

CLANTON & ASSOCIATES

# ALBUQUERQUE, NM – IDO Update

# Clanton & Associates Project Team



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IES ONE Vice Chair



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American Planning Association

An aerial photograph of Albuquerque, New Mexico, taken at dusk. The city's skyline is visible, with numerous buildings illuminated by their lights. The foreground shows residential areas with houses and trees. A large, semi-transparent red diamond is centered over the image, containing the text '1 Scope Albuquerque Lighting Ordinance Update'.

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# Scope

Albuquerque Lighting Ordinance Update

# Project Scope

An aerial photograph of a city skyline, featuring several prominent skyscrapers and a highway interchange. The sky is a mix of blue and light purple, suggesting a sunset or sunrise. The foreground shows a mix of urban buildings and greenery.

## Included in Scope:

- Examine Existing Lighting IDO Section
- Study City's Current Lighting Problems
- Implementation & Amortization for updated IDO
- Community Engagement & Feedback

## Excluded from Scope:

- Lighting in the Public Right of Way, or Street Lighting
- Master Planning
- Sign Ordinance Updates

# Topics



- **Lighting 101**
  - The Visual Sequence
  - How light is measured
- **Light Pollution**
  - Obtrusive Light
  - Light Trespass
  - Glare
- **The Impacts of Light Pollution**
  - Not just the night sky
  - Environmental Impacts
  - Health Impacts
- **Status of Albuquerque**
  - IDO Update
- **Lighting Ordinances**
  - How Code Can Help
  - Submittal Process & Applicability
  - Amortization & Enforcement
  - Lighting Zones
  - Lumen Limits, CCT Regulations, Curfews
  - ANSI/IES Guidelines
  - Prohibited Lighting & Special Uses



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# Lighting 101

Albuquerque Lighting Ordinance Update

# The Visual Sequence

GLARE



CONTRAST



ADAPTATION



SPECTRUM



# Illuminance vs Luminance

Lumens = **Total Light Output**

Luminance = **Amount Of Light In A Specific Direction**

Vertical Illuminance = **On People**

Horizontal Illuminance = **On Ground Surface**

Illuminance = amount of light on a surface (FC or lumens per sq. ft. ) Luminance = what we actually see at night ( $\text{cd}/\text{m}^2$ )

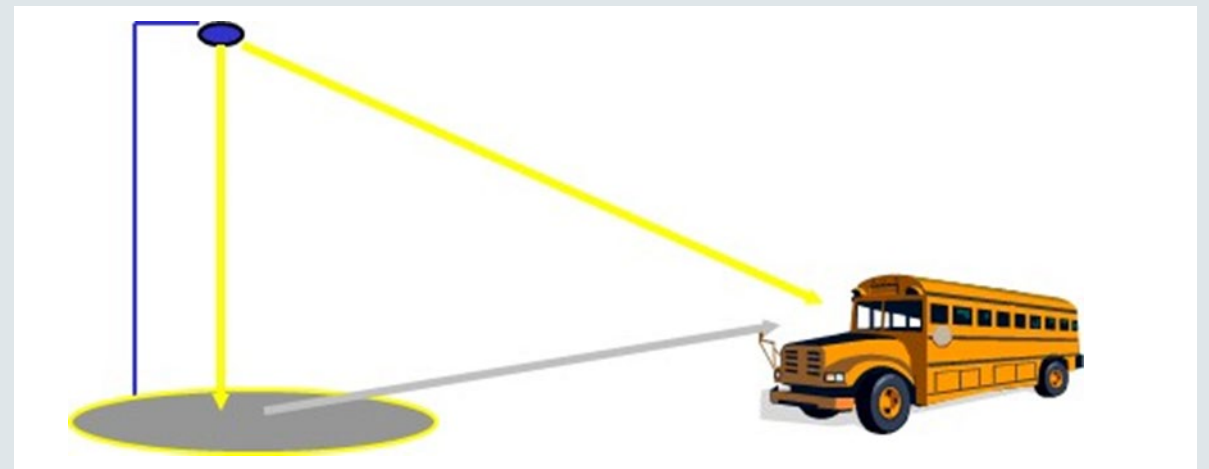




# Veiling Luminance



- Brightness of the luminaire versus pavement
- Wet pavement can exacerbate issue
- Impacts visual adaptation level



# Correlated Color Temperature (CCT)



These temperatures are measured in degrees Kelvin (K).

# Correlated Color Temperature (CCT)



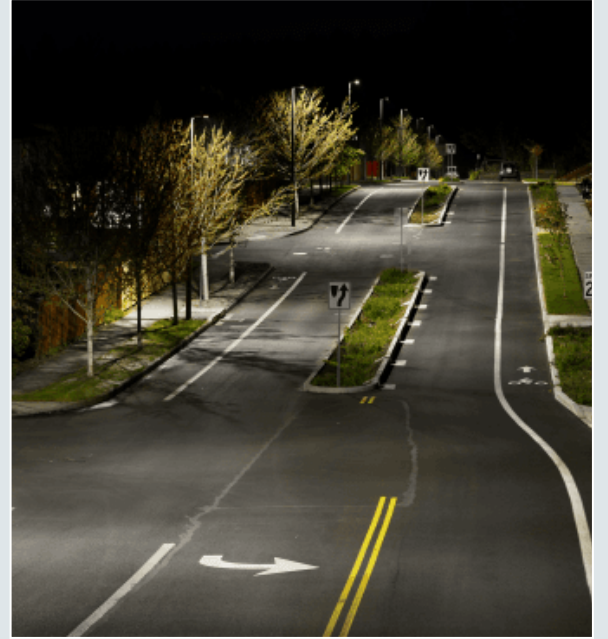
CCT = 2200K



CCT = 2700K



CCT = 3000K



CCT = 4000K

# Color Rendering Index (CRI)

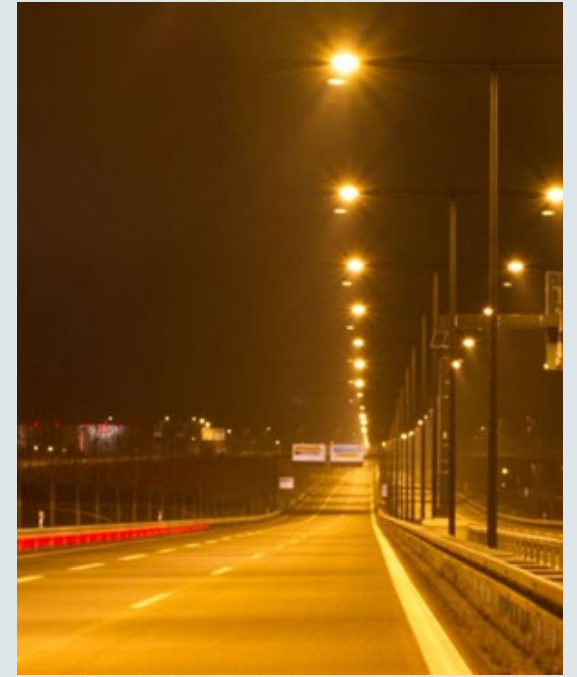
LED Lighting



Typical CRI: 70



HPS Lighting



Typical CRI: 35

# Color Rendering Index (CRI)

- C.R.I. is how well an artificial light can reproduce colors for human vision
- Helps address that the same light temperatures can have significant differences in wavelength composition
- Higher C.R.I. improves visual contrast without increasing light temperature or lumens

