APPENDIX F

GUIDELINES FOR GOOD EXTERIOR LIGHTING PLANS

Prepared by: The Dark Sky Society ( ) 2009

These guidelines have been developed in consultation with lighting professionals (with experience in developing good lighting plans) to aid communities wishing to control light pollution and preserve the night sky.

Outdoor lighting should be carefully designed with regard to placement, intensity, timing, duration, and color. Good lighting will:

- **Promote Safety**
  "More light" is not necessarily" better". If not designed and installed correctly, unsafe glare can result, reducing the effect of lighting which can contribute to accidents and hinder visibility. Lighting that is too bright interferes with the eye's ability to adapt to darker areas.

- **Save Money**
  Adhering to professionally recommended light levels provides adequate illumination. Shielded fixtures with efficient light bulbs are more cost-effective because they use less energy by directing the light toward the ground. See this website for cost comparisons:

- **Conserve Natural Resources**
  Inappropriate or excessive lighting wastes our limited natural resources and pollutes the air and water by unnecessarily burning our limited supply of fossil fuels.

- **Be Better Neighbors**
  Excessive or misdirected lighting can intrude on the privacy of others when light or glare trespasses over property lines.

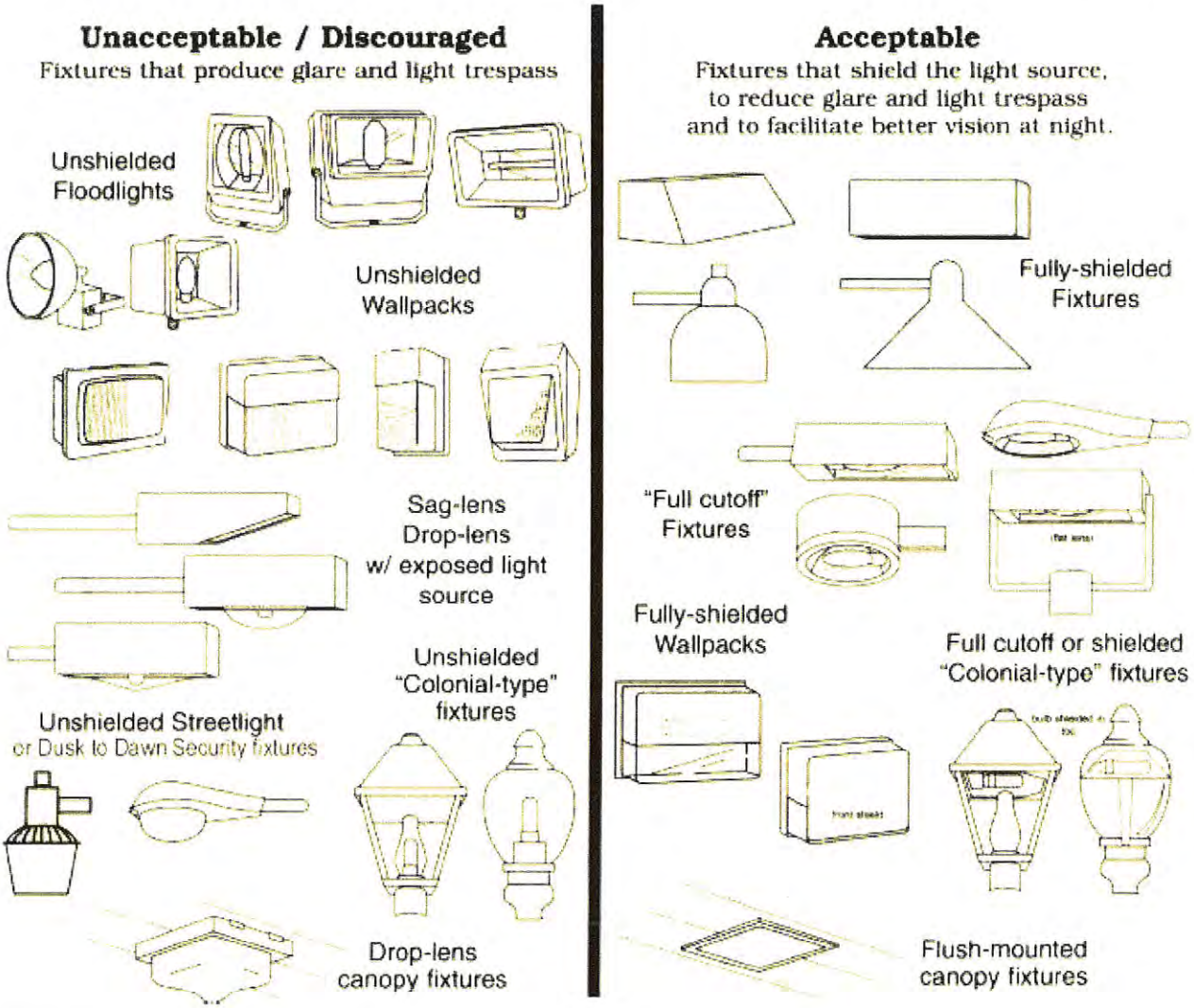
- **Retain Community's Character and Reduce Skyglow**
  Our clear view of the dark starry night sky is a resource to be preserved and protected. Stray and excessive lighting contributes to "light pollution", clutter, and unnatural "sky glow".

- **Protect Ecology of Flora and Fauna**
  Research studies indicate that artificial night lighting disrupts the migrating, feeding, and breeding habits of many wildlife species, as well as growth patterns of trees. See references in The Ecological Consequences of Artificial Night Lighting.

- **Reduce Health Risks**
  Light at night not only disrupts your sleep but also interferes with your circadian rhythms. Recent research indicates that intrusive lighting may reduce the production of melatonin, a beneficial hormone, and a resulting raise in the rates of breast and other cancers.

Included:
1. **Diagrams of Acceptable/Unacceptable Lighting Fixtures**
2. **How to Develop an Acceptable Lighting Plan**
3. **Definitions of Full Cut Off, Shielded, and RLM sign lighting Fixtures**
4. **Lighting Plan Submissions**
5. **Recommended Illumination Levels for various tasks**

UNSHIELDED FIXTURES **Full Cutoff and Fully Shielded Fixtures**



Diagrams courtesy of Bob Crelin

*****Ask your local electrical suppliers for "full-cut off" or "fully shielded" light fixtures. Once you have selected fixtures which are compatible with your architecture and community, contact the manufacturer's representative to see a sample of the fixture(s) and to ask for a free lighting plan. If you have a CAD file, the plan can be easily provided in a short period of time. *****

Most lighting manufacturers have Application Departments which will execute free lighting plans to meet local lighting codes.

