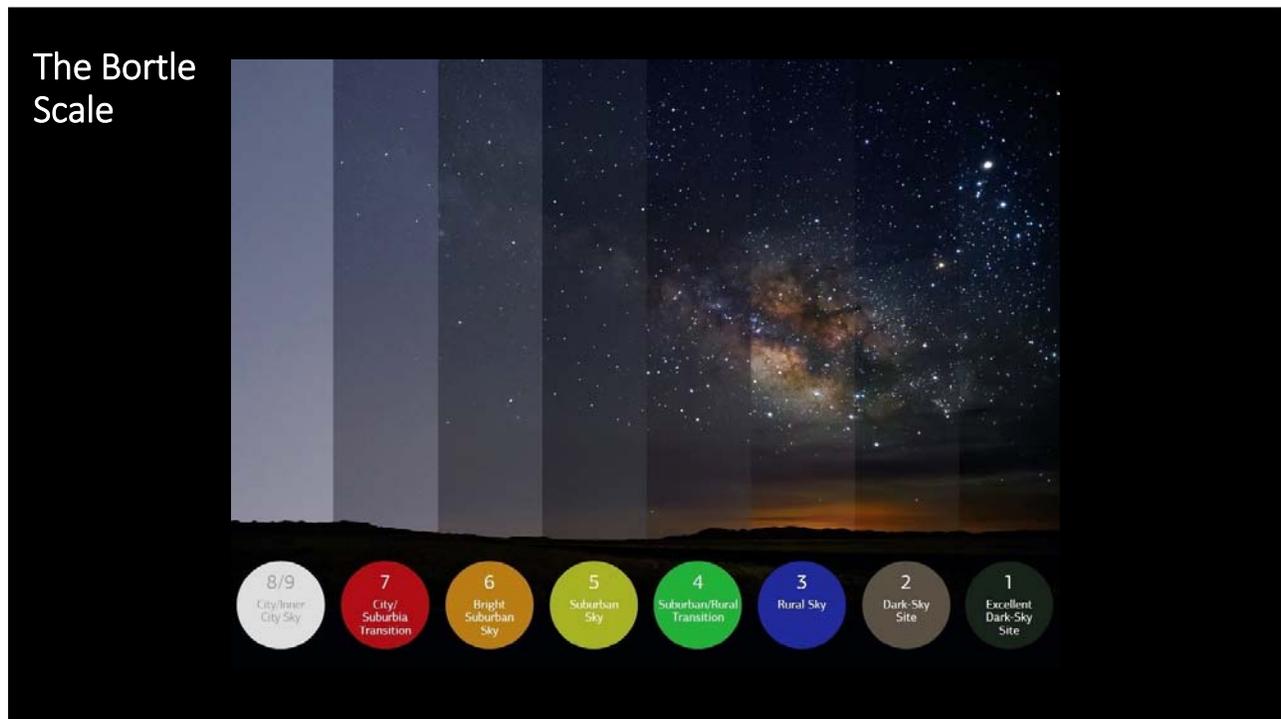
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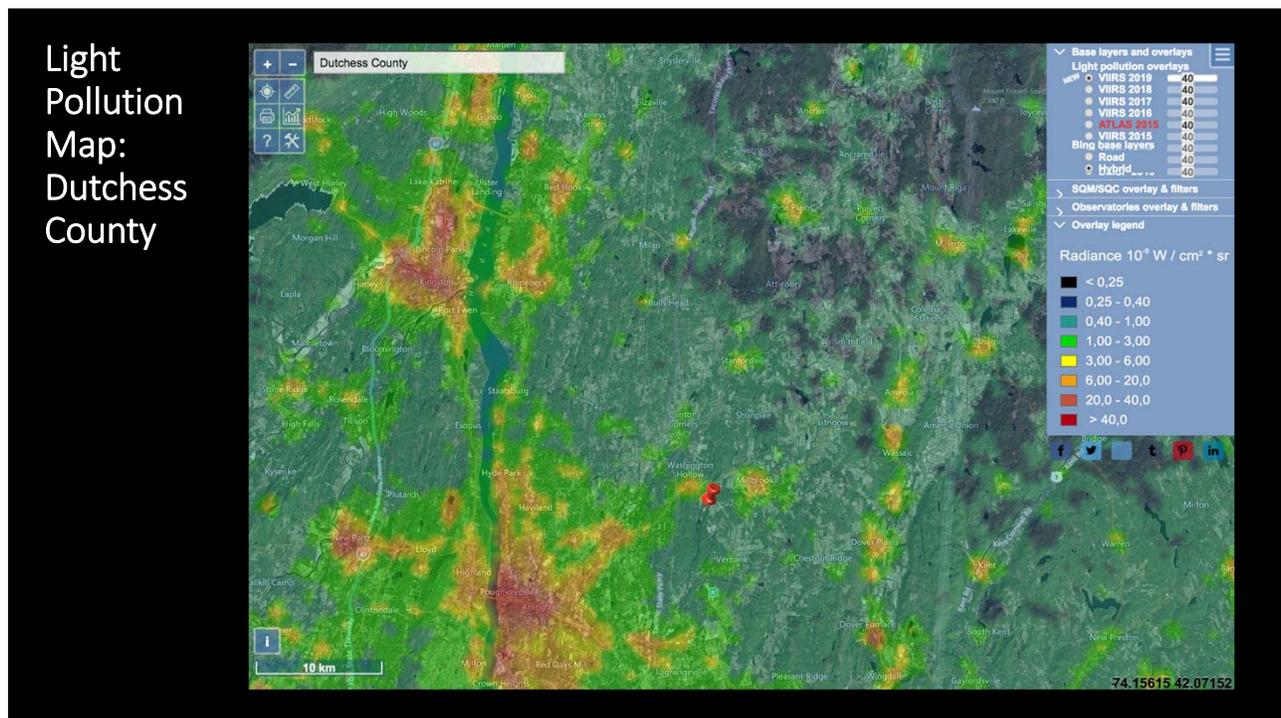
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6



