

Campus Outdoor Lighting Plan

A outdoor light management plan for the Truman State University Campus

Vayujeet Gokhale: *Professor of Physics, Truman State University*

Xxxxxxx Yyyyyyy: *Assistant Professor of Physics, Truman State University*

Xxxxxxx Yyyyyyy: *Campus Architect, Truman State University*

Xxxxxxx Yyyyyyy: *Student, Truman State University*

Xxxxxxx Yyyyyyy: *Chief of Police, DPS*

Xxxxxxx Yyyyyyy: *Physical Plant*

DRAFT

Purpose of this document

The purpose of this document is to articulate a set of principles and guidelines for outdoor lighting installations and improvements. The document also provides standards and other considerations for outdoor lighting. A more general overview of existing campus lighting, best practices in lighting design, student surveys about campus lighting, and lighting solutions is provided in an accompanying document: "TSU Outdoor Lighting White Paper".

I. Principles of Responsible Outdoor lighting

- 1) **Useful:** All light should have a clear purpose
Before installing or replacing a light, determine whether light is needed. Consider how the use of light will impact the area, including wildlife and the environment. Consider using reflective paints or self-luminous markers for signs, curbs, and steps to reduce the need for permanently installed outdoor lighting.
- 2) **Targeted:** Light should be directed only to where it's needed
Use shielding and careful aiming to target the direction of the light beam so that it points downward and does not spill beyond where it is needed.
- 3) **Low level:** Illumination should be no higher than necessary
Use the lowest light level required. Be mindful of surface conditions, as some surfaces may reflect more light into the night sky than was intended.
- 4) **Controlled:** Light should be used only when it is useful
Use controls such as timers or motion detectors to ensure that light is available when it is needed, dimmed when possible, and turned off when not needed.
- 5) **Warm-colored:** Use warmer-color lights where possible
Limit the amount of shorter wavelength (blue-violet) light to the least amount needed.
Light where you need it, when you need it, in the amount needed, and no more.

II. General Guidelines for campus lighting

The guidelines outlined below follow naturally from the general principles for responsible outdoor lighting stated above. In general, the goal of outdoor lighting on the Truman campus is to support comfortable passage for campus residents and commuters. Truman strives to help develop a sense of safety for pedestrians while minimizing light pollution and protecting wildlife habitat. We strive to take a comprehensive look at our campus and the outdoor nighttime lighting needs of our students and neighboring communities. With this in mind, we outline a set of guidelines that outline the lighting policy at Truman State:

- 1) **Adhere to a long-term vision for LED replacement:** LED lights afford greater control on color-spectrum and intensity, dimming capabilities, and greater efficiency leading to greater energy savings.
- 2) **Highlight connections and destinations:** Entrances to buildings, major walkways, and adjacent areas should be strategically illuminated. Major pathways that support

multimodal passage, must be lighted cohesively and uniformly to support safe nighttime circulation and wayfinding through campus.

- 3) **Eliminate excess light and reduce lumen output:** Use of excessive light can be unsafe for pedestrians and drivers, and decreases the environmental and financial benefits of LED lighting.
- 4) **Avoid high contrast and strive for uniform lighting:** Uniform lighting is often more important than the amount of lighting when establishing the sense of a safe, well-lit area.
- 5) **Minimize glare:** Avoid unnecessary hazards to motorists and pedestrians created by glare from building, street, or parking lot light fixtures.
- 6) **Plan for future control capabilities:** Installing fixtures and other infrastructure that is compatible with dimming and timer technologies will provide long-term savings and better management of outdoor lighting on campus.
- 7) **Account for surfaces & site-character:** Lighting should always be approached in relation to physical site conditions such as surface materials and vegetation, both in design choices and maintenance. These factors strongly influence the perception of brightness, in addition to light quality and distribution.

III. Procedures:

- 1) Truman State will consult DarkSky International's "Model Lighting Ordinance", and guiding documents, in particular ANSI/IES RP-43-22, published by the Illuminating Engineering Society (IES) before installation of new lighting and retrofitting of existing lighting.
- 2) Truman State will work towards removing, redirecting, or retrofitting currently used light fixtures on campus that do not satisfy the guidelines listed in Section II (General Guidelines for campus lighting) of this document.
- 3) Truman State will seek to establish outdoor lighting practices that are consistent with those of "Lighting Zone 2" (See Appendix A). LZ2 includes schools, churches, neighborhood recreational facilities with modest nighttime uses and lighting requirements. Unless can be justified for a specific and special application, it is recommended that all luminaires have a BUG rating commensurate with LZ2 (or better). For LZ2 this implies:
 - a) Not more than 630 lumens/space for parking lot spaces,
 - b) A limit of 2.5 lumens per square foot for hardscapes such as paths, roads, and sidewalks
 - c) A backlight rating of B0 within 0.5 mounting height to property line, and a backlight rating of B4 for fixtures greater than 2 mounting heights from property line,
 - d) An uplight rating of U2, which implies than less than 50 lumens of light is emitted in the uplight high (UH) and uplight low (UL) zones and,
 - e) A maximum allowed glare rating of G2.

See “Model Lighting Ordinance” for details.