<u>See this website for links to manufacturers:</u>

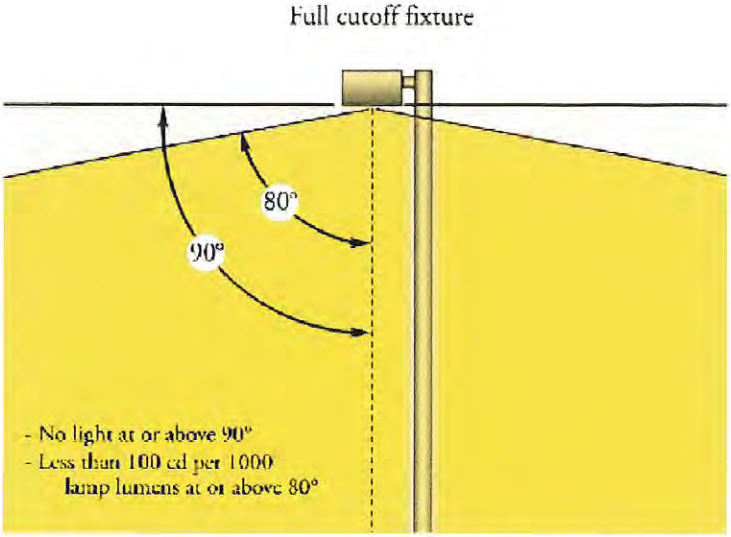
Sample of Web retailers:

and

How to Develop an Acceptable Lighting Plan

1. **Identify where as well as when lighting is needed. Confine and minimize lighting to the extent necessary to meet safety purposes.** Plans should define the areas for which illumination is planned. Itemizing each area (e.g. parking lot, doorways, walkways, signage, foliage) with the anticipated hours of use. Commercial outdoor lighting should be used for safe pedestrian passage and property identification, and lit during active business hours and shut off afterward.
2. **Direct light downward by choosing the correct type of light fixtures.** (See Appendix 3). Specify IES (Illuminating Engineering Society) "Full Cut Off" designated or "fully shielded" fixtures, so that no light is emitted above the lowest light emitting part of the fixture. Top mounted sign lighting is recommended with "RLM" (dish) type shields, and aimed so that the light falls entirely on the sign and is positioned so that the light source (bulb) is not visible from any point off the property or into the roadway to reduce glare. For each one square foot of sign, usually no more than 200 lumens is necessary for good visibility.
3. **Select the correct light source (bulb type).** Compact fluorescent (2300K) or High Pressure Sodium is recommended unless the light is motion sensor activated, in which case incandescent or the instant start compact fluorescent bulbs can be used. Metal Halide (due to its higher costs, energy use, impact on the environment, and greater contribution to "sky glow") is discouraged, as well as light sources rated over 3000 Kelvin; and outdated Mercury Vapor bulbs are prohibited.
4. **Utilize "shut off" controls such as sensors, timers, motion detectors, etc.** Automatic controls turn off lights when not needed. All lights should be extinguished no later than one half hour after the close of business. Additional motion sensor activated lighting can be used for emergency access. Avoid "dusk-to-dawn" sensors without a middle of the night shut off control. Lights alone will not serve to "protect" property and are a poor "security" device. Examine other means of protecting property and to discourage criminal activity. Let your local police know that you have a "lights out" policy so that they can investigate if they see lights or activity after hours.
5. **Limit the height of fixtures.** Locate fixtures no closer to the property line than four times the mounting height of the fixture, and not to exceed the height of adjacent structures. (Exceptions may be made for larger parking areas, commercial zones adjacent to highways, or for fixtures with greater cut off shielding behind the pole mount in commercial zones.)
6. **Limit light crossing property lines, i.e. "light trespass".** Limit light to spill across the property lines. Light levels at the property line should not exceed 0.1 footcandles (fc) adjacent to business properties, and 0.05 fc at residential property boundaries. Utility leased floodlight fixtures mounted on public utility poles in the public right-of-way should not be used.
7. **Use the correct amount of light**. Light levels and uniformity ratios should not exceed recommended values, per IESNA RP-33 or 20. (See Appendix 5, Recommended Illumination Levels for various tasks.) "Lumen cap" recommendations for areas to be illuminated are as follows: commercial properties in non-urban commercial zones = 25,000 lumens per acre; for projects in residential and LBO zones = 10,000 lumens per acre. For residential properties: for suburban: 50,000 lumens per acre cap, and in urban areas: 100,000.
8. **Ask for Assistance** Your Planning Department and local lighting sales representatives can assist you in obtaining the necessary information for good lighting. For large projects over 15,000 lumens: greater energy conservation and control of light pollution, light trespass and glare, may be achieved with the help of a professional lighting designer with "dark sky" lighting plan experience.
9. **A post installation inspection should be conducted to check for compliance.** Substitutions by electricians and contractors are common and should not be accepted. Final Approved Site Plans will not allow additional exterior fixtures or substitutes without reviews.
10. **Design interior lighting so that it does not illuminate the outdoors.** Provide interior lighting photometrics for the building's perimeter areas, demonstrating that the interior lighting falls substantially within the building and not through the windows. After closing, interior lighting that extends outdoors needs to be extinguished by the use of shut off timers.

Definition of Acceptable Fixtures:
"Full Cut Off", "Fully Shielded", and RLM shield.



- **"Full Cut Off" fixtures are independently certified by the manufacturers, and do not allow light to be emitted above the fixture and the fixture reduces glare by limiting the light output to less than 10% at and below 10 degrees below the horizontal.**
- **If the manufacturer is unable to provide the "cut off" characteristics for a fixture (also called a "luminaire"), the following definition needs to be met, which can usually be determined by a visual inspection:**

"Fully Shielded": a fixture constructed and installed in such a manner that all light emitted by it, either directly from the lamp (bulb) or a diffusing element, or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal. This can be determined by a "field test" or a visual assessment of an operating sample.