7



8

Sky Glow: diffuse lighting of the night sky



Credit: Todd Carlson

9

Light trespass: light falling where it is not wanted or needed

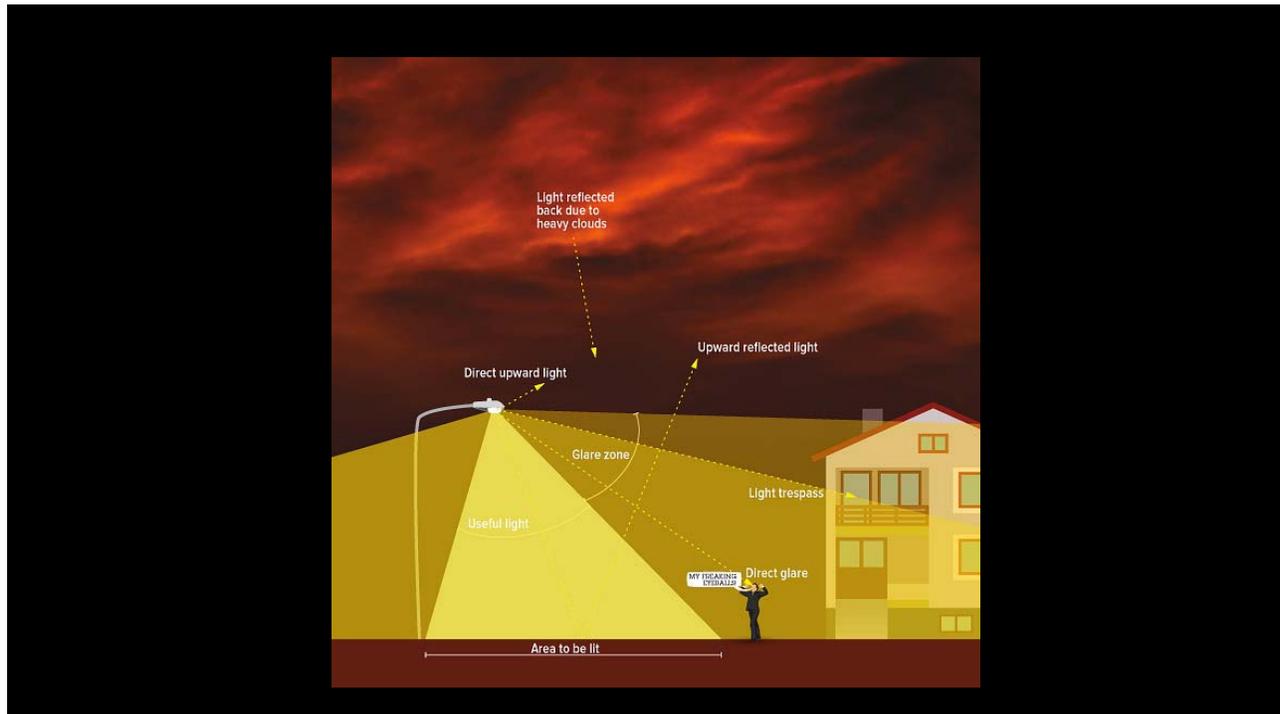


10

Glare: excessive brightness that reduces visibility and causes discomfort



11



12

"Of all the pollution we face, light pollution is perhaps the most easily remedied. Simple changes in lighting design and installation yield immediate changes in the amount of light spilled into the atmosphere and, often, immediate energy savings."

*Verlyn Klinkenborg, "Our Vanishing Night"
National Geographic Magazine*



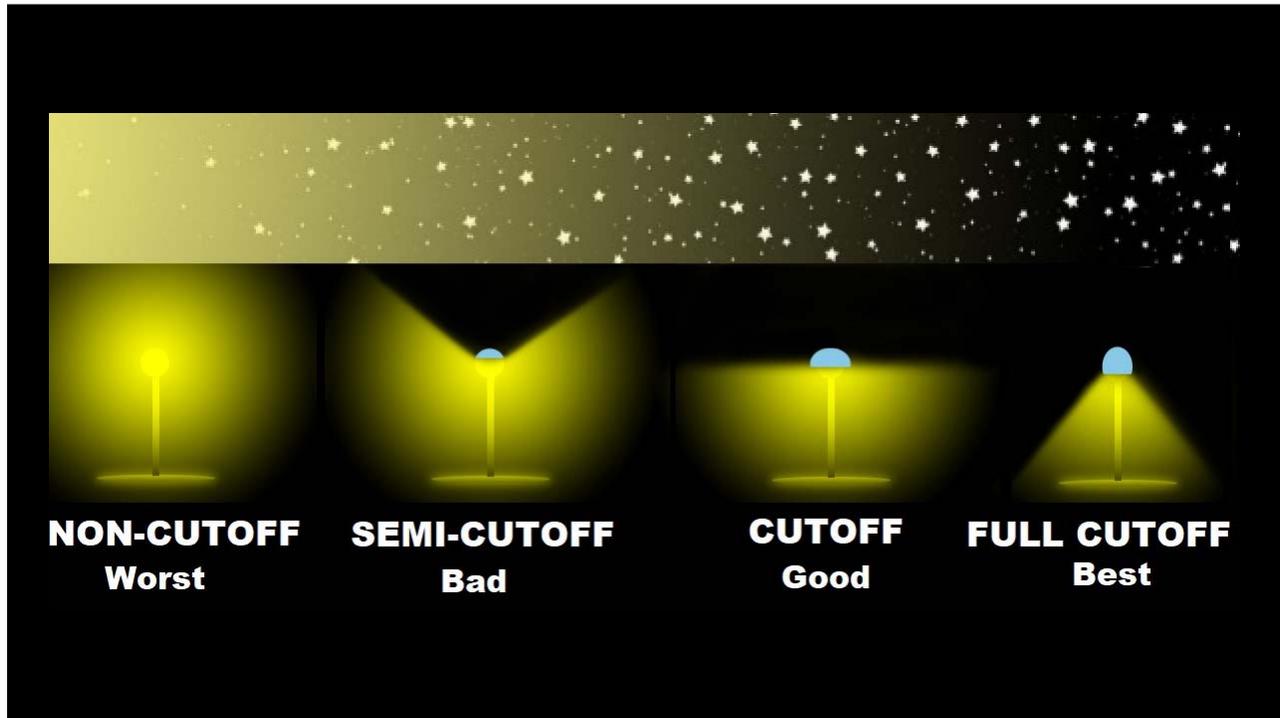
13

Lighting should:

- Only be on when needed
- Only light the area that needs it
- Be no brighter than necessary
- Minimize blue light emissions
- Be fully shielded (pointing downward)

