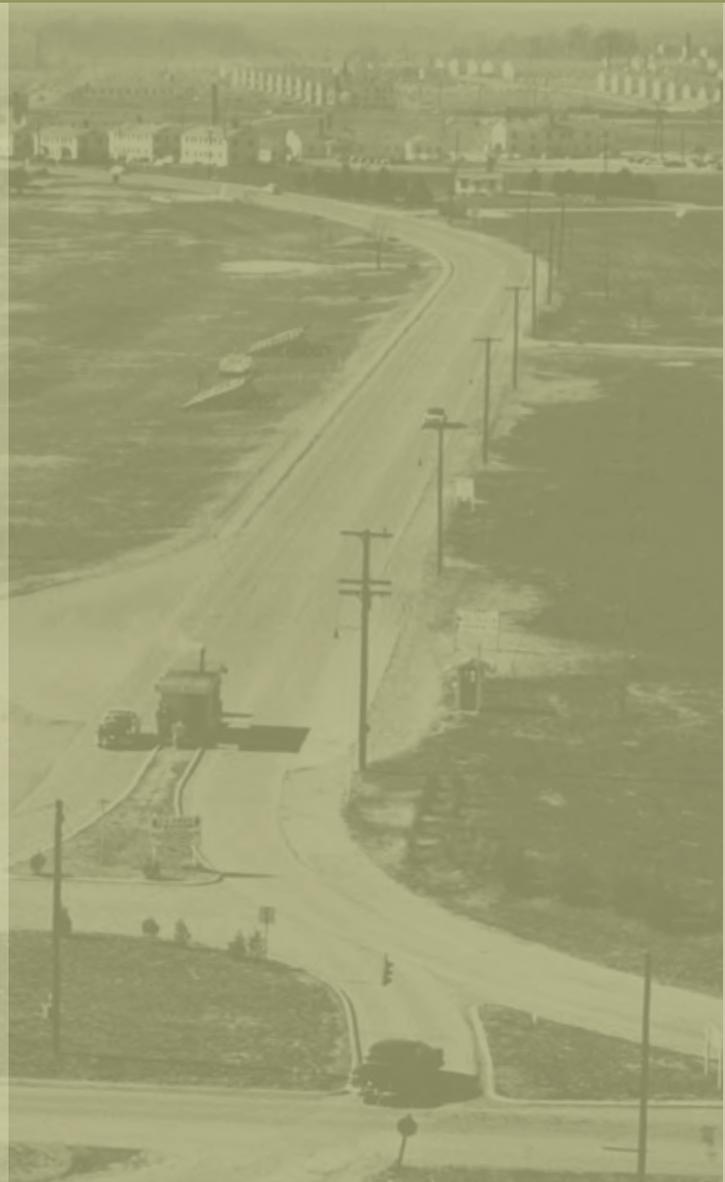
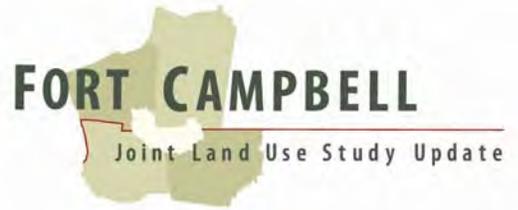


Fort Campbell

JOINT LAND USE STUDY

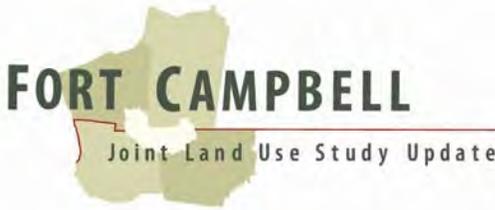




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Joint Land Use Study Update

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APPENDIX A: ACRONYMS AND GLOSSARY

ACUB	Army Compatible Use Buffer
APZ	Accident Potential Zone
CZ	Clear Zone
dB	Decibels
dBA	A-weighted decibels
dBc	C-weighted decibels
DNL	Day-night sound level
DU	Dwelling Unit
FAA	Federal Aviation Administration
FICUN	Federal Interagency Committee on Urban Noise
CAAF	Campbell Army Airfield
JLUS	Joint Land Use Study
LUPZ	Land Use Planning Zone
MOU	Memorandum of Understanding
NZ	Noise Zone
PAO	Public Affairs Office
SAH	Sabre Army Heliport
TDR	Transfer of Development Rights

Glossary

A-weighting (dBA) - A measure of sound that depicts higher frequency noise caused by small arms firing, aircraft use, and vehicle operations.