- **Manufacturers and their representatives can provide photographs of light fixtures as "cut sheets" as well as literature confirming the independently tested "cut off" characteristics of their products. These IES files may be assessed for compliance in a computer program: http://www.3dop.com/index1.html**
- **Photometric layouts for different heights, light sources, and wattages, are also available as "IES" files, upon request or through manufacturers' websites.**
- **Fixtures must be installed properly, so that the bottom of the fixture is level with the ground. Exceptions are often given for sign lighting which requires vertical lighting:**

"RLM" sign lighting shield:

Lighting Plan Submissions

The following information needs to be provided to your municipality's review board which will enable them to evaluate the Site Plan for proper exterior lighting:

The Lighting Plan should be depicted on a site plan, indicating the location of each current and proposed outdoor lighting fixture with projected hours of use. This plan will need to be stamped and certified by a licensed professional, such as an architect or engineer. Many lighting manufacturers can provide free photometric layouts on prepared site plans, to conform to your local requirements.

(1) The lighting plan should include a KEY to the proposed lighting that provides the following information:

- Type and number of luminaire equipment (fixtures), including the "cut off characteristics", indicating manufacturer and model number(s).
- Lamp source type (bulb type, i.e. high pressure sodium), lumen output, and wattage.
- Mounting height with distance noted to the nearest property line for each luminaire.
- Types of timing devices used to control the hours set for illumination, as well as the proposed hours when each fixture will be operated.
- Total Lumens for each fixture, and total square footage of areas to be illuminated. For projects that are in commercial zones, the lumens per net acre to be lit, need not exceed 25,000 lumens. For projects in residential or LBO zones: 10,000 lumens.
- For all plans of more than three fixtures: A Calculation Summary indicating footcandle levels on the lighting plan, noting the maximum, average and minimum, as well as the uniformity ratio of maximum to minimum, and average to minimum levels*.

(2) Lighting manufacturer-supplied specifications ("cut sheets") that include photographs of the fixtures, indicating the certified "cut off characteristics" of the fixture.

(3) Footcandle Distribution, plotting the light levels in footcandles on the ground, at the designated mounting heights for the proposed fixtures. Maximum illuminance levels should be expressed in footcandle measurements on a grid of the site showing footcandle readings in every five or ten-foot square. The grid shall include light contributions from all sources (i.e. pole mounted, wall mounted, sign, and street lights.) Show footcandle renderings five feet beyond the property lines.*

(4) If requested by the reviewing agency, a statement from a lighting professional that a plan, other than that set forth, is needed to meet the intent of these standards.

(5) An environmental impact statement may be required as to the impact of the exterior lighting proposed on flora, fauna, and the night sky. Location of species sensitive to light at night or the proximity to nature preserves or astronomical observatories or "Dark Sky Parks", needs to be indicated.

(6) On the Approved Plan it should be noted that no substitutions, additions, or changes may be made without prior approval by the governing authority.

* This information can be obtained from the manufacturer, your lighting supplier, or the manufacturer's representative.

Recommended Illumination Levels for various tasks*

I. Table of Limits of Illumination, measured in footcandles (fc) at ground level unless noted:

Task Area	Avg.	Not to exceed:
1. Active Building Entrance	2.0 fc	5 fc
Approach	0.2 fc	
2. Gas Station Approach		2 fc
3. Gas Station Pump Area		avg: 5 fc
4. Gas Station Service Area		avg. 3 fc
5. Sidewalks	0.2 fc	5 fc
6. Surface of signs		2 fc

II. Average/Minimum/Uniformity Ratio Limits for Parking Lots:

I. Public Parking Lots -- not to exceed:

Average	Minimum	Uniformity Ratio (Max to Min/Avg to Min)
0.8	0.2	20:1 / 4:1

II. Private Parking Lots -- not to exceed:

Average	Minimum	Uniformity Ratio (Max to Min / Avg to Min)
0.5	0.13	20:1 / 4:1

OR:

III. If illuminance grid lighting plans cannot be reviewed or if fixtures do not provide photometrics and bulbs are under 2000 lumens, use these guidelines:

1. **Pole shall be no greater in height than four times the distance to the property line.**
2. **Maximum Lumen Levels for different fixture heights:**

Mounting Height (Feet)	Recommended Lumen Maximums
6	500 - 1000 lumens
8	600 - 1,600 lumens
10	1,000 - 2,000 lumens
12	1,600 - 2,400 lumens

FOOTCANDLE: ("FC") – Is the basic unit of illuminance (the amount of light falling on a surface). Footcandle measurement is taken with a hand held light meter. One footcandle is equivalent to the illuminance produced on one square foot of surface area by a source of one candle at a distance of one foot. Horizontal footcandles measure the illumination striking a horizontal plane. Footcandle values can be measured directly with certain handheld incident light meters.

LUMEN – A unit used to measure the actual amount of light that is produced by a bulb. The lumen quantifies the amount of light energy produced by a lamp at the lamp, not by the energy input, which is indicated by the "wattage". For example, a 75-watt incandescent lamp can produce 1000 lumens while a 70-watt high-pressure sodium lamp produces 6000 lumens. Lumen output is listed by the manufacturer on the packaging.

*** IES, Recommended Practices, (RP-33-99): Lighting for Exterior Environments; and (RP-20): Parking Lots.** The Illuminating Engineering Society of North America (IES or IESNA), is an organization that establishes updated standards and illumination guidelines for the lighting industry.

8. EXTERIOR SITE LIGHTING

Goal:

Exterior lighting should be used to provide illumination for the security and safety of entry drives, parking, service and loading areas, pathways, courtyards and plazas, without intruding on adjacent properties. Site lighting shall be architecturally compatible and consistent in design between sites.

8.1 LIGHT FIXTURES SHOULD BE COMPATIBLE AND RELATE TO THE ARCHITECTURAL CHARACTER OF THE BUILDINGS.

8.1 Fixture Design and Illumination Level

Policy:

Exterior light fixtures should be compatible and relate to the architectural character of the buildings on a site. Site lighting should be provided at the minimum level to accommodate safe pedestrian and vehicle movements, without causing any off-site glare.