International Dark Sky Association

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15



16



Parking lot and walkway with unshielded globe fixtures



Parking lot and walkway with shielded fixtures

17



Unshielded wall packs



Shielded, down-directed wall packs

18



Gas station with top lens fixtures



Gas station with recessed fixtures

19

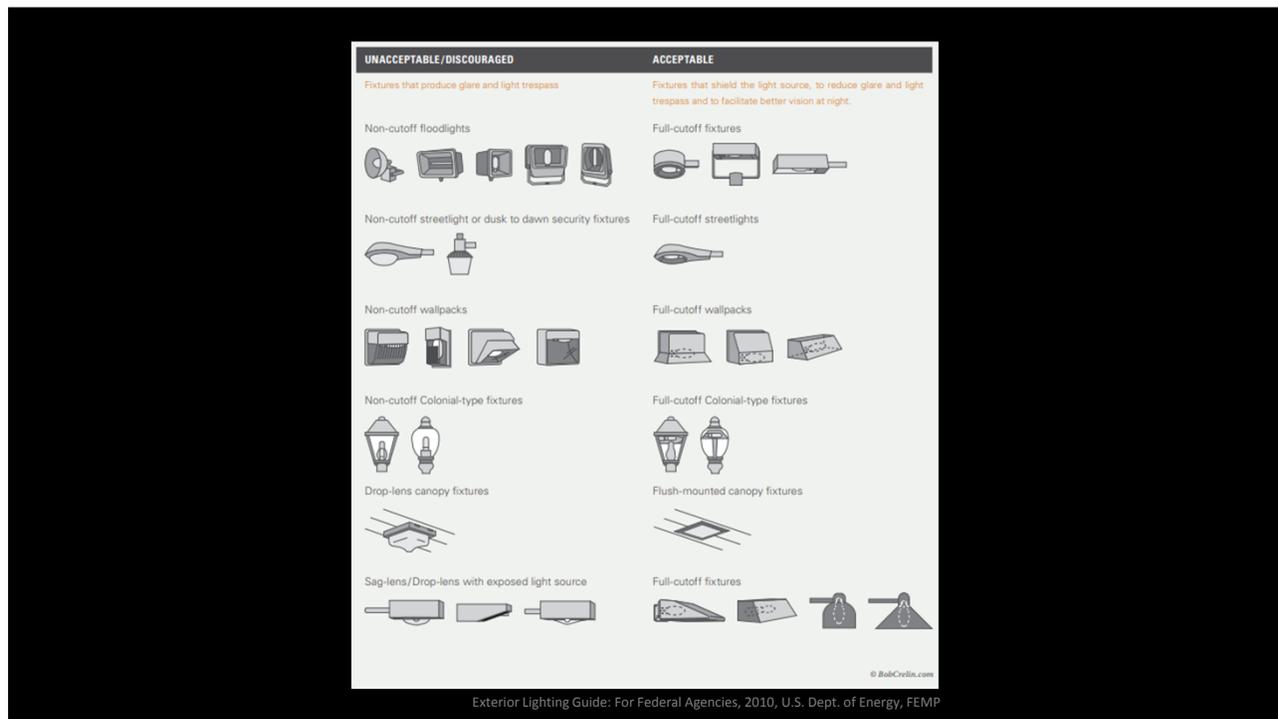


Car dealership with all unshielded lights left on after business hours



Car dealership with full cut-off fixtures and half turned off after hours

20



21

Outdoor Lighting in Dutchess County Municipal Codes: Minimal Requirements

“Location and design of all outdoor lighting facilities, including data regarding, when appropriate, lighting levels, both with the site and at the site’s boundaries.”

“Location, arrangement, size, design and general site compatibility of buildings, lighting and signage.”

Village of Pawling Zoning Law

22

Outdoor Lighting in Dutchess County Municipal Codes: Minimal Requirements

“Lighting. The location, height, design, direction and brightness of outdoor illumination (area lighting, floodlighting and illumination of signs) shall be arranged and maintained as follows:

- (1) To provide sufficient illumination for safety, convenience and security.
- (2) To minimize sky glow.
- (3) To safeguard against discomfort glare and disability veiling glare in any street and upon pedestrian ways and vehicular parking, loading and circulation areas on the lot where located or any other lot.
- (4) To harmonize with the neighborhood and avoid trespass illumination on any other lot.”

Town of North East Zoning Law

23

Outdoor Lighting in Dutchess County Municipal Codes: Scattered Provisions

“All exterior lighting in connection with all buildings, signs or other uses shall be directed away from adjoining streets and properties and shall not cause any objectionable glare observable from such streets or properties.”

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Outdoor Lighting in Dutchess County Municipal Codes: Scattered Provisions

- Signs
- Parking lots (particularly pole height – 12' to 20')
- Zoning Districts:
 - Central Main Street District (Beacon)
 - Ridgeline Overlay and Town Center Districts (Beekman)
 - Residential Business District (Tivoli)
- Uses:
 - Hospitals, clinics, nursing homes, funeral homes,
 - drive-through facilities, car washes,
 - telecommunications facilities, clubs

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Outdoor Lighting in Dutchess County Municipal Codes: Scattered Provisions

- Some specific standards:
- Shielding or “shading”
 - Pole height
 - Maximum footcandles at the property boundary
[e.g. 0.5 footcandle]
 - Some limit hours of lighting

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Outdoor Lighting in Dutchess County Municipal Codes: Scattered Provisions

“For nonresidential developments, lighting ranges should be as follows:

- (a) One-tenth to one footcandle in public areas other than parking lots.
- (b) Approximately one footcandle in parking lots.
- (c) Two footcandles to five footcandles are only allowed in high security areas.”

Pleasant Valley

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Outdoor Lighting in Dutchess County Municipal Codes: Comprehensive Approach

More Comprehensive Approach:

- T. Fishkill
- T. Hyde Park
- T. Pine Plains
- T. Red Hook
- T. Rhinebeck
- T. Poughkeepsie
- V. Rhinebeck

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Village of Rhinebeck, § 120-18 Lighting

- Goal: encourage safety and security, while conserving energy and avoiding excessive lighting, glare, and light pollution over property lines or into the night sky.
- Applies to all districts and uses
- Requires:
 - full cut-off fixtures
 - light level at property boundary not to exceed 0.1 footcandle (fc)
 - average maximum lighting level of 1 fc for parking lots
 - average maximum of 2 to 5 fc for high security areas
 - maximum height of 15' for commerce uses, 12' in Residential District
 - commercial uses, most lighting turned off after business hours
 - photometric plan may be required

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Light Emitting Diode (LED) benefits:

- Energy efficient
- Longer life
- More cost effective to operate
- Can save 50% or more on current energy usage, reducing energy bills and carbon footprint

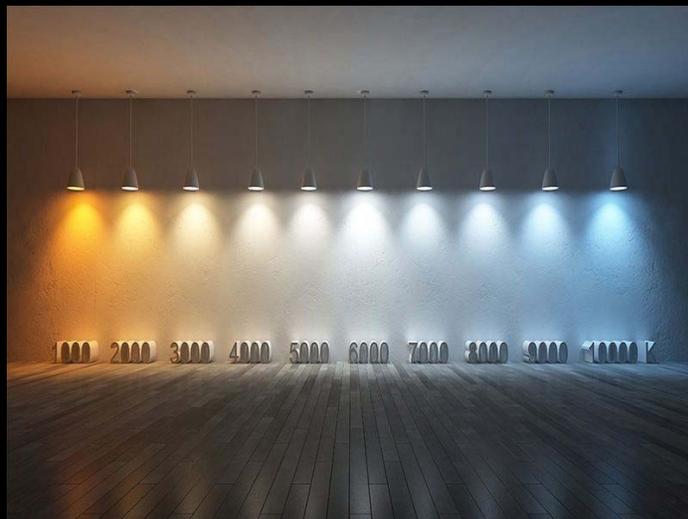
30

Color Temperature



31

Light Comparison



32

The IES no longer classifies fixtures in terms of shielding or cut-off 

33



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Let's get a little more technical...

- Lighting Terminology
- IES Levels and Right Light for the Site
- Light Sources
- Lighting Styles
- Basic Photometrics

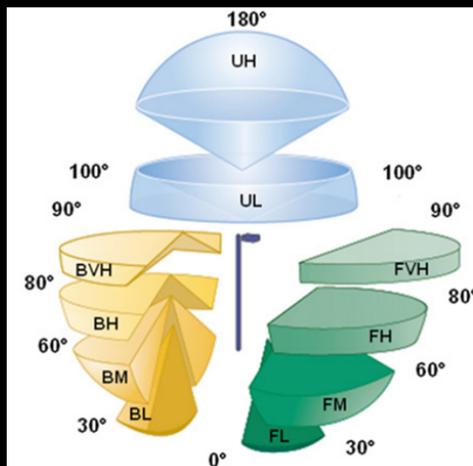


<http://www.cooperindustries.com/content/public/en/lighting/resources/LightingStories/Coweta-Fayette-LED-Site-Lighting.html>

35

BUG Rating

(B) backlight; (U) uplight; (G) glare



Backlight – lumen emitted in the quarter sphere below horizontal and in the opposite direction of the intended orientation of the luminaire.