Accident Potential Zone I (APZ I) [Class A Runway Accident] - An area just beyond the Clear Zones at each end of the runway. Less critical than the Clear Zone it still possesses significant potential for accidents. Land use compatibility guidelines allow a wide variety of industrial, manufacturing, transportation, communication, utilities, wholesale trade, open space, recreation and agricultural uses. Uses that concentrate people in small areas are not acceptable in APZ I.

Accident Potential Zone II (APZ II) [Class A Runway] - An area extending beyond APZ I. This area is less critical than APZ I but still possesses potential for accidents. Acceptable land uses include those in APZ I, as well as low density, single family residences. Also acceptable are



personal and business services and commercial retail trade uses of low intensity or scale of operation. High-density functions such as multi-story buildings, places of assembly (e.g., theaters, schools, churches, and restaurants) and high-density office uses are not considered appropriate.

Army Compatible Use Buffer (ACUB) - A new Army program which allows an installation to work with partners to encumber land to protect habitat and training without acquiring any new land for Army ownership. Through ACUBs, the Army reaches out to partners to identify mutual objectives of land conservation and to prevent development of critical open areas. The program allows the Army to contribute funds to the partner's purchase of easements or properties from willing landowners. These partnerships preserve high-value habitat and limit incompatible development in the vicinity of military installations. Partners may include states, cities and counties as well as non-governmental conservation organizations.

C-weighting (dBC) - a measure of sound that shows the low frequency noise and vibration associated with the firing of larger weapons systems.

Clear Zone (CZ) [Class A Runway] - An area 1,000 feet wide by 3,000 feet long located at the immediate end of the runway. The accident potential in this area is so high that no building is allowed.

Day-Night Average Sound Level (DNL) - The 24-hour average frequency-weighted sound level, in decibels, from midnight to midnight, obtained after addition of 10 decibels to sound levels in the night from midnight up to 7 a.m. and from 10 p.m. to midnight (0000 up to 0700 and 2200 up to 2400 hours).

Decibels (dB) - The decibel is a logarithmic unit of measure of sound pressure.

Land Use Planning Zone. The Land Use Planning Zone consists of an area where the day-night sound level (DNL) is between 60 and 65 dBA or 57 and 62 dBC. Exposure to noise within this area is considered significant during periods of increased operations. The LUPZ accounts for the variability of noise levels caused by higher daily numbers of operations than the annual average. It shows where levels of annoyance usually associated with Noise Zone II can be found during periods of increased operations. The LUPZ provides the installation with a means to predict possible complaints, and meet the public demand for a description of what will exist during a period of increased operations

Noise Zone I. Noise Zone I (NZ I) includes areas around a noise source in which the DNL is less than 65 dBA and less than 62 dBC. Since the noise exposure in this zone is low enough that it does not trigger compatibility with sensitive uses, maps of the noise environment do not show NZ I contours.

Noise Zone II. Noise Zone II (NZ II) consists of an area where the A-weighted DNL is between 65 and 75 decibels and the C-weighted DNL is between 62 and 70 decibels. Guidance deems noise exposure within this area to be significant and recommends limiting use of land to non-



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sensitive activities such as industry, manufacturing, transportation, and agriculture. However, if the community determines that land in NZ II areas must be used for residential purposes, guidance suggests that the design and construction of the buildings incorporate noise level reduction (NLR) features to minimize the annoyance experienced by residents.

Noise Zone III. Noise Zone III (NZ III) consists of the immediate areas around the source of the noise in which the A-weighted DNL (ADNL) is more than 75 decibels, and the C-weighted DNL (CDNL) exceeds 70 decibels. Guidance indicates that noise in this zone is severe enough to cause conflicts with almost all activities, particularly sensitive land uses, such as housing, schools, medical facilities, and places of worship.