Standards and Guidelines:

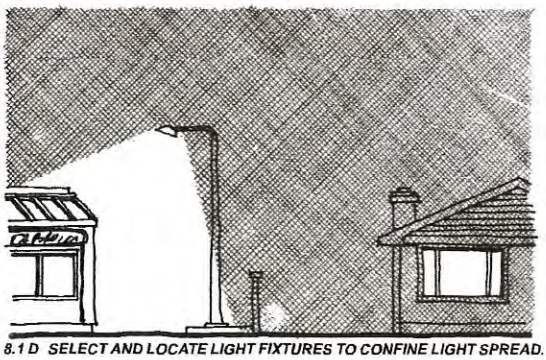
A. Poles and fixtures should be designed to be architecturally compatible with structures and lighting on adjacent properties. (G)
B. Poles and fixtures shall be compatible with all other fixtures on site. (S)
C. Illuminate all intersections with perimeter public roads with similar poles and fixtures used internal to the development. (G)
D. Select and locate all lighting fixtures to shield or confine light spread within a site's boundaries. (S)
E. To facilitate security, specify lighting levels that are adequate for visibility, but not overly bright. All building entrances should be well-lighted. (G)
F. Use metal halide or other white light fixtures. High pressure sodium is not allowed in any application. (S)
G. Maximum height of all poles within landscaped and plaza areas is 20 feet, measured from grade. Poles within these areas may be set on pedestals no more than 8 inches in height. (S)

8.1 A POLES AND FIXTURES SHOULD BE COMPATIBLE WITH ADJACENT STRUCTURES AND LIGHTING.

8.2 Decorative Architectural Lighting

Policy:

Special lighting that accents building features and creates visual interest is permitted in commercial developments, provided that design continuity is maintained among buildings.



8.1 D SELECT AND LOCATE LIGHT FIXTURES TO CONFINE LIGHT SPREAD.

Standards and Guidelines:

A. Lighting fixtures mounted directly on structures may be allowed when utilized to enhance specific architectural elements or to help establish scale or provide visual interest. (G)
B. "Wall paks" are permitted only in loading and service areas, and should be down-lit and shielded from view. (S)
C. Neon tubing is not acceptable as a building accent or to accentuate the building's form. (S)
D. Integrate illuminators or fixtures used to light building mounted signage, building facades, or pedestrian arcades into a building's architectural design. (G)
E. Consider highlighting entrances, art, terraces, and special landscape features. (G)

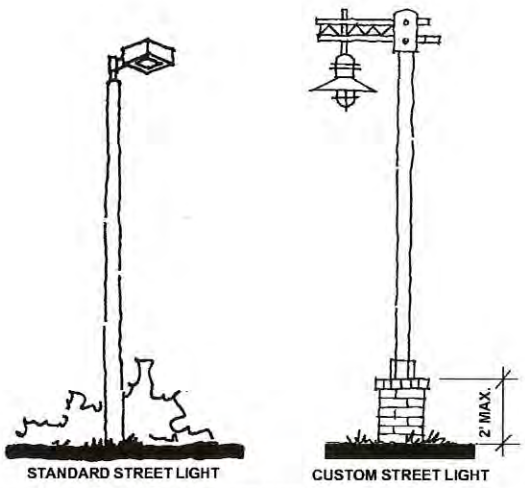
8.3 Parking Lot Lighting

Policy:

Parking lot lighting should be unobtrusive and provide safe light for orderly functions.

Standards and Guidelines:

A. Make all parking lot light fixtures similar in design for all surface parking areas. (S)
B. Select metal halide lighting with a concealed light source of the "cut-off" variety to prevent glare and "light trespass" onto adjacent buildings and sites. (S)
C. Provide separate, pedestrian scale lighting for all pedestrian ways through parking lots. (G)
D. Maximum height of parking lot poles is 24 feet measured from finished grade. (S)
E. Locate poles in medians wherever possible with a maximum base height of two (2) feet. (G)



8.3 PARKING LOT LIGHT FIXTURES (SEE TEXT).

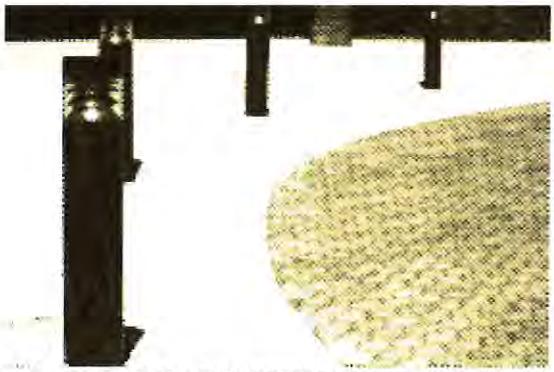
8.4 Pedestrian Area Lighting

Policy:

Walkway lighting should be scaled to the pedestrian and should provide for safe use of pathways and pedestrian areas. Walks should be lighted for the safe passage of pedestrians as should areas which are dangerous if unlit, such as stairs, ramps, intersections, and underpasses.

Standards and Guidelines:

A. Use of lighted bollards or other low level fixtures is encouraged to identify pedestrian walkways and drop-off areas at entrances to buildings. (G)
B. Emphasize pedestrian-to-vehicle intersections with low level decorative street lights. (G)
C. Illuminate all primary walkways, steps or ramps along pedestrian routes. (G)


8.4 A USE LIGHTED BOLLARDS TO IDENTIFY PEDESTRIAN AREAS.

D. Incandescent or metal halide lamps are strongly encouraged. (G)
E. Use building mounted fixtures for walkways or plazas near buildings. (G)

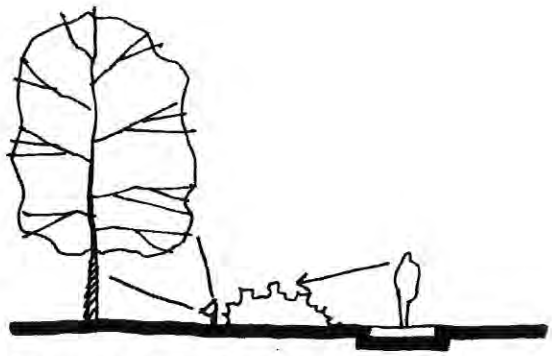
8.5 Landscape Lighting

Policy:

Landscape lighting should enhance and complement, not overpower, the landscape materials.

Standards and Guidelines:

A. Design the landscape lighting to work for all seasons of the year and through the life of the landscape. (G)
B. Conceal fixtures where possible (ie. in trees, by landscape, behind rocks), control glare , and avoid extreme bright spots on the surrounding landscape. (G)



8.5 B CONCEAL LIGHT FIXTURES WHERE POSSIBLE.

8.6 Site Security Lighting

Policy:

Security lighting is anticipated in some sites, but it should not negatively impact the site and building architecture as well as adjacent parcels.