Uplight – flux radiated in the hemisphere at or above the horizontal plane

Glare – Light entering the eye directly from luminaires or indirectly from reflective surfaces that causes visual discomfort or reduced visibility

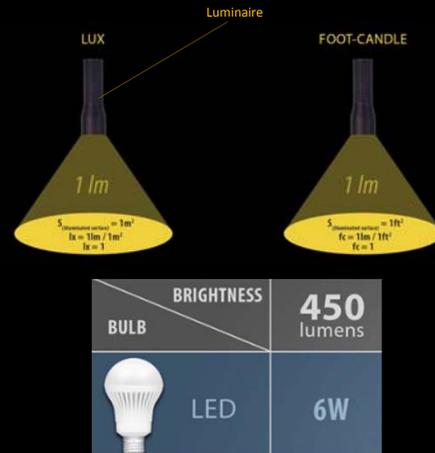
Forward – Typically the desired light projected onto a surface

Model Lighting Ordinance (MLO) with User's Guide, Illuminating Engineering Society, 2011

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Units of Lighting Measurement

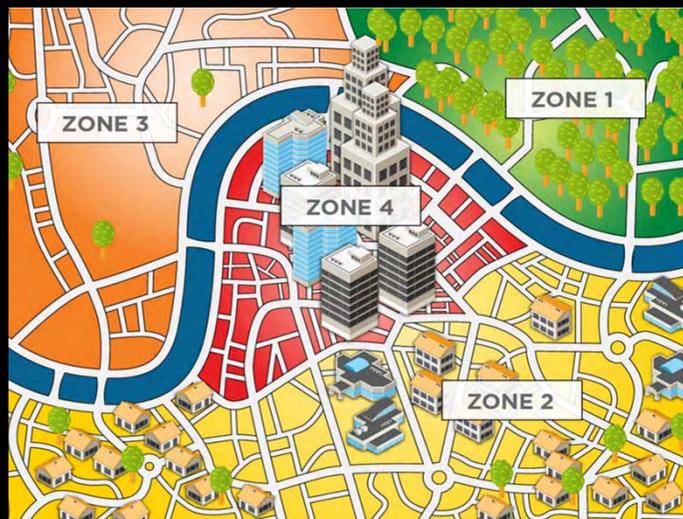
- **Lux** – SI unit of illuminance. One lux is one lumen per square meter. 1 Lux is a unit of incident illuminance approximately equal to 1/10 footcandle
- **Lumen** – unit of measure used to quantify the amount of light produced by a lamp or emitted from a luminaire (as distinct from “watt,” a measure of power consumption)
- **Footcandle (FC)** –unit of measure expressing the quantity of light received on a surface. One footcandle is the illuminance produced by a candle on a surface one foot square from a distance of one foot



Model Lighting Ordinance (MLO) with User's Guide, Illuminating Engineering Society, 2011

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Illuminating Engineering Society (IES) Lighting Levels



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LZ0 AND LZ1 LEVELS

No Ambient Lighting
wilderness areas and park



Low Ambient Lighting
low density residential areas



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LZ2 LEVEL

Moderate Ambient Lighting
Light commercial, mixed use districts



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The Right Light for the Site

LIGHTING ZONE	USES
LZ-1	Single-family, low/medium density multifamily, mobile home parks, city low-use neighborhood parks
LZ-2	High-density multifamily, mobile home parks, neighborhood-oriented business, business parks, churches, schools, larger city parks, office buildings
LZ-3	High-intensity commercial areas along arterials, Alderwood Mall, Transition Area, EDCC, Meadowdale Playfields, medium-intensity light industrial, car dealerships, office buildings

[Chapter 21.17 Outdoor Lighting Standards](#)

Goals of the Designer:

- Task/Use Appropriate
- Good Quality Light
- Fixture Aesthetics
- Energy Efficiency

***Do the designer's goals match the community's goals?**

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BUG Rating Related to Light Zones

TABLE C-1	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Backlight Rating*					
Greater than 2 mounting heights from property line	B1	B3	B4	B5	B5
1 to less than 2 mounting heights from property line and ideally oriented**	B1	B2	B3	B4	B4
0.5 to 1 mounting heights from property line and ideally oriented**	B0	B1	B2	B3	B3
Less than 0.5 mounting height to property line and properly oriented**	B0	B0	B0	B1	B2

TABLE C-2	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Uplight Rating	U0	U1	U2	U3	U4
Allowed % light emission above 90° for street or Area lighting	0%	0%	0%	0%	0%

TABLE C-3	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Glare Rating	G0	G1	G2	G3	G4
Any luminaire not ideally oriented*** with 1 to less than 2 mounting heights to any property line of concern	G0	G0	G1	G1	G2
Any luminaire not ideally oriented*** with 0.5 to 1 mounting heights to any property line of concern	G0	G0	G0	G1	G1
Any luminaire not ideally oriented*** with less than 0.5 mounting heights to any property line of concern	G0	G0	G0	G0	G1

Model Lighting Ordinance (MLO) with User's Guide, Illuminating Engineering Society, 2011

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How are the Communities Goals Communicated to the Designer?

Typically two options:

Prescriptive Method – **Quantitative** and provides definitive light standards for lighting levels, light fixture design and controls (e.g. Mounting Height shall be 12 feet, or total illuminance levels shall not exceed 5 lumens/square foot)

Performance Method – **Qualitative** and provides for guidance that general lighting objectives be met (e.g. No Light Trespass from a site, or all lighting shall meet a B-U-G rating of 1-0-0.)



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Prescriptive Method

Example:

Community Goal (Stated in Code): Total site lumens may not exceed 2.5/SF for the total site hardscaped area within the LZ2.

The designer has 100,000 square feet (SF) of illuminated hardscape (parking lots, walkways, etc).

The total Luminaire Lumens for the site is equal to 247,840. (From the photometric plan.)

The allowable lumens are based on the lighting zone and the total hardscape area and are found by multiplying 100,000 SF by 2.5/SF gives a value of 250,000 lumens allowed.

247,840 is less than 250,000

Because this value is greater than the value calculated for the site, the project complies.

Model Lighting Ordinance (MLO) with User's Guide, Illuminating Engineering Society, 2011

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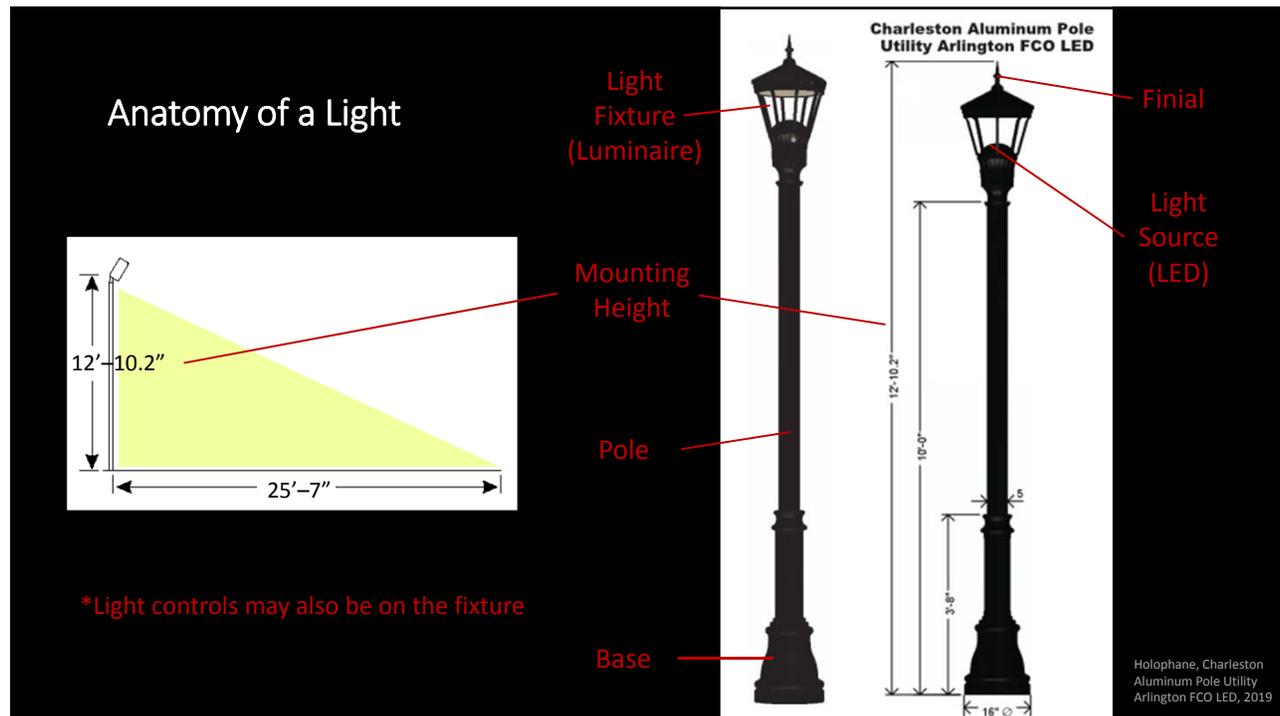
Performance Method