APPENDIX B: DETAILED COMPATIBILITY GUIDELINES

DoD COMPATIBLE LAND USE GUIDELINES FOR CLEAR ZONES AND ACCIDENT POTENTIAL ZONES (APZ). (U.S. Army 1981)

LAND USE	CLEAR ZONE	APZ I	APZ II
A. RESIDENTIAL			
Single Family Unit	No	No	Yes ²
2-4 Family Units	No	No	No
Multifamily Dwellings (Apartments)	No	No	No
Group Quarters	No	No	No
Residential Hotels	No	No	No
Mobile Home Parks or Courts	No	No	No
Other Residential	No	No	No
B. INDUSTRIAL & MANUFACTURING³			
Food and Kindred Products	No	No	Yes
Apparel	No	No	No
Lumber and Wood Products	No	Yes	Yes
Furniture and Fixtures	No	Yes	Yes
Printing, Publishing	No	Yes	Yes
Miscellaneous Manufacturing	No	Yes	Yes
C. TRANSPORTATION, COMMUNICATIONS & UTILITIES⁴			
Railroad, Rapid Rail Transit (on-grade)	No	Yes ⁴	Yes
Highway and Street Rights-of-Way	Yes ⁵	Yes	Yes
Auto Parking	No	Yes	Yes
Communications	Yes ⁵	Yes	Yes
Utilities	Yes ⁵	Yes ⁴	Yes
Other Transportation, Communications and Utilities	Yes ⁵	Yes	Yes
D. COMMERCIAL & RETAIL TRADE			
Wholesale Trade	No	Yes	Yes
Building Materials (Retail)	No	Yes	Yes
General Merchandise (Retail)	No	No	Yes
Food (Retail)	No	No	Yes
Automotive, Marine, and Aviation	No	Yes	Yes
Apparel and Accessories (Retail)	No	No	Yes
Furniture, Home Furnishings (Retail)	No	No	Yes
Eating and Drinking Facilities	No	No	No
Other Retail Trade	No	No	Yes
E. PERSONAL & BUSINESS SERVICES⁶			
Finance, Insurance, and Real Estate	No	No	Yes
Personal Services	No	No	Yes

Business Services	No	No	Yes
Repair Services	No	Yes	Yes
Professional Services	No	No	Yes
Contract Construction Services	No	Yes	Yes
Indoor Recreation Services	No	No	Yes
Other Services	No	No	Yes
F. PUBLIC AND QUASI-PUBLIC SERVICES			
Government Services	No	No	Yes ⁶
Educational Services	No	No	No
Cultural Activities	No	No	No
Medical and Other Health Services	No	No	No
Cemeteries	No	Yes ⁷	Yes ⁷
Non-profit Organizations including Churches	No	No	No
Other Public and Quasi-Public Services	No	No	Yes
G. OUTDOOR RECREATION			
Playgrounds and Neighborhood Parks	No	No	Yes
Community and Regional Parks	No	Yes ⁸	Yes ⁸
Nature Exhibits	No	Yes	Yes
Spectator Sports Including Arenas	No	No	No
Golf Courses ⁹ , Riding Stables ¹⁰	No	Yes	Yes
Water Based Recreational Areas	No	Yes	Yes
Resort and Group Camps	No	No	No
Entertainment Assembly Areas	No	No	No
Other Outdoor Recreation	No	Yes ⁸	Yes
H. RESOURCE PRODUCTION & EXTRACTION & OPEN LAND			
Agriculture ¹¹	Yes	Yes	Yes
Livestock Farming, Animal Breeding ¹²	No	Yes	Yes
Forestry Activities	No	Yes	Yes
Fishing Activities and Related Services ¹³	No ¹⁴	Yes ¹³	Yes
Mining Activities	No	Yes	Yes
Permanent Open Space	Yes	Yes	Yes
Water Areas ¹³	Yes	Yes	Yes

Footnotes:

- 1 A "Yes" or "No" designation for compatible land use is to be used only for gross comparison. Within each, uses exist where further definition may be needed as to whether it is clear or usually acceptable/unacceptable owing to variations in densities of people and structures. For heliports and stagefields, the takeoff safety zone is equivalent to the clear zone and the approach-departure zone is equivalent to APZ I for these land use guidelines.
- 2 Suggested maximum density 1-2 dwelling units per acre, possibly increased under a Planned Unit Development where maximum lot coverage is less than 20 percent.
- 3 Factors to be considered: Labor intensity, structural coverage, explosive characteristics, and air pollution.
- 4 No passenger terminals and no major above ground transmission lines in APZ I.
- 5 Not permitted in graded area.
- 6 Low intensity office uses only. Meeting places, auditoriums, etc., not recommended.
- 7 Excludes chapels.