Standards and Guidelines:

A. No light source (bulb) shall be directly visible from adjacent parcels. (S)
B. Provide only as much light/illumination as necessary to provide safety and security of the area. (G)

8.7 Light Intensity

Policy:

The light intensity levels within all areas should correspond to use and potential hazards.

Standards and Guidelines:

A. A photometric lighting plan is required for all proposed commercial developments to ensure adequate and appropriate light levels are provided for each site condition. (S)

B. The following levels of illumination should be maintained for each of the specific locations*: (G)

1)	Building Entrances	5.0 footcandles
2)	Sidewalks	2.0 footcandles
3)	Bikeways	1.0 footcandles
4)	Courts/Plazas/Terraces	1.5 footcandles
5)	Ramps	5.0 footcandles
6)	Stairways	5.0 footcandles
7)	Underpasses	5.0 footcandles
8)	Waiting Areas	1.0 footcandles
9)	Parking Lots	1.0 footcandles
10)	Roadways	1.5 footcandles

* Values given area in minimum average maintained horizontal, footcandles which are measured at the average point of illumination between brightest and darkest areas, 4'-5' above the ground surface. (Source: IES Lighting Handbook - 4th Edition).

C. Site lighting should provide consistent levels of illumination, avoiding pockets of very high or low levels of illumination. (G)

8. Exterior Site Lighting

Goal:
Exterior lighting should be used to provide illumination for the security and safety of entry drives, parking, service and loading areas, pathways, courtyards and plazas, without intruding on adjacent properties. Site lighting shall be architecturally compatible and consistent in design between sites.

8.1 Fixture Design

Policy:
Exterior light fixtures should be compatible and relate to the architectural character of the buildings on a site. Site lighting should be provided at the minimum level to accommodate safe pedestrian and vehicle movements, without causing any off-site glare.

Standards and Guidelines:

A. Poles and fixtures should be designed to be architecturally compatible with structures and lighting on adjacent properties. (G)
B. Poles and fixtures shall be compatible with all other fixtures on site. (S)
C. Illuminate all intersections with perimeter public roads with similar poles and fixtures used internal to the development. (G)
D. Select and locate all lighting fixtures to shield or confine light spread within a site's boundaries. (S)
E. To facilitate security, specify lighting levels that are adequate for visibility, but not overly bright. All building entrances should be well-illuminated. (G)
F. Use metal halide or other white light fixtures. High-pressure sodium is not allowed in any application. (S)
G. Maximum height of all poles within landscaped and plaza areas is 20-feet, measured from grade. Pole pedestals (bases) are limited to a minimum of eight-inches in height. (S)
H. Decorative light fixtures, which are appropriately shielded, and provide visual interest, are allowed. (G)

8.2 Parking Lot Lighting

Policy:
Parking lot lighting should be unobtrusive and provide safe light for orderly functions.

Standards and Guidelines:

A. Make all parking lot light fixtures similar in design for all surface parking areas. (S)
B. Select lighting with a concealed light source of the 'cut-off' variety to prevent glare and 'light trespass' onto adjacent buildings and sites. (S)
C. Provide separate, pedestrian scale lighting for all pedestrian ways through parking lots. (G)

D. Maximum height of parking lot poles is 24-feet measured from finish grade. (S)
E. Locate poles in medians wherever possible with a maximum base height of 2-feet. (G)
F. 'Wall packs' are permitted only in loading and service areas, and shall be down-lit and fully shielded from view. (S)

8.3 Pedestrian Area Lighting

Policy:
Walkway lighting should be scaled to the pedestrian and should provide for safe use of pathways and pedestrian areas. Walks should be lighted for the safe passage of pedestrians, as should areas that are dangerous if unlit, such as stairs, ramps, intersections, and underpasses.

Standards and Guidelines:

A. Bollard light fixtures or other low-level fixtures are encouraged to identify pedestrian walkways and drop-off areas at entrances to buildings. (G)
B. Emphasize pedestrian-to-vehicle intersections with low-level decorative streetlights. (G)
C. Illuminate all primary walkways, steps or ramps along pedestrian routes. (G)
D. Incandescent or metal halide lamps are strongly encouraged. (G)
E. Use building mounted fixtures for walkways and plazas near buildings. (G)

8.4 Site Security Lighting

Policy:
Security lighting may be necessary on some sites, but it should not negatively impact the site and building architecture or adjacent parcels.

Standards and Guidelines:

A. No light source (bulb) shall be directly visible from adjacent parcels. (S)
B. Provide only as much light/illumination as necessary to provide safety and security of the area. (G)

8.5 Light Intensity

Policy:
The light intensity levels within all areas should correspond to use and potential hazards.

Standards and Guidelines:

A. A photometric lighting plan is required for all proposed industrial developments to ensure adequate and appropriate light levels are provided for each site condition. (S)
B. The following levels of illumination should be maintained for each of the specific locations[1]: (G)

Building Entrances	5.0 footcandles	54 lumens/square meter
Sidewalks	2.0 footcandles	22 lumens/square meter
Bikeways	1.0 footcandles	11 lumens/square meter
Courts/Plazas/Terraces	1.5 footcandles	16 lumens/square meter
Ramps	5.0 footcandles	54 lumens/square meter

Stairways	5.0 footcandles	54 lumens/square meter
Underpasses	5.0 footcandles	54 lumens/square meter
Waiting Areas	1.0 footcandles	11 lumens/square meter
Parking Lots	1.0 footcandles	11 lumens/square meter
Roadways	1.5 footcandles	16 lumens/square meter

[1] Values given area in minimum average maintained horizontal, footcandles (lumens/square meter) which are measured at the average point of illumination between brightest and darkest areas, 4'-5' above the ground surface. (Source: IES Lighting Handbook - 4th Edition).
[2] Metric conversion is provided for convenience only. Photometric plans must be submitted using imperial measurement values.

C. Site lighting should provide consistent levels of illumination, avoiding pockets of very high or low levels of illumination. (G)
D. Maximum 400-watt fixtures are permitted for parking lot pole lighting. (S)
E. Wall packs of a full cut-off and fully shielded design shall not exceed a maximum of 70-watts for man doors and 175-watts in loading areas. (S)

(END)

Policy: Site Furniture
Site furnishings, including bicycle racks, waste receptacles and light standards, are features of contemporary life in Louisville. The City has undertaken a downtown streetscape improvement project in which several of these features are included. In order to maintain the visual continuity within downtown, the same style of furnishings used for public improvements should be used in private endeavors as well.

G5. Site furniture should be simple in character.