CRI: 40



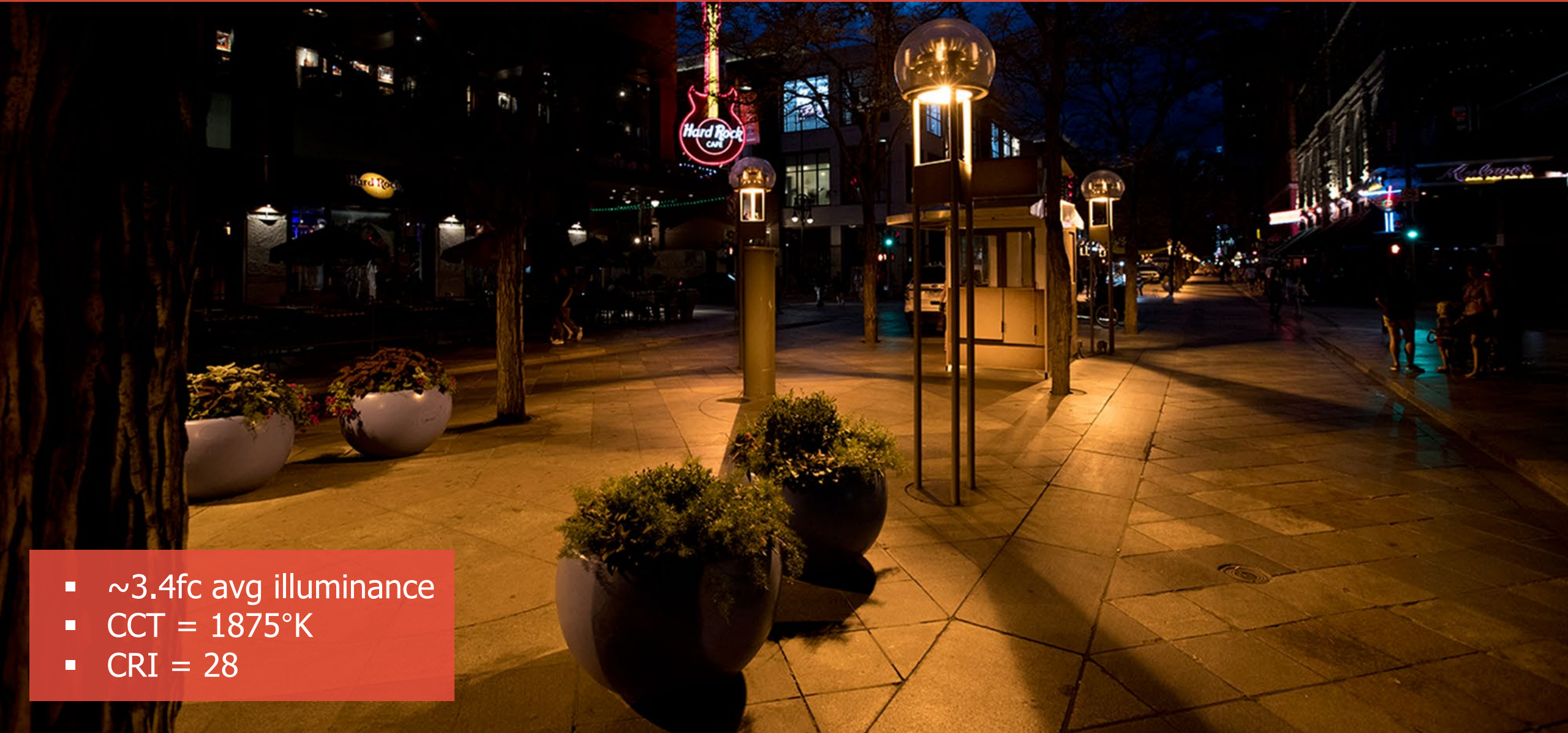
CRI: 60



CRI: 80



# 16<sup>th</sup> Street Mall – Denver, CO – 2016



- $\sim 3.4$ fc avg illuminance
- CCT = 1875°K
- CRI = 28

# 16<sup>th</sup> Street Mall – Denver, CO – 2017



- ~1.1fc avg illuminance
- CCT = 3100°K
- CRI = 83

An aerial night view of a city, likely Austin, Texas, with a large red diamond overlay in the center. The city lights are visible against a dark sky, and the diamond contains the number 3 and the title 'Light Pollution'.

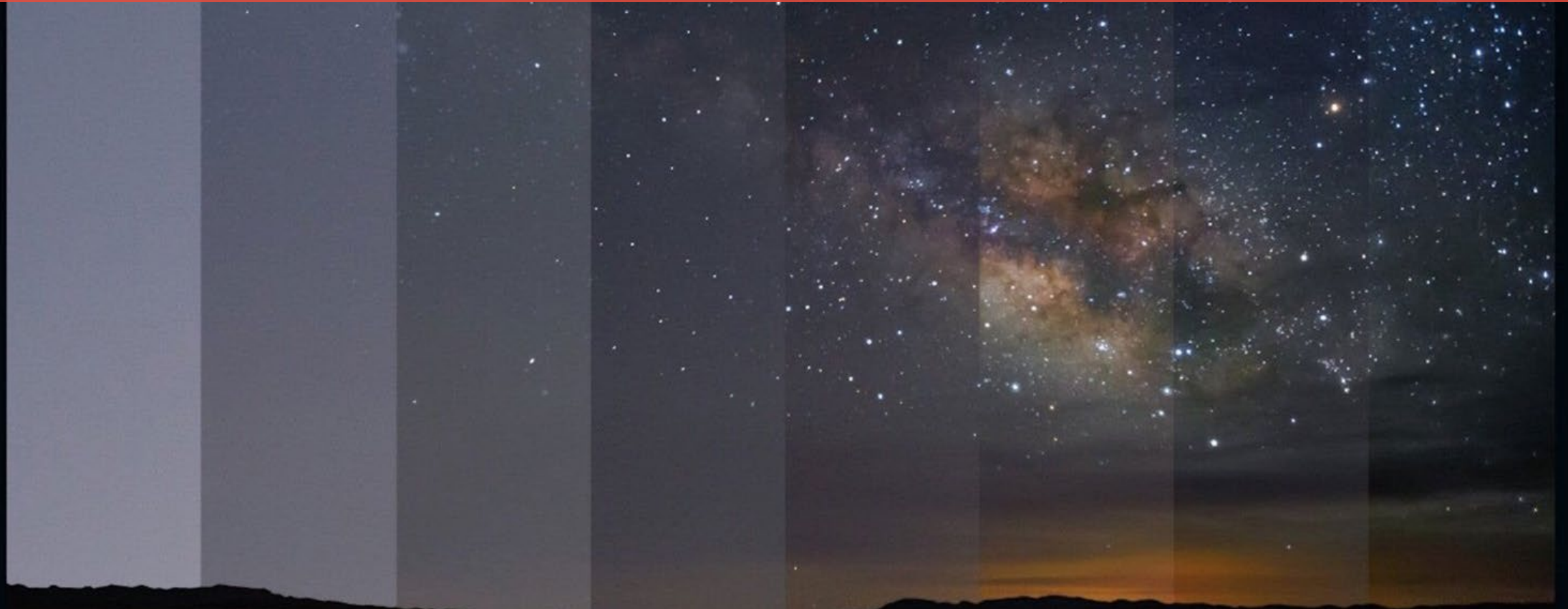
3

# Light Pollution

[what is it and what causes it]