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- 8 Facilities must be low intensity.
- 9 Clubhouse not recommended.
- 10 Concentrated rings with large classes not recommended.
- 11 Includes livestock grazing but excludes feedlots and intensive animal husbandry.
- 12 Includes feedlots and intensive animal husbandry.
- 13 Includes hunting and fishing.
- 14 Controlled hunting and fishing may be permitted for the purpose of wildlife control.

GUIDELINES FOR CONSIDERING NOISE IN LAND USE PLANNING AND CONTROL. (FICUN 1980)

	NZ I		NZ II		NZ III		
	0-55	55-65	65-70	70-75	75-80	80-85	85+
RESIDENTIAL							
Household Units	Yes	Yes	25 ¹	30 ¹	No	No	No
Group Quarters	Yes	Yes	25 ¹	30 ¹	No	No	No
Residential Hotels	Yes	Yes	25 ¹	30 ¹	No	No	No
Manufactured Housing	Yes	Yes	No	No	No	No	No
Other Residential	Yes	Yes	25 ¹	30 ¹	No	No	No
MANUFACTURING							
Food Products	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Textile Mill Products	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Apparel	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Wood Products	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Furniture	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Paper	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Printing	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Manufacturing	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
TRANSPORT, COMMS & UTIL							
Railroad	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	Yes ⁴
Motor Vehicle	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	Yes ⁴
Aircraft	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	Yes ⁴
Marine Craft	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	Yes ⁴
Highway & Street	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	Yes ⁴
Parking	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Communications	Yes	Yes	Yes	25 ⁵	30 ⁵	No	No
Utilities	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	Yes ⁴
Other T, C & U	Yes	Yes	Yes	25 ⁵	30 ⁵	No	No
TRADE							
Wholesale Trade	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Retail - Building	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Retail - General	Yes	Yes	Yes	25	30	No	No
Retail - Food	Yes	Yes	Yes	25	30	No	No
Retail - Auto	Yes	Yes	Yes	25	30	No	No
Retail - Apparel	Yes	Yes	Yes	25	30	No	No
Retail - Furniture	Yes	Yes	Yes	25	30	No	No
Retail - Eating	Yes	Yes	Yes	25	30	No	No
Other Retail Trade	Yes	Yes	Yes	25	30	No	No
SERVICES							
Finance, Insurance	Yes	Yes	Yes	25	30	No	No
Personal Services	Yes	Yes	Yes	25	30	No	No
Cemeteries ¹¹	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	Yes ⁶

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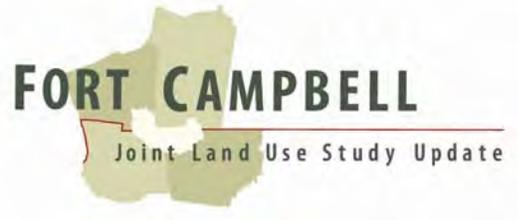
Repair Services	Yes	Yes	Yes	Yes ²	Yes ³	Yes ⁴	No
Profess Services	Yes	Yes	Yes	25	30	No	No
Hospitals, Nursing	Yes	Yes	25	30	No	No	No
Other Medical Facilities	Yes	Yes	Yes	25	30	No	No
Contract Construction	Yes	Yes	Yes	25	30	No	No
Government Services	Yes	Yes	Yes	25	30	No	No
Educational Services	Yes	Yes	25	30	No	No	No
Misc Services	Yes	Yes	Yes	25	30	No	No
CULTURAL, ENTERTAINMENT & REC							
Churches	Yes	Yes	25	30	No	No	No
Nature Exhibits	Yes	Yes	Yes	No	No	No	No
Public Assembly	Yes	Yes	Yes	No	No	No	No
Auditoriums	Yes	Yes	25	30	No	No	No
Amphitheaters	Yes	Yes	No	No	No	No	No
Outdoor Sports	Yes	Yes	Yes ⁷	Yes ⁷	No	No	No
Amusements	Yes	Yes	Yes	Yes	No	No	No
Recreational	Yes	Yes	Yes	25	30	No	No
Resorts	Yes	Yes	Yes	Yes	No	No	No
Parks	Yes	Yes	Yes	Yes	No	No	No
Other	Yes	Yes	Yes	Yes	No	No	No
RESOURCE PRODUCT							
Agriculture	Yes	Yes	Yes ⁸	Yes ⁹	Yes ¹⁰	Yes ¹⁰	Yes ¹⁰
Livestock	Yes	Yes	Yes ⁸	Yes ⁹	No	No	No
Forestry	Yes	Yes	Yes ⁸	Yes ⁹	Yes ¹⁰	Yes ¹⁰	Yes ¹⁰
Fishing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mining	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Resource	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Legend:

Yes	Land use and related structures compatible without restrictions.
No	Land use and related structures are not compatible and should be prohibited.
ADNL	A-weighted day-night sound level
NZ	Noise Zone
Yes ^x	(Yes with restrictions) Land use and related structures generally compatible; see footnotes.
25, 30, 35	Land use and related structures generally compatible; measures to achieve noise level reduction (NLR) of 25, 30 or 35 must be incorporated into design and construction of structure.
25 [*] , 30 [*] , 35 [*]	Land use generally compatible with NLR; however, measures to achieve an overall NLR do not necessarily solve noise difficulties; additional evaluation is warranted.
NLR	Noise level reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.

Footnotes:

- * The designation of these uses as "compatible" in this zone reflects individual Federal agencies' consideration of general cost and feasibility factors as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider.
- 1 (a) Although local conditions may require residential use, it is discouraged in 65-70 ADNL and strongly discouraged in 70-75 ADNL. The absence of viable alternative development options should be determined and an evaluation indicating that a demonstrated community need for residential use would not be met if development were prohibited in these zones should be conducted prior to approvals.
 (b) Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor NLR of at least 25 dB (65-70 ADNL) and 30 dB (70-75 ADNL) should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to provide a NLR of 20 dB, thus the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. Additional consideration should be given to modifying NLR levels based on peak noise levels.
 (c) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, design, and use of berms and barriers can help mitigate outdoor noise exposure particularly from ground level transportation sources. Measures that reduce noise at a site should be used wherever practical in preference to measures that only protect interior spaces.
- 2 Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
- 3 Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
- 4 Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
- 5 If noise-sensitive, use indicated NLR; if not, use is compatible.
- 6 No buildings.
- 7 Land use compatible provided special sound reinforcement systems are installed.
- 8 Residential buildings require a NLR of 25.
- 9 Residential buildings require a NLR of 30.
- 10 Residential buildings not permitted.



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In areas with ADNL greater than 80, land use not recommended, but if community decides use is necessary, hearing protection devices should be worn by personnel.



APPENDIX C: SAMPLE REAL ESTATE DISCLOSURE FORM LANGUAGE

AREA OF MILITARY IMPACT REAL ESTATE DISCLOSURE FORM

Property at the following location is situated within the vicinity of Fort Campbell/Campbell Army Airfield/Sabre Army Heliport. The subject property may therefore be exposed to periodic low-level military aircraft over-flights, large artillery noise, small arms noise, and impacts associated with other such military training activities.

Parcel #: _____ Deed Book # _____ Page # _____

Address: _____

I, _____, (owner of the subject property) hereby certify that I have informed _____ (prospective purchaser/lessee/renter) that the subject property is located within the vicinity of Fort Campbell/Campbell Army Airfield/Sabre Army Heliport and may therefore be exposed to periodic low-level military aircraft over-flights, artillery/small arms noise, other such military training activities.

Owner/ Date

I, _____, (prospective purchaser/lessee/renter of the subject property) hereby certify that I have been informed by _____ (owner) that the subject property is located in the vicinity of Fort Campbell/Campbell Army Airfield/Sabre Army Heliport and may therefore be exposed to periodic low-level military aircraft over-flights, artillery/small arms noise, other such impacts of military training activities.

Purchaser/Lessee/Renter Date

Signed before me on this _____ day of _____, 20____, in the
County of _____, Tennessee/Kentucky
_____, Notary Public, State of Tennessee/Kentucky.
My Commission Expires on _____. (SEAL)



APPENDIX C: SAMPLE REAL ESTATE DISCLOSURE ORDINANCE LANGUAGE

NAVAL AIR STATION PENSACOLA, ESCAMBIA COUNTY, FLORIDA

Real Estate Disclosure Area. All real estate transactions within the Pensacola Regional Airport Real Estate Disclosure Area shall include a form disclosing the proximity of the site to the airport. The form shall be affixed to all listing agreements, sales and rental contracts, subdivision plats, and any individual marketing materials, such as brochures, etc. Disclosure is required as soon as practicable, but must be before the execution of a contract, i.e., before the making or acceptance of an offer.