1) Avoid any highly ornate design that would misrepresent the history of the area.
2) Benches, bike racks (which are strongly encouraged) and trash receptacles are examples of site furnishings that may be considered.
3) A bike rack may be located along a street front where space is available and a minimum clear walkway can be maintained.
4) Design of private furnishings should be consistent with public site furniture.

G6. Street lights within a project should be compatible with the City's streetscape design.

1) Designs which reflect the simple standards the City has used in its public streetscape improvements are encouraged.
2) Historic styles that are out of character with the history of Louisville are inappropriate because they could misrepresent the heritage of the community.

Policy: Public Art
While public art is a new feature to occur in the community, it enhances the quality of life and can contribute to one's appreciation of the natural and historic features of the area. The use of public art is therefore encouraged, particularly in larger private projects and in public places.

G7. The use of public art is encouraged.

1) Consider locating public art in a courtyard or at a building entrance where it may be viewed from the street.
2) Also consider installing public art along alley facades or in the sidewalk itself.
3) Art that is developed as an integral part of the architecture is also encouraged.

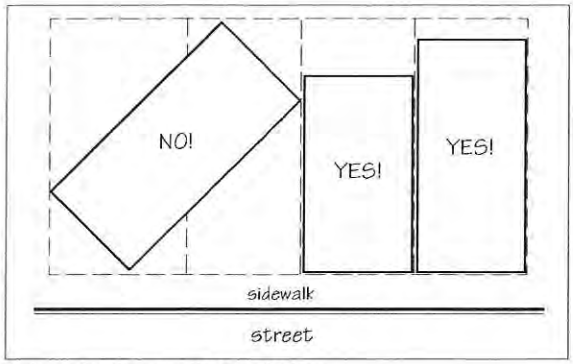
The use of public art is encouraged. Consider using public art in the sidewalk itself.

SITE DESIGN

Policy: Building Orientation
Traditionally, a building was oriented with its primary wall planes in line with the parcel's property lines. Since most buildings were rectangular in form, this siting pattern helped reinforce the image of the town grid. These traditional patterns of building orientation should be maintained.

G8. Orient a new building parallel to its lot lines, similar to that of traditional building orientations.

1) The front of a primary structure shall be oriented to the street.
2) Buildings should have a clearly defined primary entrance. For example, provide a recessed entry way on a commercial storefront, or provide a porch on a residential type structure, to define its entry.



Orient a building parallel to its lot lines.

Policy: Exterior Lighting
The character and level of lighting is a special concern. It should be a subordinate element. Traditionally, exterior lights were simple in character. Most used incandescent lamps, which cast a color similar to that of daylight. These were relatively low in intensity and were shielded with simple shade devices. This overall effect should be continued.

G9. Exterior lights should be simple in character and similar in color and intensity to that used traditionally.

1) The design of a fixture should be simple in form and detail. Designs similar in character to those used traditionally are encouraged.
2) Lights along alleys should be utilitarian in design.
3) All exterior light sources should have a low level of luminescence. Lamps with a maximum equivalent of a 40 watt incandescent bulb (490 lumens) are preferred for site lighting. Lower intensities should be used in architectural fixtures such as step lights.

G10. Minimize the visual impacts of site and architectural lighting.

1) Prevent glare onto adjacent properties by using shielded and focused light sources that direct light onto the ground.
2) Un-shielded, high intensity light sources and those which direct light upward will not be permitted.
3) Shield lighting associated with service areas, parking lots and parking structures.
4) Avoid placing lights in highly visible locations, such as on the upper walls of buildings.

AcuityBrands. Lighting

your GREEN SOURCE
FOR SUSTAINABLE LIGHTING DESIGN SOLUTIONS

Recommended Light Levels for Exterior Spaces

Select your exterior application or issue:

- Bikeways
- Car Dealerships
- Floodlighting Building & Monuments
- Intersections
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- Outdoor Merchandising
- Parking
- Pedestrian Ways
- Roadways
- Security Locations/Tasks
- Service Stations
- Small Target Visibility
- Walkways

Car Dealerships

See RP-33-99 for full details.

Area	Maximum Illuminance on Pavement - lux (fc)	Max-to-Min Ratio
Main Business Districts		
Adjacent to Roadway	100-200 (10-20)	5:1
Other Rows	50-100 (5-10)	10:1
Entrances	50-100 (5-10)	5:1
Driveways	20-30 (2-3)	10:1
Secondary Business Districts and Small Towns		
Adjacent to Roadway	50-100 (5-10)	5:1
Other Rows	25-50 (2.5-5)	10:1
Entrances	25-50 (2.5-5)	5:1
Driveways	10-20 (1-2)	10:1

Floodlighting Buildings and Monuments

See RP-33-99 for full details.

Description of Site		Average Vertical Illuminance - lux (fc)
Surface	Surroundings	
Light	Bright	50 (5)
Medium	Bright	70 (7)
Dark	Bright	100 (10)
Light	Dark	20 (2)
Medium-to-Light	Dark	30 (3)

Medium-to-Dark	Dark	40 (4)
Dark	Dark	50 (5)

Intersections

Recommended Average Maintained Illuminance at the pavement - lux (fc) (See RP-8-00 for details)

	Average Maintained Illuminance by Pedestrian Conflict Area - lux (fc)			Uniformity
Intersection Type	**High**	**Medium**	**Low**	E_{avg}/E_{min}
Major / Major	34.0 (3.4)	26.0 (2.6)	18.0 (1.8)	3.0
Major / Collector	29.0 (2.9)	22.0 (2.2)	15.0 (1.5)	3.0
Major / Local	26.0 (2.6)	20.0 (2.0)	13.0 (1.3)	3.0
Collector / Collector	24.0 (2.4)	18.0 (1.8)	12.0 (1.2)	4.0
Collector / Local	21.0 (2.1)	16.0 (1.6)	10.0 (1.0)	4.0
Local / Local	18.0 (1.8)	14.0 (1.4)	8.0 (0.8)	6.0

Light Trespass

The following recommended levels of illuminance are suggested from the report Light Trespass Research (*Light Trespass Research*, EPRI, Palo Alto, CA and Lighting Research Institute: 2000. TR-114914). The specific illuminance levels are measured at the observers eye in a plane perpendicular to the line of sight. See RP-33-99 for full details.

