**ATTACHMENT 01** 

#### CLANTON & ASSOCIATES

#### Town of VIENNA mathematical

#### Town of Vienna, VA - Lighting Ordinance

### **Clanton & Associates Project Team**



### **Project Scope & Presentation**

#### **Project Scope**

#### **Included in Scope:**

- Privately Owned Lighting
- City Owned/Non-ROW Lighting
- Façade Lighting
- Temporary Lighting

#### **Excluded from Scope:**

 Street & Pedestrian Lighting in the Public ROW

#### Topics

- Project Structure & Schedule
- Lighting 101
- Impacts of Light Pollution
  - Community Survey Results
  - Role of Lighting Standards & Criteria

# **Project Structure**

#### Town of Vienna Outdoor Lighting Regulations & Guidelines Project Schedule



Community Engagement

Lighting Compliance Forms

**Project Initiation & Assessment** 

**Draft Regulations & Guidelines** 

**Formal Review** 

## **Project Stages**

#### **Project Initiation & Assessment**

- Review of existing lighting standards
- Site visits to review existing night lighting conditions at 4 sites
- Memo of existing site lighting conditions

#### **Community Outreach & Engagement**

- Lighting 101 Presentations
- Online Lighting Preferences & Nighttime Behaviors Survey
- Memo of survey findings







## **Project Stages**

#### **Lighting Ordinance Updates**

- Updated language for all land use zones
- Currently around 50% complete
- 75% Draft by mid-May
- Anticipated for Council vote in October



#### **Lighting Design Guidelines**

- Design guidance for buildings & illuminated signs
- Identifying quality luminaires for multiple architectural styles
  - 50% Completed



## **Project Stages**

#### **Lighting Compliance Forms**

- Tool to assist with lighting compliance
- Drafting in May 2025
- Virtual training for staff

#### **Public Hearings & Final Steps**

- Ordinance draft provided to Council and PC by July for comment
- Guidelines Draft provided to BAR in June
  - Final approvals in October





# Lighting 101

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## Why do we light?



### **Lighting Metrics: Illuminance vs Luminance**

#### Lumens = Total Light Output

Vertical Illuminance = **On People, Buildings, Walls** 

Illuminance = amount of light on a surface, such as the ground or a pedestrian (FC or lumens per sq. ft.)

Luminance = what we actually see at night, or the amount of light returned from a surface to the eye  $(cd/m^2)$ 

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



At some point you may come back to read this line or maybe not. And then you will read this line next.

You will go back to read this body copy if you want to know more. It takes the most effort to read because it has a lot of text in a small font in a light weight with tight line spacing. Many people will skip paragraphs like this unless if they aren't engaged right away. This is why it's important to draw attention to your message using visual hierarchy.

You'll probably read this before the paragraph.

### **Perceiving Lighting**







### **Glare - Visibility**

# High glare reduces our ability to see and perceive contrast.

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



### **Glare - Light Trespass**



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

### **Adaptation - Light Level**



### **Adaptation – Dimming**



**Dusk to 10pm** Light to Criteria

**10pm to 12am** Reduce Pedestrian Criteria

Weekends 12am to 2am Light to Criteria

**2am to Dawn** Reduce to Low Ped Criteria

#### **Contrast - Positive vs Negative**

CONTRAST CONTRAST CONTRAST CONTRAST CONTRAST CONTRAST

**CONTRAST CONTRAST CONTRAST CONTRAST** 

### **Contrast - Uniformity**

Excessive uniformity of lighting can reduce contrast to the point where objects can seem to vanish. Appropriate uniformity maintains contrast and allows small objects in the road to be seen.





#### Spectrum: Correlated Color Temperature (CCT)



These temperatures are measured in degrees Kelvin (K).

#### Spectrum: Correlated Color Temperature (CCT)



#### Spectrum: Color Rendering Index (CRI)

- C.R.I. is how well an artificial light can reproduce colors for human vision
- Light sources with the same Color Temperature (CCT) can have significant differences in wavelength composition
- Higher C.R.I. improves visual contrast without increasing light temperature or lumens



#### Spectrum: Color Rendering Index (CRI)

#### LED Lighting

#### **HPS Lighting**



#### Typical CRI: 70

Typical CRI: 35

# **Light Pollution**

### **Light Pollution & Cities**

- Providing lighting at night is a significant amount of municipal energy budgets
- Yet around 30% of that lighting is wasted
- Light pollution is going up 10% annually, not down



### **Types of Light Pollution**



Types:
Glare
Light Trespass
Sky Glow

Can be minimized by:
Directional lighting
Full cut-off or shielded luminaires
Curfews

### **Bortle Scale**



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## **Regional Light Pollution**







## **Quality Lighting Systems**



# Community Survey Results

#### Lighting Preferences & Nighttime Behaviors Survey

- Open from Mid-October 2024 through Mid-March 2025
- 25 Questions on demographics, lighting, and nighttime behavior patterns
- 336 Responses Analyzed
- 799 Unique Free Responses Analyzed

![](_page_31_Figure_5.jpeg)

### Demographics

![](_page_32_Figure_1.jpeg)

Male Female Another Gender Prefer not to answer

### **Nighttime Activity in the Town**

#### **Outdoor Activities at Night**

![](_page_33_Figure_2.jpeg)

### **Aesthetic Satisfaction**

#### **Outdoor Lighting Aesthetic Satisfaction**

![](_page_34_Figure_2.jpeg)

#### Lighted Signage Aesthetic Satisfaction

![](_page_34_Figure_4.jpeg)

### **Color Temperature**

**Residential CCT** 

![](_page_35_Figure_2.jpeg)

**Commercial CCT** 

![](_page_35_Figure_4.jpeg)