# Bortle Scale



8/9  
City/Inner  
City Sky

7  
City/  
Suburbia  
Transition

6  
Bright  
Suburban  
Sky

5  
Suburban  
Sky

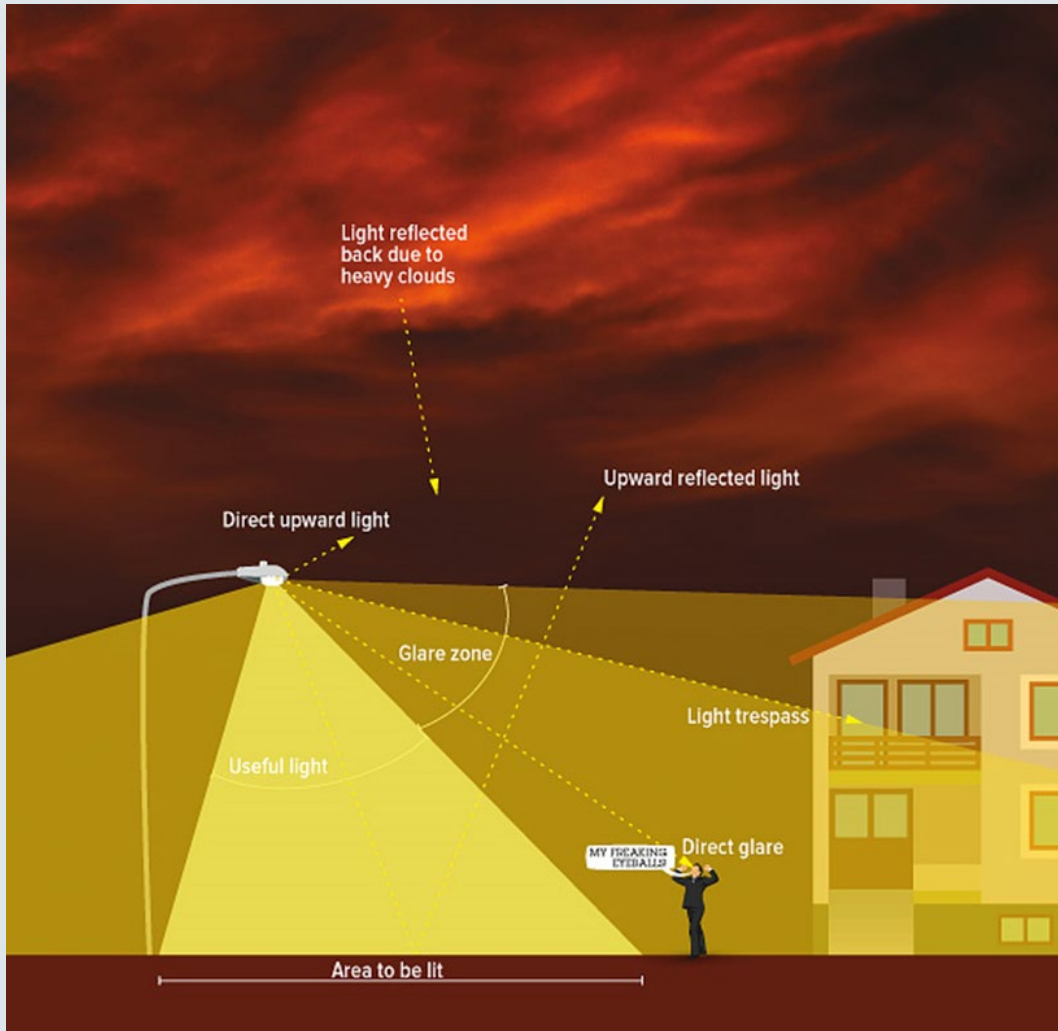
4  
Suburban/Rural  
Transition

3  
Rural Sky

2  
Dark-Sky  
Site

1  
Excellent  
Dark-Sky  
Site

# Types of Light Pollution



## Types:

- Skyglow
- Light Trespass
- Glare
- Light Clutter

## Can be minimized by:

- Directional lighting
- Full cut-off or shielded luminaires
- Warm CCT luminaires
- Curfews

# Glare

High glare reduces our ability to see and perceive contrast.



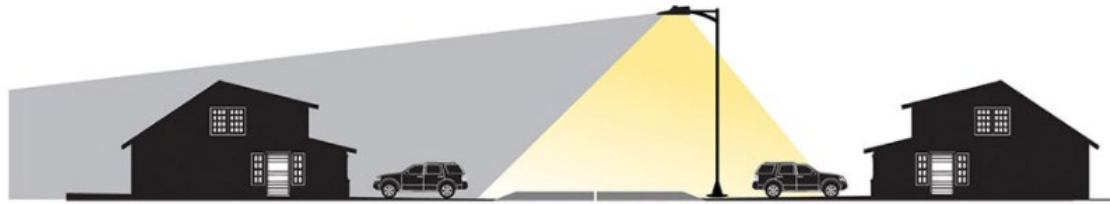
The absence of glare prevents unwanted adaptation and significantly improves the visual experience.