Zone	Zone Description	Pre-Curfew	Post-Curfew
E1	**Intrinsically Dark** - national parks, residential areas where inhabitants have expressed a strong desire that light trespass be strictly limited	1 lux (0.1 fc)	• 0 for systems not intended for public safety or security. • 1 lux (0.1 fc) otherwise
E2	**Low Ambient Brightness** - outer urban and rural residential areas	3 lux (0.3 fc)	1 lux (0.1 fc)
E3	**Medium Ambient Brightness** - urban residential areas	8 lux (0.8 fc)	2 lux (0.2 fc)
E4	**High Ambient Brightness** - urban areas with high levels of night time activity	15 lux (1.5 fc)	6 lux (0.6 fc)
	These recommended levels assume the affected luminaires are continuously on during the subject night time period.		

Outdoor Merchandising

Recommended Illuminances for Outdoor Merchandising: (See IESNA RP-2-01 for full details)

Application	Area	Maintained Illuminance - lux (fc) when Illuminance of Surrounding Area is:		
		HIGH	MEDIUM	LOW

Seasonal Outdoor Merchandise	Circulation	100 (10)	70 (7)	50 (5)
	Merchandise	300 (30)	200 (20)	100 (10)
	Feature Displays	600 (60)	400 (40)	200 (20)
Auto Dealerships	Circulation	100 (10)	70 (7)	50 (5)
	Merchandise	500 (50)	300 (30)	200 (20)
	Feature Displays	750 (75)	500 (50)	350 (35)
Service Stations	Approach	150 (15)	100 (10)	50 (5)
	Gas Islands	500 (50)	300 (30)	200 (2)

Parking Facilities

Parking Lots: (See RP-20-98 for details)

	Basic[1]		Enhanced Security[2]	
Minimum Maintained Horizontal Illuminance[3]	2 lux	0.2 fc	5 lux	0.5 fc
Maximum Maximum-to-Minimum Ratio	20:1		15:1	
Minimum Maintained Vertical Illuminance[5]	1 lux	0.1 fc	2.5 lux[4]	0.25 fc
1 = typical conditions				
2 = where personal security or vandalism is a likely or severe problem.				
3 = Measured on the parking surface without any shadowing effect at the points of measurement.				
4 = Facial recognition can be made at 2.5 lux. 5.0 lux is recommended for facial identification.				
5 = Measured 1.5m above parking surface at point of lowest horizontal illuminance (not including points on the boundaries facing outward.)				

Parking Garages: (See RP-20-98 for details)

Area		Minimum Horizontal Illuminance[2] - lux (fc)	Maximum Max-to-Min Ratio	Minimum Vertical Illuminance[3] - lux (fc)
Basic[1]		10 (1.0)	10:1	5 (0.5)
Ramps[4]	Day[5]	20 (2.0)	10:1	10 (1.0)
	Night	10 (1.0)	10:1	5 (0.5)
Entrance Areas	Day[5]	500 (50)		250 (25)
	Night	10 (1.0)	10:1	5 (0.5)
Stairways		20 (2.0)		10 (1.0)
1 = For typical conditions				
2 = Measured on the parking surface without any shadowing effects.				
3 = Measured 1.5m above parking surface at point of lowest horizontal illuminance (not including points on the boundaries facing outward.)				
4 = Applies to clearway ramps (no adjacent parking) but not to sloping floor designs				

5 = Daylight may be considered in the design calculation

Pedestrian Ways, *Lighting for*

Recommended Maintained Illuminance Levels: See RP-33-99 for full details.

Application	Minimum Average Horizontal Illuminance at Pavement Level - lux (fc)	Average Vertical Illuminance 1.8 m (6') Above Walkway - lux (fc)
Roadside Walkways and Type A Bikeways		
Commercial Areas	10 (1)	20 (2)
Intermediate Areas	5 (0.5)	10 (1)
Residential Areas	2 (0.2)	5 (0.5)
Walkways Away from Roadside and Type B Bikeways		
Walkways & Bikeways	5 (0.5)	5 (0.5)
Pedestrian Stairways	5 (0.5)	10 (1)
Pedestrian Tunnels	20 (2)	55 (5)

Roadways

Illuminance Method - Recommended Minimum Maintained Average (See RP-8-00 for details) Lux (fc)

Application		Pavement Classification			Uniformity Illuminance	Veiling Luminance Ratio
Roadway Type	Pedestrian Conflict Area	R1	R2/R3	R4	E_{avg}/E_{min}	L_{vmax}/L_{avg}
Freeway Class A		6 (0.6)	9 (0.9)	8 (0.8)	3.0	0.3
Freeway Class B		4 (0.4)	6 (0.6)	5 (0.5)	3.0	0.3
Expressway	High	10 (1)	14 (1.4)	13 (1.3)	3.0	0.3
	Medium	8 (0.8)	12 (1.2)	10 (1)	3.0	0.3
	Low	6 (0.6)	9 (0.9)	8 (0.8)	3.0	0.3
Major	High	12 (1.2)	17 (1.7)	15 (1.5)	3.0	0.3
	Medium	9 (0.9)	13.0 (1.3)	11.0 (1.1)	3.0	0.3
	Low	6.0 (0.6)	9.0 (0.9)	8.0 (0.8)	3.0	0.3
Collector	High	8.0 (0.8)	12.0 (1.2)	10.0 (1.0)	4.0	0.4
	Medium	6.0 (0.6)	9.0 (0.9)	8.0 (0.8)	4.0	0.4
	Low	4.0 (0.4)	6.0 (0.6)	5.0 (0.5)	4.0	0.4

Local	High	6.0 (0.6)	9.0 (0.9)	8.0 (0.8)	6.0	0.4
	Medium	5.0 (0.5)	7.0 (0.7)	6.0 (0.6)	6.0	0.4
	Low	3.0 (0.3)	4.0 (0.4)	4.0 (0.4)	6.0	0.4

Luminance Method: (See RP-8-00 for details)

Application		Average Luminance	Maximum Avg-to-Min Allowed	Maximum Max-to-Min Allowed	Veiling Luminance Ratio
Roadway Type	**Pedestrian Conflict Area**	**L_{avg} (cd/m^2)**	**L_{avg}/L_{min}**	**L_{max}/L_{min}**	**L_{vmax}/L_{avg}**
Freeway Class A		0.6	3.5	6.0	0.3
Freeway Class B		0.4	3.5	6.0	0.3
Expressway	High	1.0	3.0	5.0	0.3
	Medium	0.8	3.0	5.0	0.3
	Low	0.6	3.5	6.0	0.3
Major	High	1.2	3.0	5.0	0.3
	Medium	0.9	3.0	5.0	0.3
	Low	0.6	3.5	6.0	0.3
Collector	High	0.8	3.0	5.0	0.4
	Medium	0.6	3.5	6.0	0.4
	Low	0.4	4.0	8.0	0.4
Local	High	0.6	6.0	10.0	0.4
	Medium	0.5	6.0	10.0	0.4
	Low	0.3	6.0	10.0	0.4