Example:

- Car sales lot where more light might be required on the new cars than would be needed for a standard parking lot
- Steps:
 - Regulates over lighting by establishing Total Initial Site Lumens (combination of initial lumens allowed per site/per area of hardscape/additional lumens for unique site conditions)
 - Does lighting produce BUG?

Model Lighting Ordinance (MLO) with User's Guide, Illuminating Engineering Society, 2011

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Luminaire

A complete lighting unit (fixture), consisting of one or more lamps (light sources), 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.



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Mounting Heights

- Mounting Height – The height of the photometric center of a luminaire above grade level
- The horizontal spacing of poles is often measured in units of “mounting height”
 - Ex. If an area to be lighted is 40 feet, the mounting height of the flood light should be at minimum of 20 feet high.
- Mounting Height is associated with the BUG rating and serves as a guide to determine those limits.

TABLE C-1	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Allowed Backlight Rating*					
Greater than 2 mounting heights from property line	B1	B3	B4	B5	B5
1 to less than 2 mounting heights from property line and ideally oriented**	B1	B2	B3	B4	B4
0.5 to 1 mounting heights from property line and ideally oriented**	B0	B1	B2	B3	B3
Less than 0.5 mounting height to property line and properly oriented**	B0	B0	B0	B1	B2

Model Lighting Ordinance (MLO) with User's Guide, Illuminating Engineering Society, 2011

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Lighting Controls

- Manual Switches - a strategy where users have the capability of choosing light levels either in steps (switching) or over a wide range with smooth transitions between levels (dimming)
- Dimmer - alters the current that flows through the load during the ON state, which raises or lowers light output
- Photocells – provides light output when ambient lighting levels are below a specified threshold
- Motion Sensors - provides light output based on sensed activity near a light
- Timers - adjusts the output of the lighting system based on a time event implemented using a time-clock

<http://lightingcontrolsassociation.org/2017/07/21/introduction-to-lighting-controls/>

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Four Basic Types of Light Sources

- Incandescent
- Fluorescent
- High Intensity Discharge (high and low pressure sodium, metal halide, mercury vapor)
- Light-Emitting Diode (LED)

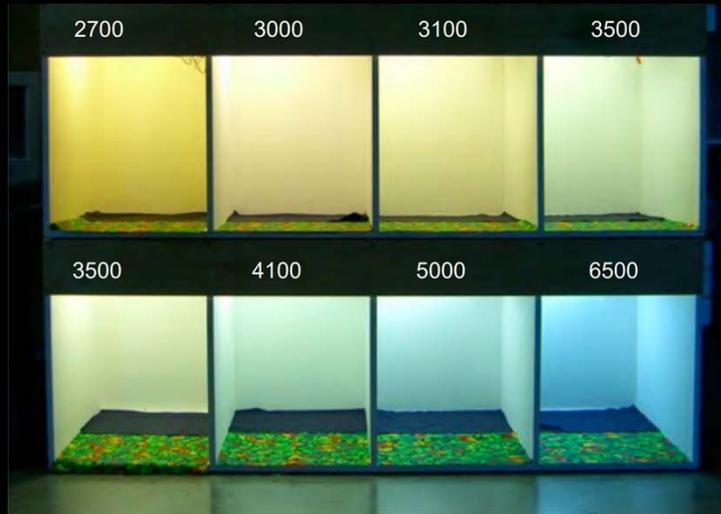
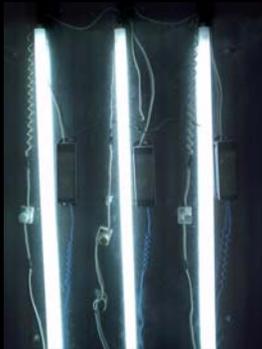
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Incandescent



53

Fluorescent



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High Intensity Discharge



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Light-Emitting Diode (LED)