# Light Trespass



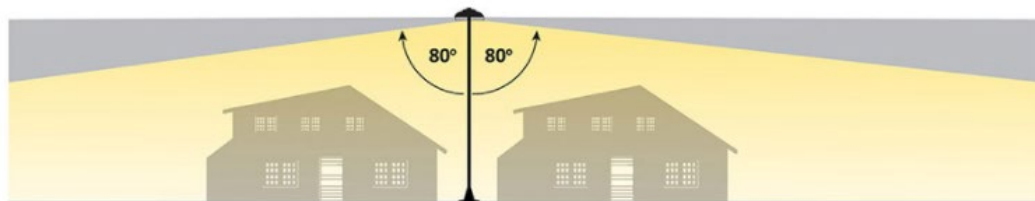
HOUSE-SIDE SHIELD



FRONT-SIDE SHIELD



CUL-DE-SAC SHIELD



GLARE CUT-OFF SHIELD

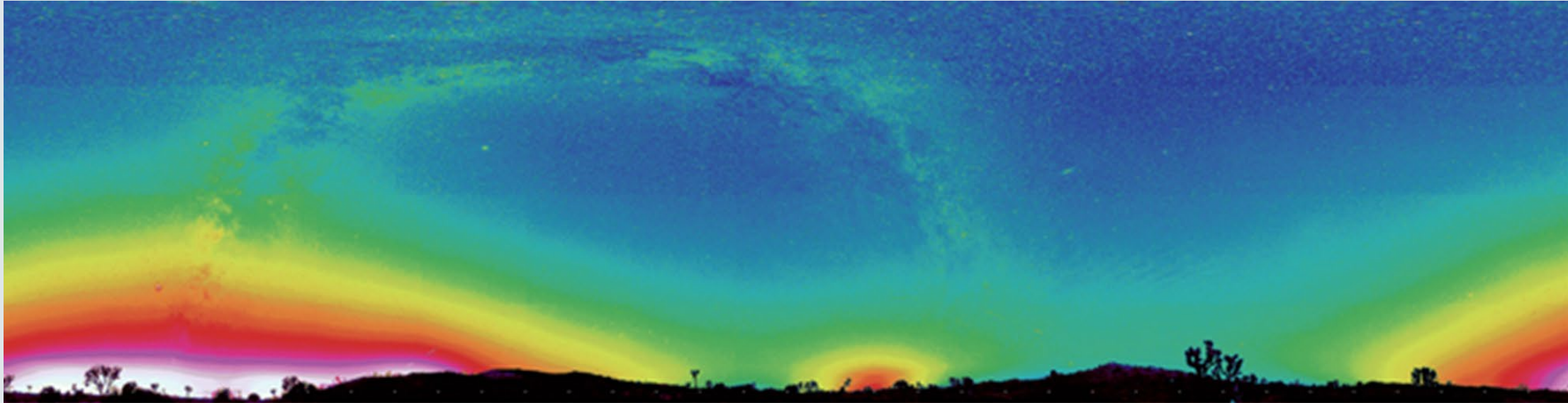
This is unwanted, “stray” light from nearby luminaires.

It’s affected by:

- Light Distribution Selection
- Light Trespass Calculations
- Appropriate Light Level
- Shielding
- High-End Tuning
- Adaptive Dimming

# Sky Glow

Light travelling  
100+  
away from  
urban  
area



We can  
do so  
much  
better.





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# Impacts of Light Pollution

Albuquerque Lighting Ordinance Update

# Light Pollution & Cities

- Providing lighting at night is a significant amount of municipal energy budgets
- Yet around 35% of that lighting is wasted
- Many municipalities are updating their lighting ordinances for LED luminaire conversions
- Light pollution is going up rapidly, not down
- Global light pollution has increased by at least 49% over the last 25 years



# Lighting & Human Health

Impacts human behaviors both consciously & unconsciously

## Physical Health

- Increases rates of some cancers
  - Breast Cancer
  - Prostate Cancer
- Physical Activity After Dark
  - Under & over-lighting can reduce outdoor activity
- Eyestrain

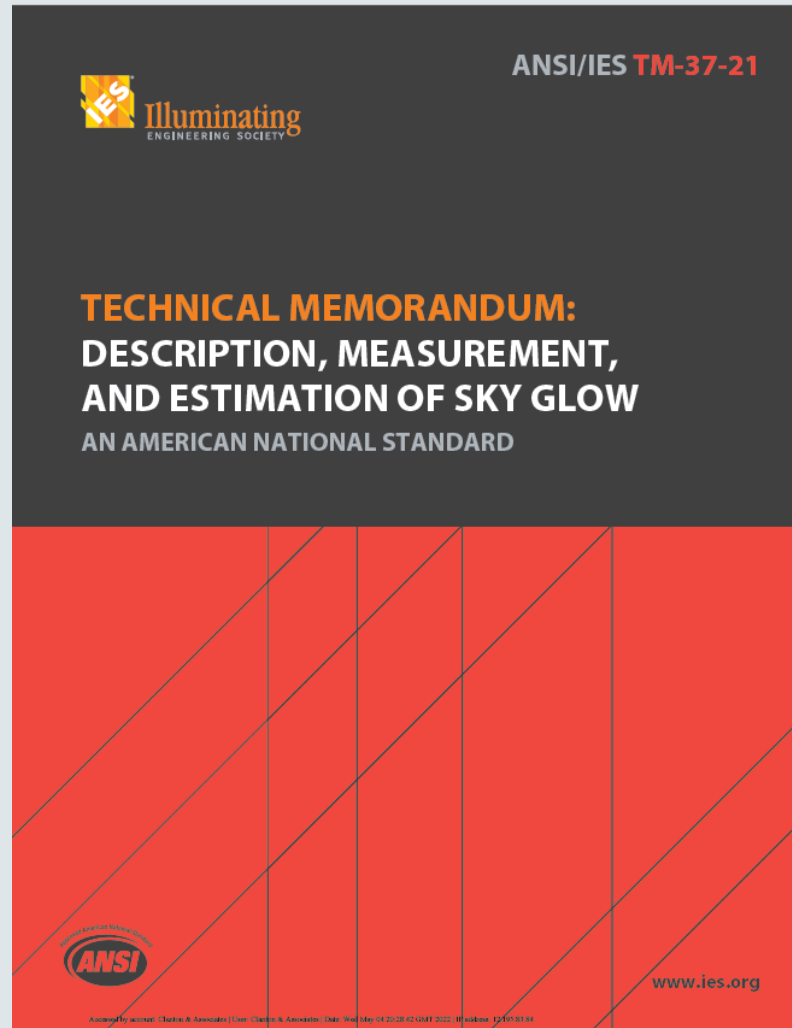
## Mental Health

- Sleep Quality & Circadian Rhythm
  - Delayed melatonin production
  - Sensitivity Varies
  - Exacerbates any existing sleep disorders
  - Brighter areas & higher sleep aid use
  - Lower quality REM sleep
- SAD
- Stress
  - Another source of urban stress - like noise pollution or overcrowding





# CCT – Skyglow & Health Risk (TM-18)



- “Because blue light is more strongly scattered in the atmosphere, it is more likely to be eventually redirected back toward earth, creating the physical manifestation of sky glow. In addition, advances in biology are showing that many living organisms are sensitive to light at night, and particularly blue light.”
- “Since the effects of optical radiation can be profound for human health and well-being, it is increasingly important for the lighting community to understand the direct **biological influences of light/dark cycles.**”
- “Exposure between 1 lux and 5 lux (0.1 fc and 0.5 fc) at the cornea of specific monochromatic wavelengths of **optical radiation (460nm and 509 nm, respectively) could suppress melatonin in healthy humans.**”

#### Related:

- Flagstaff, AZ, the first IDA Community in 2001, uses 1800-2200K
- California Bill Proposal- State properties would use 2700K maximum and dim to 50% during curfew
- Maui, HI, Bill #21 (Passed Oct 2022) –Limits the amount of blue spectrum (400-500nm) to 2% and limits uplight to U0

# Accessibility & Equity

## Visual Ability

- Harder on the visually impaired, such as anyone with astigmatism or cataracts

## The Elderly

- Slower to adjust to changes in brightness
- More sensitive to blue light glare

## Neurodivergent Groups

- Often more sensitive to the stimulus

## Neighborhood Equity

- Affluent neighborhoods often spend the least time with streetlights in disrepair and most time requesting additional lighting
- Struggling neighborhoods are often underlit due to historic disinvestment or harshly overlit, further stigmatizing the neighborhood

## Public Health Equity

- Poor sleep plays a major role in poor health outcomes

## Equal Access

- Astrotourism is not an equitable replacement for local access to the night sky



# Lighting & Wildlife

Impacts behavior of mammals, birds, insects, and zooplankton

- Migratory Disruption
  - Sea turtles, whales, birds, insects, and zooplankton are impacted
- Reproductive Decline
  - Impacts normal communication
  - Fireflies and amphibians are affected
- Premature Death
  - Disorientation
  - Bird Strikes



# Lighting & Wildlife

## Artificial night lighting and insects: Attraction of insects to streetlamps in a rural setting in Germany.

**Source:** [Ecological Consequences of Artificial Night Lighting](#). Catherine Rich & Travis Longcore (eds). 2006. Island Press. Pages 281-304.