### **Light Pollution**

Light Pollution

![](_page_36_Figure_2.jpeg)

![](_page_36_Figure_3.jpeg)

### **Light Trespass**

Light Trespass Experiences

![](_page_37_Figure_2.jpeg)

![](_page_37_Figure_3.jpeg)

#### Light Trespass & Residency

![](_page_37_Figure_5.jpeg)

# Free Response: What do you hope a new outdoor lighting ordinance will accomplish for the Town of Vienna?

![](_page_38_Figure_1.jpeg)

- Light Trespass
- Ecological/Health Concerns
- Public Safety/Walkability
- Street Lighting
- Commercial Spaces
- Community Spaces
  - Night Sky
  - Color Temperature
  - Regulatory
  - Against

"A new lighting ordinance would ensure that light-energy is not wasted by lighting the sky, and interfering with wildlife needs"

"Less nighttime light pollution in town and regulations for private property. My neighbor has spot lights they often keep on all night and it's very disturbing to sleep when the light shines on my house."

"As town residents become older eye sight is an important consideration. Provide better focused lighting."

"I've never thought about the Town's lighting ordinance once before this survey."

# Free Response: In the future, I want nighttime in the Town of Vienna to feel like...

![](_page_39_Figure_1.jpeg)

- Light Trespass
- Ecological/Health Concerns
- Public Safety/Walkability
- Street Lighting
  - Commercial Spaces
  - Community Spaces
  - Night Sky
  - Color Temperature
  - Regulatory
  - Against

"A cozy suburban town with just enough light to see. Not a bright city."

"Balanced! Thirty years ago our Town did not have this level of light pollution."

"Dark enough to see some stars, light enough to feel safe"

"a safe place for an evening stroll."

# Role of Lighting Regulations

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### **How Municipal Regulations Can Help**

HINGTON & OLD DOMINION

![](_page_41_Picture_1.jpeg)

- Purpose & Goals
- Residential vs. Non-Residential
- Applicability & Amortization
- Exemptions & Prohibitions

#### **Defines General Lighting Requirements:**

- Light Level
- Uplight control
- Trespass thresholds
- Nighttime hours or curfews
- Spectrum / CCT

#### **Procedures:**

- Application Process
- Enforcement & Penalty

## **Lighting Zones**

- Protects communities and the natural environment from the unintended consequences of excessive or misapplied light at night
- Best used by municipalities, counties, and states as a planning strategy
- Foundational for many illuminance recommendations and their additional auxiliary design and energy standards

#### **Current Lighting Zones**

- NLz 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 Special District Use Only

#### Los Alamos Townsite

![](_page_42_Figure_12.jpeg)

![](_page_42_Figure_13.jpeg)

![](_page_42_Figure_14.jpeg)

## Skyglow & Health Risk (TM-18)

![](_page_43_Picture_1.jpeg)

#### ANSI/IES TM-37-21

#### **TECHNICAL MEMORANDUM:** DESCRIPTION, MEASUREMENT, AND ESTIMATION OF SKY GLOW

AN AMERICAN NATIONAL STANDARD

![](_page_43_Picture_5.jpeg)

- "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, <u>advances in biology</u> 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 <u>biological influences of light/dark cycles</u>."
- "Exposure between 1 lux and 5 lux (0.1 fc and 0.5 fc) at the cornea of specific monochromatic wavelengths of <u>optical radiation (460nm and</u> <u>509 nm, respectively) could suppress melatonin in healthy humans</u>."

#### **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

### Light Level: ANSI/IES RP-43

![](_page_44_Picture_1.jpeg)

#### ANSI/IES RP-43-22

#### RECOMMENDED PRACTICE: LIGHTING EXTERIOR APPLICATIONS AN AMERICAN NATIONAL STANDARD

![](_page_44_Figure_4.jpeg)

#### ANSI/IES RP-43 Illuminance Recommendations:

- Orientation / Wayfinding
- Reassurance
- Terrain Safety
- Atmosphere / Identity
- Enjoyment

### Light Levels: ANSI/IES RP-43

ANSI/IES RP-43: Lighting for Pedestrians in Outdoor Environments	Lighting for Human Vision, Visibility, and Reassurance									Lighting for Responsible Design			
Table A-3	Recommended Average Maintained Illuminance Targets <sup>10</sup>								Optic	Control	Controls	Spectrum	
	Illuminances are at height of Task Surface (TS) above finished grade (AFG)										Vacancy,	Acceptable	
	Horizontal Illuminance					Vertical Illuminance						Seasonal, &	Short
	Target E <sub>n</sub> @ Height AFG		Uniformity			Target E <sub>v</sub> @ Height AFG		Uniformity		Glare, Uplight Ratings		Curfew Reduction	Wavelength Content <sup>7</sup>
APPLICATION TASK/AREA <sup>8</sup>	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)
CONTEXT, ORIENTATION, WAYFINDING, REASSURANCE													
Façades													
Façades (low reflectance materials, <0.3) <sup>10</sup>													
Façades (medium reflectance materials, <u>&gt;</u> 0.3 and <u>&lt;</u> 0.6) <sup>10</sup>													
Façades (high reflectance materials, >0.6) <sup>10</sup>													
Building Entrances, Drop-Off, Pick-Up													
Building Entrances <sup>2,10</sup>													
LZ4													
Lower limit (avg.)	30 @ 0.00	(3 @ 0.0)	5:1	Avg:Min		10 @ 1.5	(1 @ 5.0)	5:1	Avg:Min	62	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	62			
LZ3													
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				
LZ2													
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				
LZ1			- -										
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	114	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		01		

# **Questions**?

## **Thank You!**

CLANTON & ASSOCIATES

![](_page_47_Picture_2.jpeg)

Tab

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