LED

Metal Halide

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Light Styles

- Pole
- Bollard
- Building Mounted

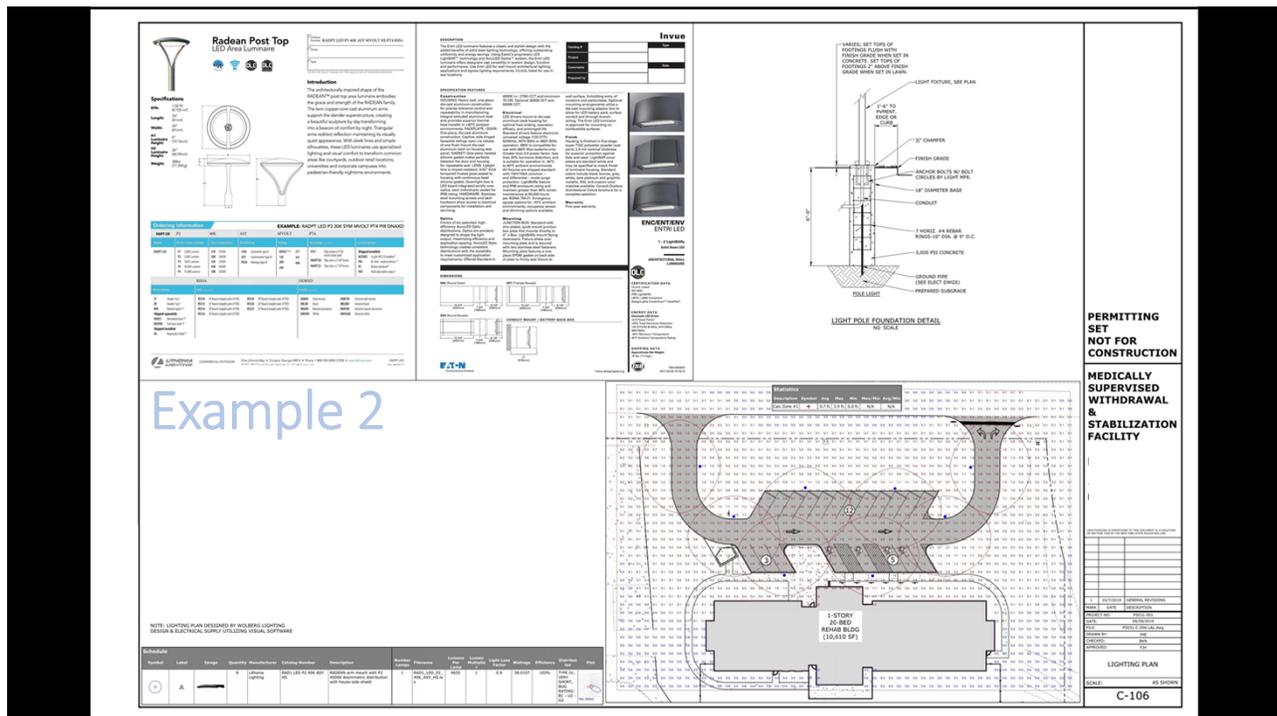
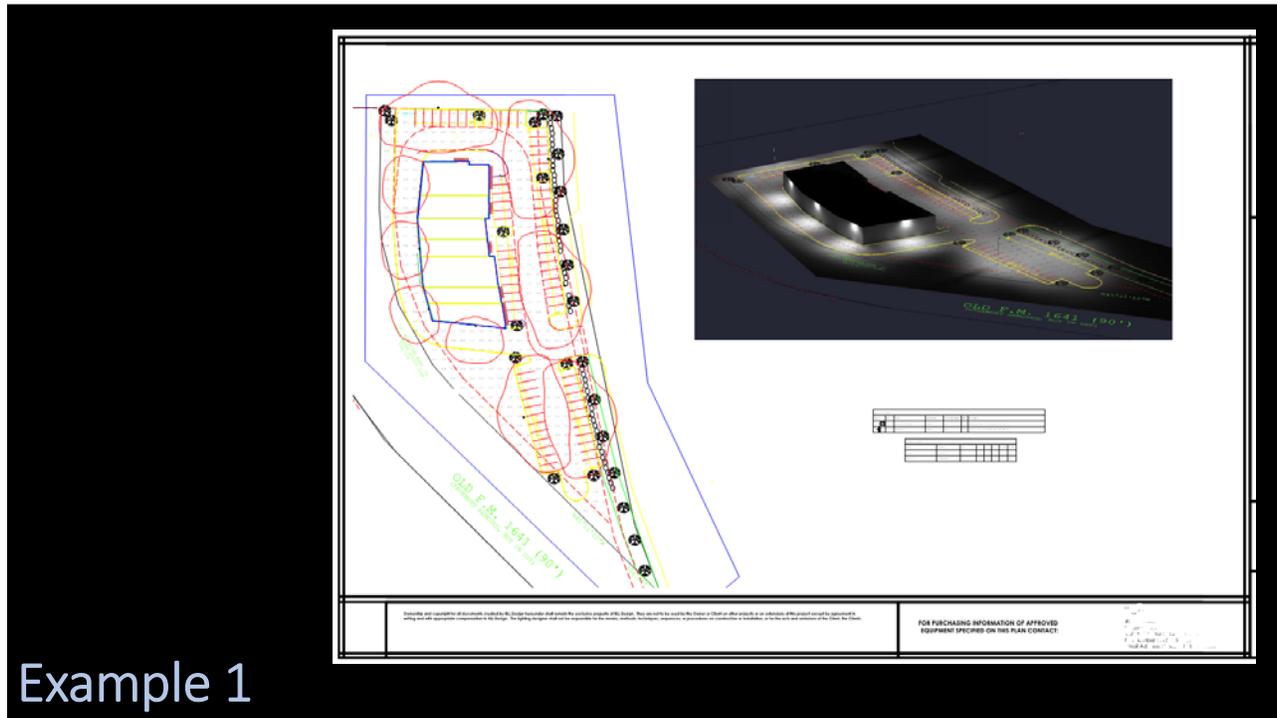


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How to Read a Lighting Plan and Cut-Sheet

- Require as part of Site Plan
- Details to look for and include when making plans
- Examples

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Detail Sheet



**Radean Post Top
LED Area Luminaire**






Specifications

EPA: 1.02 ft² (0.105 m²)

Length: 24" (0.1m)

Width: 24" (0.1m)

H1 Luminaire Height: 4" (10.16cm)

H2 Luminaire Height: 26" (66.04cm)

Weight: 88lbs (17.24kg)

Introduction

The architecturally-inspired shape of the RADEAN™ post top area luminaire embodies the grace and strength of the RADEAN family. The twin copper-core cast aluminum arms support the slender superstructure, creating a beautiful sculpture by day transforming into a beacon of comfort by night. Triangular arms redirect reflection maintaining its visually quiet appearance. With sleek lines and simple silhouettes, these LED luminaires use specialized lighting and visual comfort to transform common areas like courtyards, outdoor retail locations, universities and corporate campuses into pedestrian-friendly nighttime environments.

Example: RADPT LED P3 40K ASY MVOLT HS PT4 RSS16

Ordering Information

Series	Performance package	Color temperature	Beam/distribution	Package	Mounting options	Options
RADPT LED	P1 1,000 Lumens	27K	SYM Symmetric spot 1	MVOLT 111 277	PT4 1/2" hole x 1/2" hole metal pole	SHIPPED INSTALLED
	P2 1,000 Lumens	30K 3000K	ASY Asymmetric spot 1	136 347	RADPT20 1/2" hole x 1.0" hole	REWARD 1/2" hole AR 2.3 (metal)
	P3 1,000 Lumens	40K 4000K	FWY Flatwye spot 1	208 488	RADPT25 1/2" hole x 1.0" hole	PIR 1/2" hole, non-adjustable**
	P5 1,000 Lumens	50K 5000K		240	RADPT25 1/2" hole x 1.0" hole	PI 1/2" hole, adjustable**
						RAO 1/2" hole, adjustable**

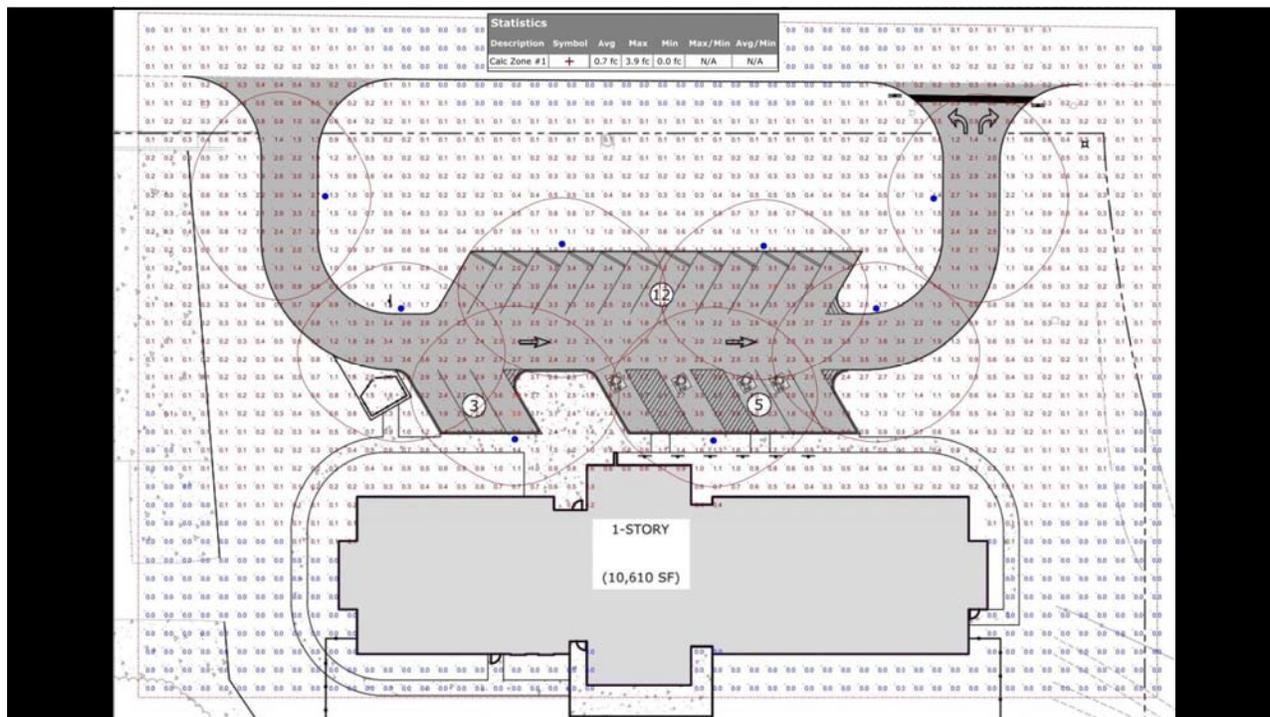
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Photometric Plan Data Tables