[Gerhard Eisenbeis](#)

Department of Biology, Institute of Zoology, Mainz University, Germany.

The Xerces Society for Invertebrate Conservation

## Documentation of Insect Declines due to Light Pollution.

Eisenbeis noted the declines of insect catches from different decades as reported in three papers. This table helps to show the declines he saw across the decades:

Authors	Year	Publishing Info.	Count of Insects Caught	Number of Traps	Catch Span Times
Robinson & Robinson	1950	<i>Entomologist's Gazette</i> 1:3-20	over 50 thousand moths	1	the one night of August 20-21, 1949
Worth & Miller	1979	<i>J. of the Lepidopterists' Society</i> 33:261-264	50 thousand moths	1	May 2nd to Sept 12, 1978
Eisenbeis & Hassel	2000	<i>Natur und Landschaft</i> 75(4):145-156	6205 moths	19	May 29th to Sept. 29, 1997



# Lighting & Plant Life

- Photosynthesis Alteration
- Pollinator & Pollination Reduction
- Crop Yield Reduction



- Photoperiodism
- Plants' health and lifespan is impacted
- Also impacts phytoplankton and algae bloom



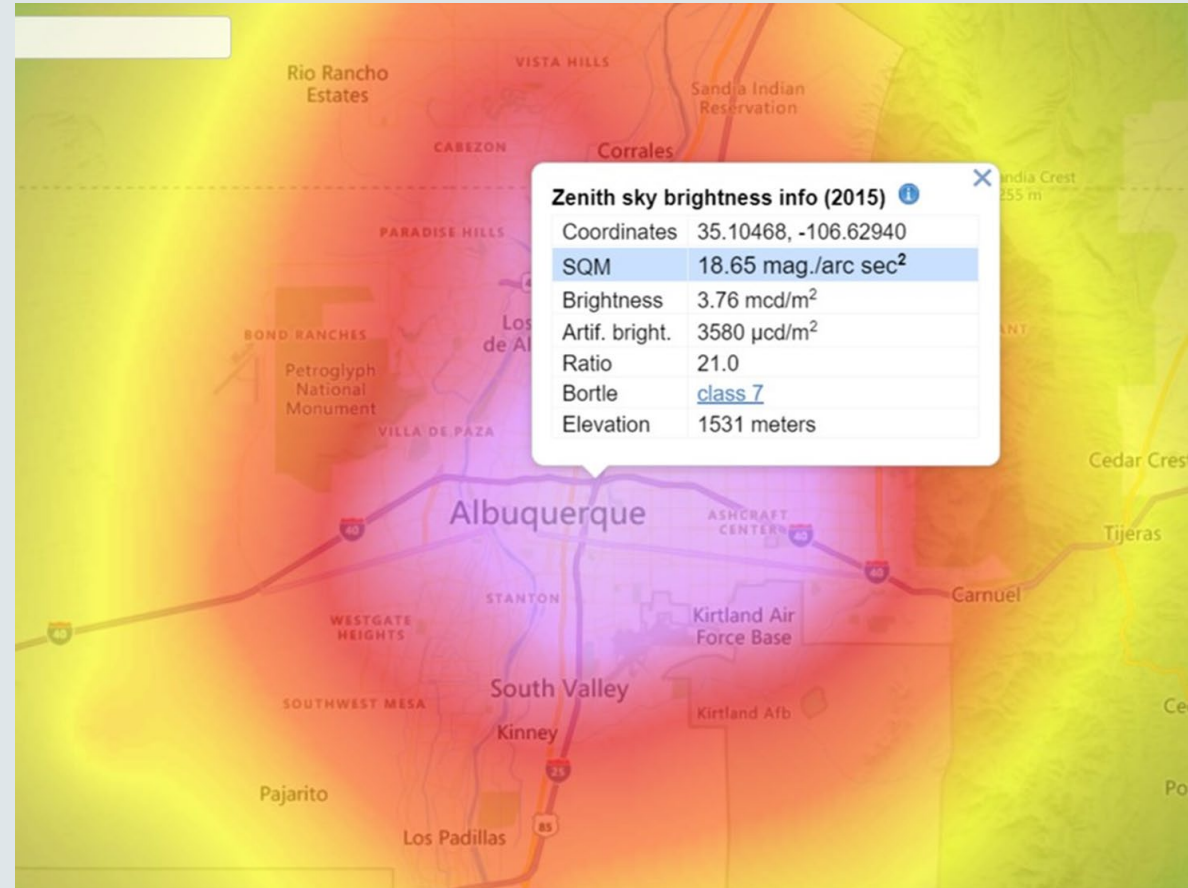
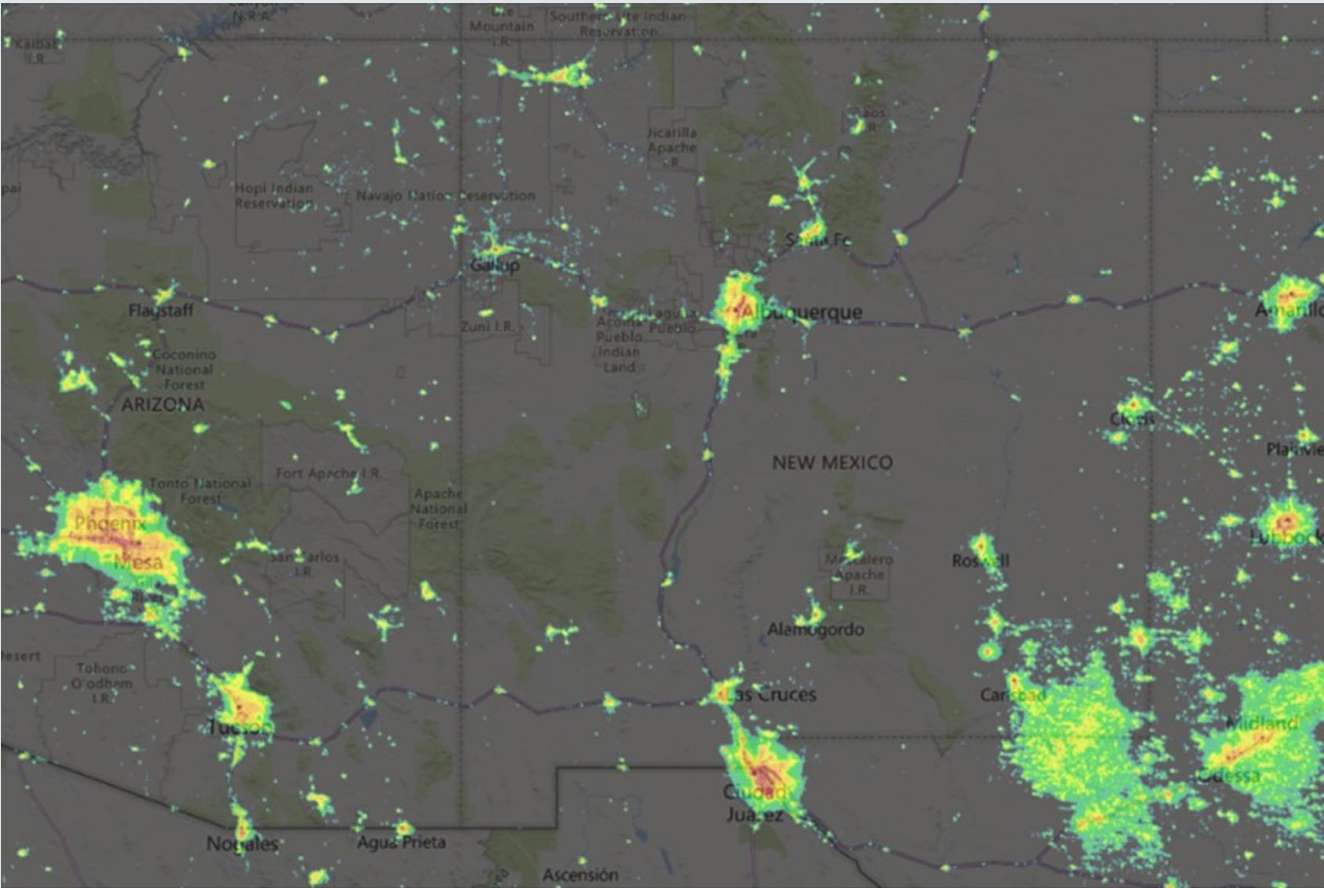
An aerial photograph of Albuquerque, New Mexico, taken at dusk or night. The city's lights are visible, including the prominent gold-colored tower of the New Mexico State Capitol building in the center. A large, semi-transparent red diamond is overlaid on the image, containing the number '5' and the city name 'Albuquerque'.