- 4) Lighting solutions will strive to meet the following design standards (given in terms of horizontal illuminance), based on location of lighting application listed below.
 - a) **Design Standards for Pedestrian Areas** - all campus paths, and the perimeter of courtyards and campus greens such as the Quad, the area around the water fountain etc.
 - i) Average light levels shall be 1.0 foot-candle;
 - ii) Uniformity of not more than 4:1;
 - iii) No area less than 0.25 foot-candle;
 - b) **Design Standards for Campus Streets:**
 - i) Average light levels shall be 2.0 foot-candles;
 - ii) Uniformity of not more than 5:1;
 - iii) No area less than 0.40 foot-candle.
 - c) **Design Standards for Campus Parking Lots:**
 - i) Average light levels shall be 1.0 foot-candle;
 - ii) Uniformity of not more than 3:1;
 - iii) No area less than 0.30 foot-candle.
 - d) **Building Façade Lighting, Building Mounted Fixtures:**
 - i) Building façade lighting shall be shielded to the greatest extent possible.
 - ii) Building mounted fixtures shall be fully shielded when the fixture output is greater than 1000 lumens
- 5) No single lamp should exceed 1000 lumens unless housed in a “full cutoff” fixture (i.e. it is fully shielded, see Appendix B) so that all light is directed downward with no lateral glare. Full cutoff fixtures are recommended for all outdoor lighting.
- 6) All outdoor lights should have a coordinated color temperature of less than 3000K. Allowed lighting must not emit more than 25% of its total spectral power at wavelengths < 550 nanometers with a scotopic/photopic [S/P] ratio < 1.22.
- 7) In campus areas that experience very little nighttime usage, illumination should be triggered by motion detectors or manual on/off switches wherever feasible. This could be done on an experimental basis before widespread application.
- 8) Sport stadium lighting (tennis courts, Stokes stadium) should follow the guidelines outlined in DarkSky International’s “Outdoor Sports Lighting guidelines” document¹ (<https://darksky.org/what-we-do/darksky-approved/outdoor-sports-lighting/guidelines/>).

¹ <https://darksky.org/app/uploads/2023/08/Outdoor-Sports-Lighting-Guidelines-v1.3-08-28-2023.pdf>

- a) All stadium lights will have either automatic or manual controls that enforce a shut-off at an appropriately established curfew time, but not later than 2300 hours, local time (see “Exemptions” below).
 - b) Athletic playing field lighting shall be shielded to prevent uplight and direct view of the lamps to the greatest extent possible.
- 9) **Prohibited Lighting:** The following are prohibited:
- a) Uplighting to illuminate buildings and other structures such as water fountains, or vegetation, except as allowed by other provisions in this document.
 - b) Flashing, blinking, intermittent or other lights that move or give the impression of movement..
 - c) Floodlights or spotlights affixed to buildings for the purpose of lighting parking lots or sales display lot areas.
 - d) Searchlights, laser source lights or any similar high intensity light.
- 10) **Exemptions:** The following shall be exempt from the requirements of this chapter:
- a) Special occasion lighting (such as for religious festivals, celebrations, weddings, sporting events etc.) as long as it does not create a hazard or nuisance to surrounding activities, businesses or residences.
 - b) Traffic control signals and devices.
 - c) Temporary emergency lighting in use by law enforcement or government agencies, or at their direction.
 - d) The lighting of federal or state flags; provided, that the light is a narrow beam aimed and shielded to illuminate only the flag. Flag lighting should use appropriate illumination levels to light the flag, while at the same time fulfilling the purposes of this chapter.
 - e) Low voltage LED lights and solar lights used to illuminate pathways, provided the lights are installed no more than eighteen inches (18") above the adjacent ground level and have caps that direct the light downward.
 - f) The Light Management Plan Committee may approve lighting that does not conform to these standards if need is established. An applicant requesting such lighting is required to provide proof of requirements and/or findings of competent research demonstrating the need for the requested lighting. The LMP committee may attach other conditions to the approval of such lighting that will make the lighting comply with the spirit of this document.

IV. Recommendations

- 1) **After-dark lighting walks:** We recommend that after-dark, walk-throughs of existing lighting fixtures be conducted, once during the spring and once during the fall semester to determine compliance with Procedures of this Outdoor Lighting Policy². A summary of recommendations for actions to be taken, if any, should be submitted to the President’s

² Dr. Gokhale is willing to facilitate and conduct such walks

Sustainability Action Committee and to the VP Administration and Finance at Truman State. The walk-through will be scheduled by the Chief of Police, who should invite, at a minimum, a representative from each of the following: Physical Plant, President's Sustainability Action Committee, University Police, Dark Sky Truman, ECO, and a member of Student Government.

- 2) **Prioritized Plan for Outdoor Lighting Walkways**³: The creation of a prioritized plan for outdoor lighting walkways will help achieve the general lighting goals described above by helping to provide a sense of a safe night environment on campus while conserving energy to the greatest degree possible and preserving the landscaped, park-like character of campus. The premise behind this network of walkways is that it is of primary importance to encourage people to use well-traveled paths as supported by the Department of Public Safety. Lighting these walkways identifies them and encourages pedestrians to use them. In general a walkway, plus about 20 feet on either side, should be adequately lit as appropriate. The network of walkways includes corresponding main entrances and parking areas.