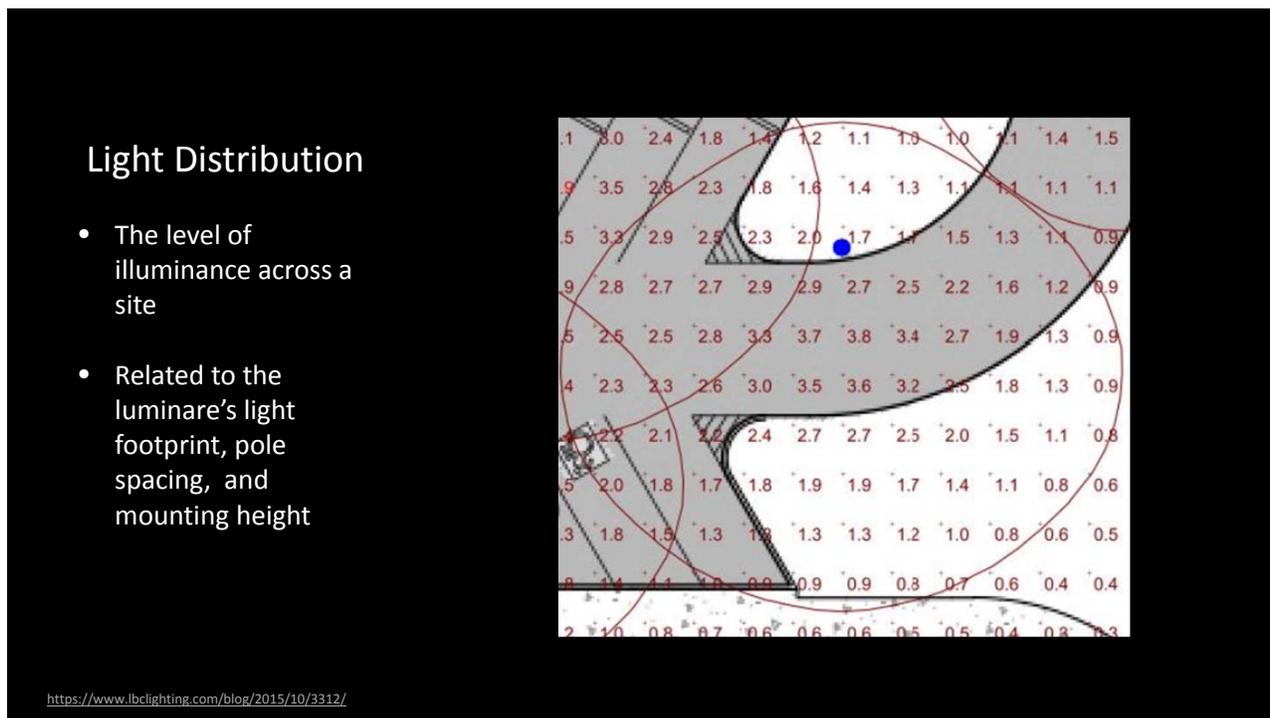
Symbol	Label	Image	Quantity	Manufacturer	Catalog Number	Description	Number Lamps	Filename	Lumens Per Lamp	Lumen Multiplier	Light Loss Factor	Wattage	Efficiency	Distribution	Plot
	A		8	Lithonia Lighting	RAD1 LED P2 40K ASY HS	RADEAN arm mount with P2 4000K Asymmetric distribution with house-side shield	1	RAD1_LED_P2_40K_ASY_HS.IES	4655	1	0.9	38.0107	105%	TYPE IV, VERY SHORT	

Label	Qty	Catalog Number	Description	Lamp	File	Lumens	LLF	Watts	Mounting Height (ft)
G2	46	H2210S5GGQ	FILTER-GARD H2	1; 100W HPS, CLEAR ED23.5, VBU	GE177024.IES	9500	0.86	100	8
W1	91	W25C10S2M1GM GLDB	WALLLIGHTER 250 CUTOFF	1; 100W HPS, CLEAR ED23.5, VBU	GE178825.IES	9500	0.86	100	8 or 12
W2	54	W25C20S2M1GM GLDB	WALLLIGHTER 250 CUTOFF	1; 200W HPS, CLEAR ED18, HORZ	GE178830.IES	22000	0.86	200	12
D	73	G250HP00HDCXXX	MONGOOSE	250W CLEAR HPS	G250HP00HD CXXX.ies	28000	1.00	289	25
A	3	G250HP00HDCXXX	MONGOOSE	250W CLEAR HPS	G250HP00HD CXXX.ies	28000	1.00	289	15

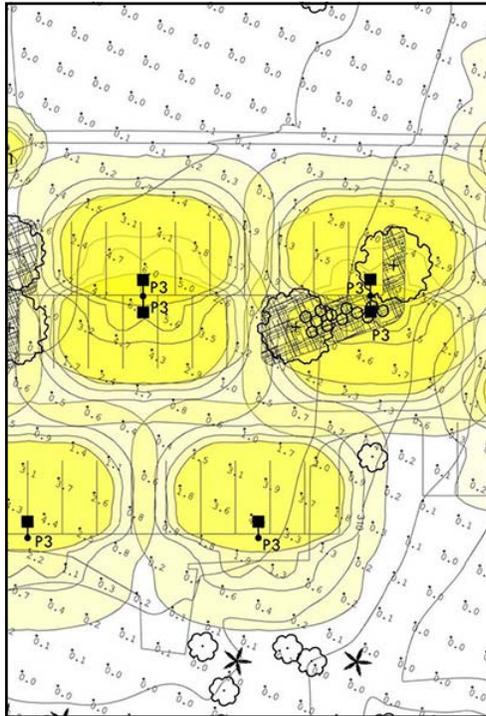
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Site Specific Outdoor Lighting Applications

- Single-family and Multi-family
- Commercial & Institutional
- Signage
- ATM Machines

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Single-family & Multi-family Residential Lighting

- Key Concerns are glare & trespass
- Time restrictions for multi-family housing are not realistic



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Commercial and Institutional Lighting

- Glare and trespass are a concern
- Light timers, curfews, light reduction, and dimmers become feasible due to defined hours of operation

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Sign Lighting

- Signs also contribute to the overall lighting and glare of the site
- Photometrics for externally illuminated signs should also be shown on the Lighting Plan