Small Target Visibility - Recommended Values (Table based on a 60 year old driver with normal vision, an 18 cm x 18 cm target with 50% reflectance and 0.2 second fixation time.) (See RP-8-00 for details)

Application		STV Criteria	Luminance Criteria		
Roadway Type	**Pedestrian Conflict Area**	**Weighting Average VL**	**L_{avg} cd/m^2 Median < 7.3m**	**L_{avg}* cd/m^2 Median ≥ 7.3m**	**Maximum Max-to-Min Allowed**
Freeway Class A		3.2	0.5	0.4	6.0
Freeway Class B		2.6	0.4	0.3	6.0
Expressway		3.8	0.5	0.4	6.0
Major	High	4.9	1.0	0.8	6.0
	Medium	4.0	0.8	0.7	6.0
	Low	3.2	0.6	0.6	6.0

Collector	High	3.8	0.6	0.5	6.0
	Medium	3.2	0.5	0.4	6.0
	Low	2.7	0.4	0.4	6.0
Local	High	2.7	0.5	0.4	10.0
	Medium	2.2	0.4	0.3	10.0
	Low	1.6	0.3	0.3	10.0
				*This column also applies to freeways and expressways where the alignment at the two roadways is independent of each other or where there is a median barrier sufficient to block the direct view of oncoming headlights or a one way street.	

Security Locations/Tasks

Recommended Illuminances in lux (divide by 10 for fc). See G-1-03 for full details.

Application	Task	Average Horizontal Illuminance	Vertical Illuminance	Avg-to-Min Ratio	Footnotes
ATMs & Night Depositories (Exterior)	Face of ATM		150	3:1	d,e,f
	Within 10' of ATM	100	a		
	Between 10' and 50' from ATM	20	a	3:1	
	Supported Parking	20	a	3:1	
	Side of Building out to 40' when ATM is within 10' of corner	20		3:1	
Building Facades			5-20	8:1	
Building Interiors (Unoccupied patrol areas)		10		6:1	
Convenience Stores and Gas Stations	Pump Island	60	a	4:1	
	Sidewalks, refuse areas and grounds	30	a	4:1	
	Interior of store	300	a	4:1	
Facial Identification			5-8	4:1	
Fast Food Restaurants	General Parking	30	a	3:1	
	Drive-up window out to 30'	60	a	3:1	
	Refuse area	30	a	3:1	
Guarded Facilities	Entrances and Gatehouse inspection	100	a	3:1	b
	Guardhouse Interior				c
Hotels and Motels	General parking	30	a	4:1	
	Sidewalks and grounds	10	a	4:1	
Law Enforcement, Fire, Ambulance and other Emergency	Within 60' of all vehicle and pedestrian movement areas	80	a	3:1	

Service Facilities	General parking and walkways	30	a	3:1	
Parking Facilities, Garages and Covered Parking Spaces	On Pavement	60	a	4:1	
	Gathering Points (stairs, elevators, ramps)	50	a	4:1	
Parking Garages For the Elderly	Entrance	500	a		i
	Exterior walkways around senior facilities	50	a		l
Parking Lots, Areas for Public Parks	Open parking spaces	30	a	4:1	
	Park trails and walkways	6	a	4:1	j
	Likely loitering areas	10	a	4:1	
Residence, Single Family	Exterior Doorways		8		
Residence, Multi-family	Common areas	30	a	4:1	
	Common mailbox areas	100	a	4:1	
Schools and Institutions	General parking	30	a	4:1	l
	Sidewalks and footpaths	10	a	4:1	l
Supermarket, Major Retail Parking	Parking lot	30	a	4:1	
	Low activity - close-in parking	50	a	4:1	k

Notes for previous table.

Identifier	Note
a	Vertical illuminance of 5 to 8 lux or values that produce a uniformity ratio of no more than 4:1 (25% of horizontal illuminance).
b	Horizontal illuminance should be as shown or twice that of immediate surrounding area, whichever is greater
c	Interior illuminance should be minimum recommended for specific task performance
d	Redundant lamps so loss of any one lamp will not reduce lighting levels below minimum
e	Good to excellent facial recognition required at a distance of 30'.
f	Unobstructed view out to 50' in all directions from face of machine
i	See IESNA RP-28, *"Lighting and the Visual Environment for Senior Living"*
j	Lighting should extend out on both sides of trail to a distance of 30'
k	Size of parking area determined by estimated customer count
l	For special events, parking lots and grounds should be lit from 2 hours prior to the event through 2 hours after the event.

Service Station Lighting

Recommended Average Illuminances for Service Stations: See RP-33-99 for full details.

Description of Area	Average Illuminance - lux (fc)	
	With Dark Surroundings	With Light Surroundings
Approach	15 (1.5)	20 (2)

Driveway	15 (1.5)	20 (2)
Pump Island Area	50 (5)	100 (10)
Building Facades	20 (2)	30 (3)
Service Areas	20 (2)	30 (3)
Landscaping	10 (1)	20 (2)

Walkways/Bikeways

Maintained Illuminance Values (See RP-8-00 for details)

Pedestrian Conflict Area	**Walkway/Bikeway Type**	**E_h - lux (fc)**	**E_{vmin} - lux (fc)**	**E_{avg}/E_{min}**
High	Mixed Vehicle and Pedestrian	20.0 (2.0)	10.0 (1.0)	4.0
	Pedestrian Only	10.0 (1.0)	5.0 (0.5)	4.0
Medium	Pedestrian Areas	5.0 (0.5)	2.0 (0.2)	4.0
Low	Rural/Semi-Rural Areas	2.0 (0.2)	0.6 (0.06)	10.0
	Low Density Residential	3.0 (0.3)	0.8 (0.08)	6.0
	Medium Density Residential	4.0 (0.4)	1.0 (0.1)	4.0
Underpasses	Day	100.0 (10.0)	50.0 (5.0)	3.0
	Night	40.0 (4.0)	20.0 (2.0)	3.0