Identifying these outdoor lighting walkways does not preclude the possible need to light other areas of campus; rather, it helps determine where to focus lighting efforts as resources become available. It should be noted that many of the outdoor lighting walkways are already adequately lit.

To be designated as outdoor lighting walkways, the routes will:

- a) Follow all general lighting guidelines (see above).
- b) Link major building entrances to each other and to primary auto/bike parking areas and transit stops (pay particular attention to buildings that have high levels of nighttime use).
- c) Add to a sense of a safe night environment.
- d) Encourage the use of well-traveled areas.
- e) Correspond with ADA access routes.
- f) Preserve the landscaped, park-like character of campus.
- g) Protect significant landscape features.
- h) Conserve energy to the greatest degree possible.
- i) Correspond with call box locations.
- j) Correspond with designated bike paths.

The prioritized plan for outdoor lighting walkways is represented on the attached map below (Map 1).

³ https://cpfm.uoregon.edu/sites/default/files/lightingplan_update03_2012_0.pdf

Appendix A: Lighting Zone Definitions (From Model Lighting Ordinance)

The Lighting Zone shall determine the limitations for lighting as specified in this ordinance. The Lighting Zones shall be as follows:

LZ0: No ambient lighting

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

LZ1: Low ambient lighting

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

LZ2: Moderate ambient lighting

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

LZ3: Moderately high ambient lighting

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

LZ4: High ambient lighting

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

Appendix B: Glossary

- 1) **Backlight:** For an exterior luminaire, lumens 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 front light.
- 2) **BUG rating:** A luminaire classification system that classifies backlight (B), uplight (U) and glare (G).
- 3) **Footcandle:** The 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.
- 4) **Forward Light:** For an exterior luminaire, lumens emitted in the quarter sphere below horizontal and in the direction of the intended orientation of the luminaire
- 5) **Full-cutoff luminaire:** A luminaire constructed and installed in such a manner that all light emitted by the luminaire, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the luminaire, is projected below the horizontal plane through the luminaire's lowest light-emitting part.
- 6) **Fully Shielded:** Attribute of a luminaire from which no light is emitted at or above a horizontal plane drawn through the lowest light-emitting portion of the luminaire.
- 7) **Glare:** Lighting entering the eye directly from luminaires or indirectly from reflective surfaces that causes visual discomfort or reduced visibility.
- 8) **Hardscape:** Permanent hardscape improvements to the site including parking lots, drives, entrances, curbs, ramps, stairs, steps, medians, walkways and non-vegetated landscaping that is 10 feet or less in width. Materials may include concrete, asphalt, stone, gravel, etc.
- 9) **Hardscape Area:** The area measured in square feet of all hardscape. It is used to calculate the Total Site Lumen Limit in both the Prescriptive Method and Performance Methods. Refer to Hardscape definition.
- 10) **Hardscape Perimeter:** The perimeter measured in linear feet is used to calculate the Total Site Lumen Limit in the Performance Method. Refer to Hardscape definition.
- 11) **Horizontal Footcandles:** The amount of light being received on a horizontal surface such as a roadway or parking lot pavement.
- 12) **Illuminance:** Quantity of incident light, measured in footcandles

- 13) **Landscape Lighting:** Lighting of trees, shrubs, or other plant material as well as ponds and other landscape features.
- 14) **Light Trespass:** Light that falls beyond the property (or intended area) it is intended to illuminate.
- 15) **Lumen:** The 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).
- 16) **Luminaire:** The complete lighting unit (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.
- 17) **Lux:** The 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.
- 18) **Partially Shielded Luminaire:** A luminaire with opaque top and translucent or perforated sides, designed to emit most light downward.
- 19) **Shielded Directional Luminaire:** A luminaire that includes an adjustable mounting device allowing aiming in any direction and contains a shield, louver, or baffle to reduce direct view of the lamp.
- 20) **Shielding:** The application of opaque material to a luminaire to block the direct view of the light source (lamp or bulb). This may be accomplished by such devices as shields, barn doors, baffles, louvers, skirts or visors.
- 21) **Sky Glow:** The brightening of the nighttime sky that results from scattering and reflection of artificial light by moisture and dust particles in the atmosphere. Skyglow is caused by light directed or reflected upwards or sideways and reduces one's ability to view the night sky.
- 22) **Unshielded Luminaire:** A luminaire capable of emitting light in any direction including downwards.
- 23) **Uplight:** For an exterior luminaire, flux radiated in the hemisphere at or above the horizontal plane.
- 24) **Vertical Footcandles:** The amount of light being received on a vertical surface such as a billboard or building facade.
- 25) **Vertical Illuminance:** Illuminance measured or calculated in a plane perpendicular to the site boundary or property line.

Appendix C: Examples of Acceptable and Unacceptable Lighting Fixtures⁴



⁴ <https://www.darkskyconsulting.com/uploads/1/3/8/5/138535194/crelin-diagram.pdf>