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- Avoid “up” lighting



- Avoid excess or “double” lighting



- Digital signs are a source of glare



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ATM Lighting



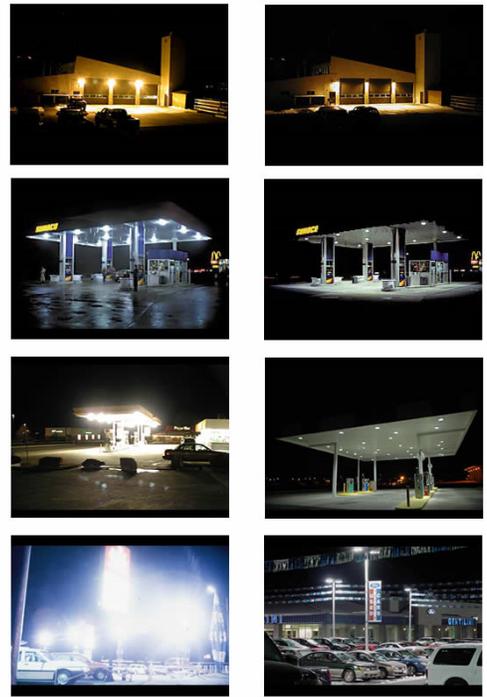
Subject to the NYS ATM Safety Act which requires a minimum illuminance of:

- 5 footcandles 5 feet from the ATM
- 2 footcandles 30 feet from the ATM
- 1 footcandle 60 feet from the ATM

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Over illumination can...

- waste energy
- increase project costs
- have negative impacts to people and the environment including disruption of biological rhythms and impact on nocturnal wildlife



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And don't forget about SEQR!

Full EAF Part 1 Questions D.2.n

n. Will the proposed action have outdoor lighting? Yes No

If yes:

i. Describe source(s), location(s), height of fixture(s), direction/aim, and proximity to nearest occupied structures:

ii. Will proposed action remove existing natural barriers that could act as a light barrier or screen? Yes No

Describe: _____

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Question 15 of Part 2 of the Full EAF

15. Impact on Noise, Odor, and Light The proposed action may result in an increase in noise, odors, or outdoor lighting. <input type="checkbox"/> NO <input type="checkbox"/> YES (See Part I. D.2.m., n., and o.) <i>If "Yes", answer questions a - f. If "No", go to Section 16.</i>			
	Relevant Part I Question(s)	No, or small impact may occur	Moderate to large impact may occur
d. The proposed action may result in light shining onto adjoining properties.	D2n	<input type="checkbox"/>	<input type="checkbox"/>
e. The proposed action may result in lighting creating sky-glow brighter than existing area conditions.	D2n, E1a	<input type="checkbox"/>	<input type="checkbox"/>

Will there be an Impact?

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Small Impact

- No signs, accessory structures or buildings will be illuminated.
- A limited number of lighting fixtures are planned for parking and safety lighting but all fixtures will be fully shielded, downward-directed and no glare or light spillage on adjacent properties or roadways will result



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Moderate to Large Impact

- Lighting will be provided for large recreational facilities or arenas
- Lighting will remain illuminated all night
- Lighting will be created in a rural area where there is currently dark skies and little sky glow



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Moderate to Large Impact

- There are no natural barriers present to screen lighting effects and the project site is visible from adjacent land uses.
- Visibility of drivers on adjacent or nearby roads and streets may be impaired



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What do we do with all of this information??



You could adopt Lighting Regulations...

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What are your Lighting Goals

- Provide lighting in outdoor public places where public health, safety and welfare are priority
- Protect drivers and pedestrians from the glare of non-vehicular light sources that impair safe traverse
- Protect neighbors and the night sky from nuisance glare and stray light from poorly shielded, aimed, placed, applied or maintained light sources
- Promote efficient design and operation with regard to energy conservation
- Protect and retain established character of the community

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Will there be uses that are exempt?

	Outdoor lighting for single-family dwellings?
	Temporary lighting for festivals or holiday observances?
	Emergency lighting?

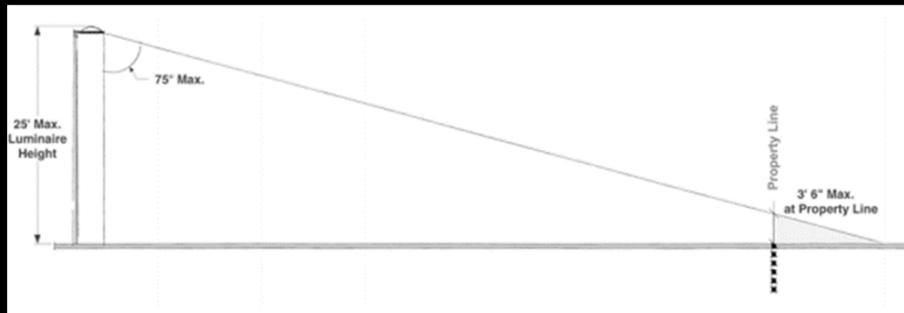
79

Simple additions to your regulations that can make a difference:

- Require a Photometric Plan and detailed cut sheets of all proposed lighting
- Footcandle requirements at the property line
- Limit the height of lights in commercial parking lots to be 12 to 15 feet
- Prohibit up-lighting of signs and buildings

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- Require all fixtures to be full cutoff. A luminaire is considered to have no cut off if it is unshielded or has a cut off angle greater than 75 degrees



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More detailed information that could be included in Lighting Ordinances

Require that LED lighting has:

- A color temperature not to exceed 3000K.
- CRI between 80-100
- Uniformity Ratio of about 5:1

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More detailed information that could be included in Lighting Ordinances

Require that LED lighting has:

- Average of 1 footcandle in most pedestrian & parking areas (possibly 0.8)
- Require commercial lighting to be equipped with dimmers and require lighting to be dimmed or shut-off at a certain hour



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Create Lighting Zones or Districts

- Lighting Zone 1
 - Areas that require low-level ambient lighting or with limited night activity
 - Single-family residential, business parks, commercial storage facilities
- Lighting Zone 2
 - Areas that require moderate ambient lighting levels
 - Multi-family, institutional uses, hotels/motels, churches embedded in a residential area.

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Create Lighting Zones or Districts

- Lighting Zone 3
 - Areas with moderately to high ambient lighting levels
 - Commercial corridors, industrial uses with high night time activity, shopping malls, car dealerships
- Lighting Zone 4
 - Areas with special cases that require very high ambient lighting levels
 - Heavy industrial uses or recreational facilities

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Additional items to consider:

- Non-conforming uses and future compliance
- Waiver vs. variance
- Requirements of inspection with light meter after installation
- Don't forget definitions
- Signage

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Things to avoid:

- Making the regulations too detailed that you lose focus of the purpose or too difficult to implement.
- Making regulations too strict for the proposed use. Some uses require lighting for safety
- Over-lighting or under-lighting
- Lighting space that does not need to be lit
- Not reexamining regulations every few years to keep up with technology

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Questions?



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Resources

- [International Dark Sky Association](#) (IDA)
- [Illuminating Engineering Society](#) (IES)
- [Local Codes](#)
- [U.S. Department of Energy](#)
- [American Planning Association](#) (APA)

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Contact Information

Michele R. Greig - greig@hvc.rr.com

Brandee K. Nelson – bnelson@tighebond.com

Sarah Brown - sbrown@hardestyhanover.com

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