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# Albuquerque

[status of Albuquerque]

# City of Albuquerque



# General Observations

Horizontal Light



Skyglow





An aerial photograph of a city at dusk or dawn. The sky is a mix of grey and blue, with some clouds. The city lights are visible, particularly in the background where a dense cluster of buildings is lit up. In the foreground, there are residential houses and trees. A large, semi-transparent red diamond is centered over the image, containing the number '6' and the title 'Lighting Ordinances'.

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# Lighting Ordinances

[the role of code and how it can help]

# How Code Can Help



## **Submittal Process**

- Prescriptive vs. Performance

## **Applicability**

- New Development, Expansions, Renovations
- Maintenance

## **Amortization**

- Grandfathering
- 10 years, 20 years, etc.

## **Enforcement**

- Complaints, Investigation, Penalty, Appeal

# Guidance & Criteria

## Illuminating Engineering Society (IES)

### **IES:**

Governing body that guides lighting professionals

The Lighting Handbook  
Recommended Practices.

### **IES RP-8-14:**

Recommended Practices for Roadway Lighting  
Recommended criteria for roadways, sidewalks and crosswalks

### **IES RP-43:**

Outline for outdoor lighting. Criteria supports pedestrian engagement, safety, etc. without overlighting.



# Model Lighting Ordinance (MLO)

- Guidelines to help communities create their outdoor lighting standards.
- Created jointly by the IES and the International Dark Sky Association (IDA)
- Utilizes lighting zones, B.U.G ratings, and light trespass limits to regulate quality lighting



# ANSI/IES RP-43



## ANSI/IES RP-43 Illuminance Recommendations:

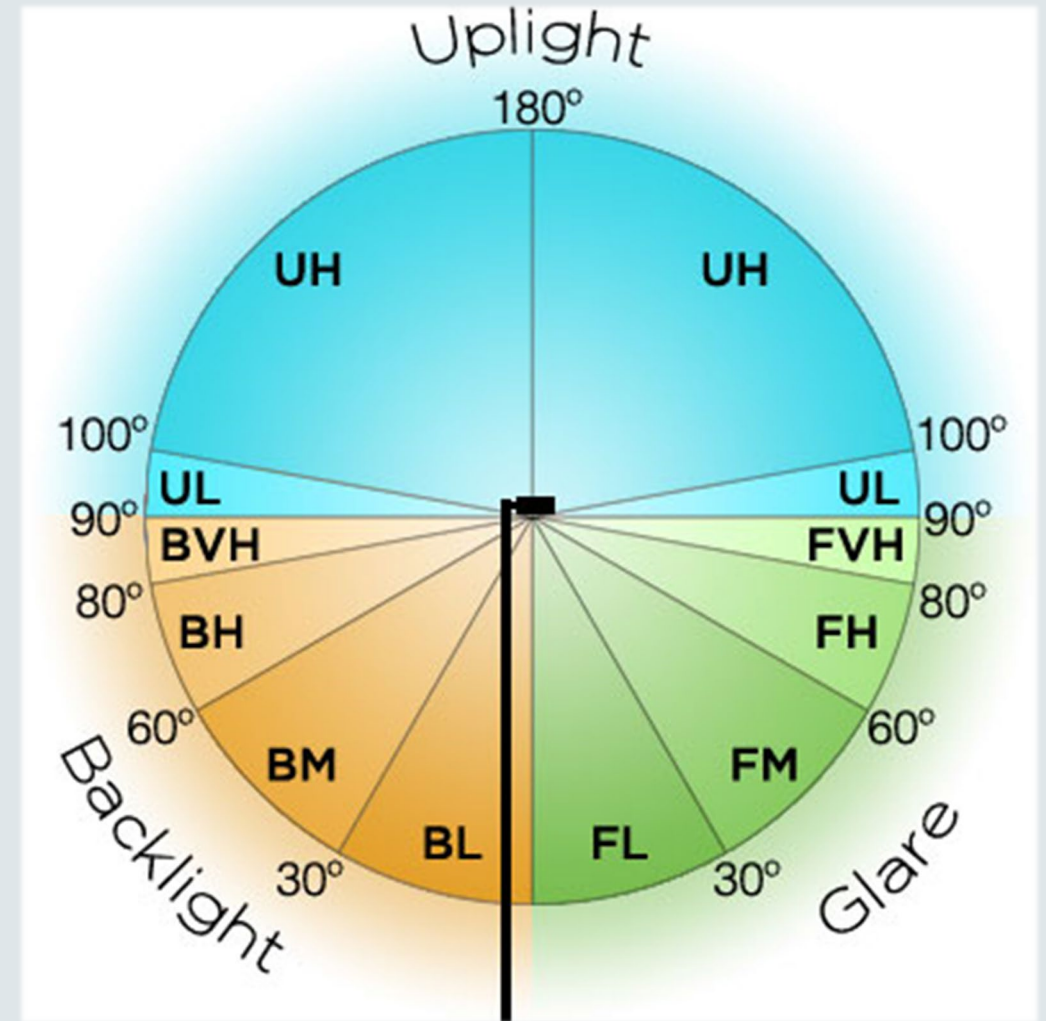
- Provides energy consumption standards
- Orientation / Wayfinding / Reassurance
- Terrain Safety
- Atmosphere / Enjoyment
- Curfew + Dimming
- Spectral Power Distribution (SPD)
  - Correlated Color Temperature (CCT)
  - Color Rendering Index (CRI)

# ANSI/IES RP-43

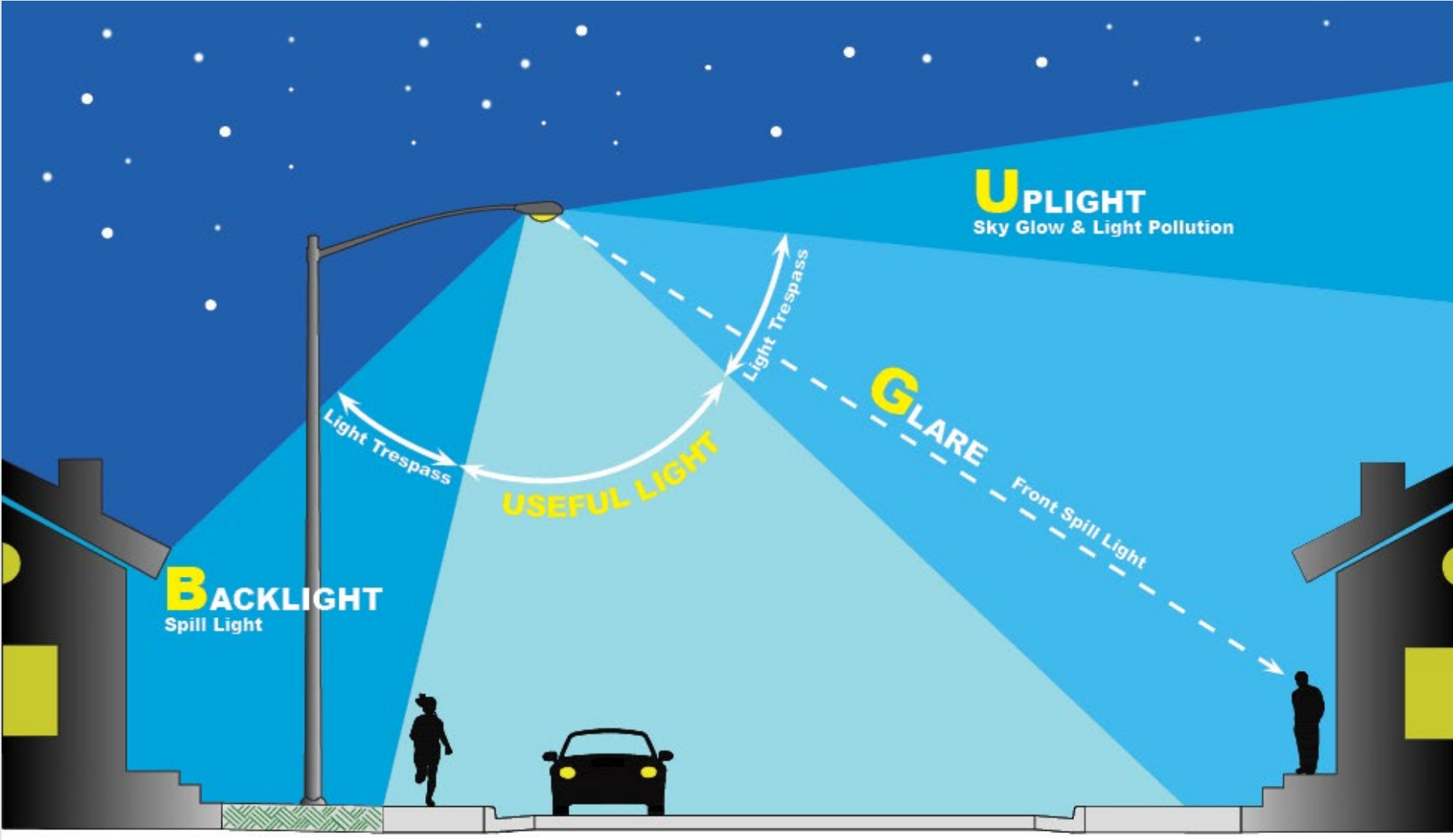
ANSI/IES RP-43: Lighting for Pedestrians in Outdoor Environments  Table A-3	Lighting for Human Vision, Visibility, and Reassurance								Lighting for Responsible Design							
	Recommended Average Maintained Illuminance Targets <sup>10</sup>								Optic Control		Controls	Spectrum				
	Illuminances are at height of Task Surface (TS) above finished grade (AFG)															
	Horizontal Illuminance				Vertical Illuminance				Glare, Uplight Ratings		Vacancy, Seasonal, & Curfew Reduction	Acceptable Short Wavelength Content <sup>7</sup>				
Target E <sub>h</sub> @ Height AFG	Uniformity			Target E <sub>v</sub> @ Height AFG	Uniformity											
lux @ m	(fc @ ft)	Ratio (Avg:Min)	Ratio Basis	lux @ m	(fc @ ft)	Ratio (Avg:Min)	Ratio Basis	Max Glare Rating (G)	Max Uplight Rating (U)	Light Output During Controls Reduction	Very Low (VL); Low (L); Medium (M); High (H); Very High (VH)					
<b>APPLICATION TASK/AREA<sup>8</sup></b>																
<b>CONTEXT, ORIENTATION, WAYFINDING, REASSURANCE</b>																
<b>Façades</b>																
Façades (low reflectance materials, <0.3) <sup>10</sup>																
Façades (medium reflectance materials, >0.3 and <0.6) <sup>10</sup>																
Façades (high reflectance materials, >0.6) <sup>10</sup>																
<b>Building Entrances, Drop-Off, Pick-Up</b>																
Building Entrances <sup>2,10</sup>																
<b>LZ4</b>																
	Lower limit (avg.)				30 @ 0.00	(3 @ 0.0)	5:1	Avg:Min	10 @ 1.5	(1 @ 5.0)	5:1	Avg:Min	G2	U3	20% to 50%	VL, L, M, H
	Upper limit (avg.)				50 @ 0.00	(5 @ 0.0)	5:1	Avg:Min	30 @ 1.5	(3 @ 5.0)	5:1	Avg:Min				
<b>LZ3</b>																
	Lower limit (avg.)				20 @ 0.00	(2 @ 0.0)	5:1	Avg:Min	8 @ 1.5	(0.8 @ 5.0)	5:1	Avg:Min	G2	U3	20% to 50%	VL, L, M
	Upper limit (avg.)				40 @ 0.00	(4 @ 0.0)	5:1	Avg:Min	20 @ 1.5	(2 @ 5.0)	5:1	Avg:Min				
<b>LZ2</b>																
	Lower limit (avg.)				10 @ 0.00	(1 @ 0.0)	5:1	Avg:Min	4 @ 1.5	(0.4 @ 5.0)	5:1	Avg:Min	G2	U2	20% to 50%	VL, L, M
	Upper limit (avg.)				20 @ 0.00	(2 @ 0.0)	5:1	Avg:Min	10 @ 1.5	(1 @ 5.0)	5:1	Avg:Min				
<b>LZ1</b>																
	Lower limit (avg.)				5 @ 0.00	(0.5 @ 0.0)	5:1	Avg:Min	2 @ 1.5	(0.2 @ 5.0)	5:1	Avg:Min	G1	U1	20% to 50%	VL, L
	Upper limit (avg.)				10 @ 0.00	(1 @ 0.0)	5:1	Avg:Min	5 @ 1.5	(0.5 @ 5.0)	5:1	Avg:Min				

# IES TM-15: B.U.G. Ratings

- Three main components are evaluated:
  - Backlight
  - Uplight
  - Glare
- Backlight = how much light falls behind the luminaire
- Uplight = if any light is shining above the horizontal plane running through the lowest point of the light source
- Glare = how much light is shining too far in front or to the sides of the luminaire
- Each of these categories then gets a numerical rating that gives the luminaire a quality score



# IES TM-15: B.U.G. Ratings





# How Code Can Help

## Lighting Zones:

Lighting zone designations are designed to help protect the natural environment from unintended consequences of excessive or misapplied light at night. Used as a municipal design and planning tool, lighting zones have become the foundation for many illuminance recommendations and additional auxiliary design and energy standards.

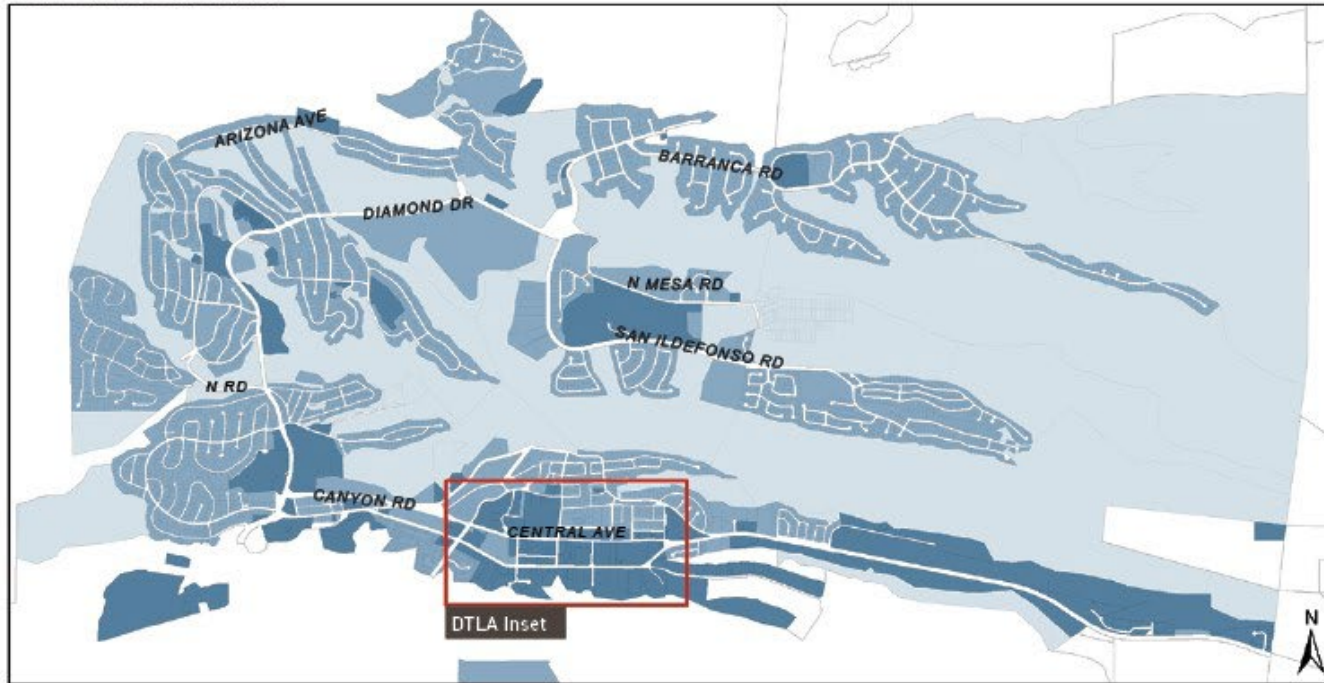
- NDZ – Natural Dark Zone, no lighting allowed
- LZ0 – Parks and Protected Space, Rural Farms
- LZ1 – Residential, Office, Service, Institutional
- LZ2 – Small/Mid City Commercial, Industrial
- LZ3 – Large City Commercial, Hospitality, Heavy Industrial
- LZ4 – Limited Use



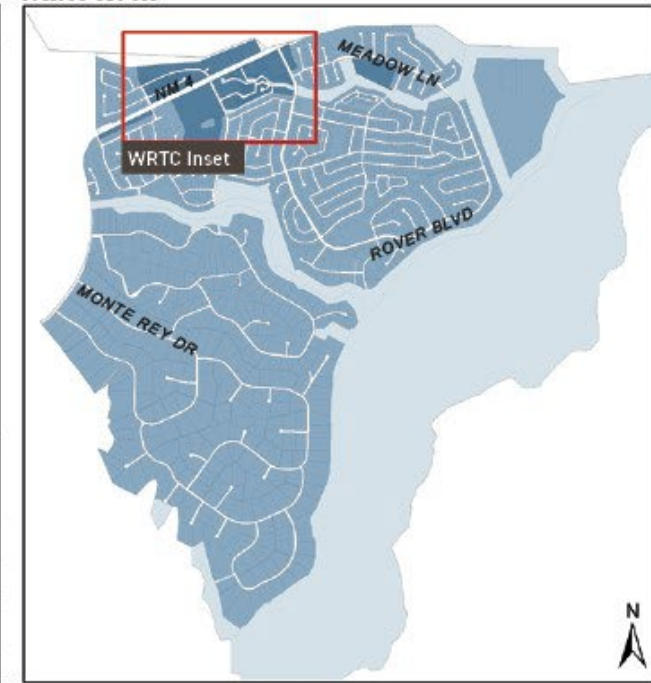
# Lighting Zones as Overlay Zoning

4-9(B)(VI)(1) DESIGNATED SIGNAGE ZONES

Los Alamos Townsite



White Rock



## Legend

- LZ0 Lighting Zone 0
- LZ1 Lighting Zone 1
- LZ2 Lighting Zone 2

# Permit Only & Special Use

- Security Lighting
- Historic Luminaires
- Art / Decorative
- Construction Lights
- Seasonal / Holiday
- Sports
  - Light Trespass
  - Max Candela
  - Curfew



Questions?



An aerial night view of a city, likely Austin, Texas, with the Capitol building illuminated in the background. A large red diamond shape is overlaid on the center of the image, containing the text.

# Thank You!

**CLANTON & ASSOCIATES**

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LIGHTING DESIGN AND ENGINEERING