The Pensacola Regional Airport Real Estate Disclosure Area shall be comprised of all properties abutting the Pensacola Regional Airport and all properties within noise zone A, B, or C. The area is depicted on the "Pensacola Regional Airport Real Estate Disclosure Area" map which is adopted by reference, located in the Department of Planning and Zoning offices, and is available for review during normal business hours.

Split parcels. For purposes of regulating parcels split by PNSPD lines, only that portion of a parcel that falls within the PNSPD shall be subject to the conditions of the PNSPD. For parcels located within more than one noise zone inside PNSPD, the more stringent requirements shall apply to the entire parcel.



APPENDIX D: SAMPLE AVIGATION EASEMENT FORM

Parcel _____ County _____

Grantor (s) Name _____

Grantor (s) Address _____

LEGAL DESCRIPTION:

In accordance with section XXXXX of the Land Use Ordinance for XXXXX County, State of XXXXX, approving a permit for residential development on the above described property, and in consideration of such approval, Grantors grant to the owners of all property adjacent to the above described property, a perpetual nonexclusive easement as follows:

1. The Grantors, their heirs, successors, and assigns acknowledge by the granting of this easement that the residential development is situated in an area that may be subjected to conditions resulting from military training at Fort Campbell/Campbell Army Airfield/Sabre Army Heliport. Such conditions include the firing of small and large caliber weapons, the overflight of both fixed-wing and rotary-wing aircraft, the movement of vehicles, the use of generators, and other accepted and customary military training activities. These activities ordinarily and necessarily produce noise, dust, smoke and other conditions that may conflict with Grantors' use of Grantors' property for residential purposes. Grantors hereby waive all common law rights to object to normal and necessary military training activities legally conducted on adjacent Fort Campbell which may conflict with Grantors' use of Grantors' property for residential and other purposes, and Grantors hereby grant an easement to the adjacent Fort Campbell for such activities.
2. Nothing in this easement shall grant a right to Fort Campbell/Campbell Army Airfield/Sabre Army Heliport for ingress or egress upon or across the described property. Nothing in this easement shall prohibit or otherwise restrict the Grantors from enforcing or seeking enforcement of statutes or regulations of governmental agencies for activities conducted on adjacent properties.
3. This easement is appurtenant to all property adjacent to the above described property and shall bind to the heirs, successors, and assigns of Grantors and shall endure for the benefit of the adjoining Fort Campbell/Campbell Army Airfield/Sabre Army Heliport. Fort Campbell/Campbell Army Airfield/Sabre Army Heliport is hereby expressly granted the right of third party enforcement of the easement.

IN WITNESS WHEREOF, the Grantors have executed this easement dated this ___ day of _____, 20__

Grantor

Grantor



APPENDIX E: MEMORANDA OF UNDERSTANDING

SAMPLE MEMORANDUM OF UNDERSTANDING - TIER 1(ADVANCED)

Between Fort Campbell/Campbell Army Airfield/Sabre Army Heliport and

The Counties of _____ and

The Cities of _____

This Memorandum of Understanding between Fort Campbell/Campbell Army Airfield/Sabre Army Heliport, the Counties of _____, and the Cities of _____, is enacted to establish a mutually beneficial process that will ensure timely and consistent notification and cooperation between the parties on projects, policies, and activities. These parties have a mutual interest in the cooperative evaluation, review, and coordination of local plans, programs, and projects in the Counties of _____, the Cities of _____, and on Fort Campbell/Campbell Army Airfield/Sabre Army Heliport.

The Cities of _____ and the Counties of _____ agree to:

1. Submit information to Fort Campbell/Campbell Army Airfield/Sabre Army Heliport on plans, programs, actions, and projects that may affect Fort Campbell/Campbell Army Airfield/Sabre Army Heliport. This may include, but not be limited to the following:
 - Development proposals
 - Transportation improvements and plans
 - Sanitary waste facilities/wastewater facilities/ water facilities/any infrastructure necessary to support development
 - Open space and recreation
 - Public works projects
 - Land use plans, comprehensive plan, and ordinances
 - Rezoning and variances
 - School facility siting plan
 - Lighting plans for roadways, subdivision developments and major commercial/industrial developments
 - Capital Improvements Plan
 - Demographic data
2. Submit to Fort Campbell/Campbell Army Airfield/Sabre Army Heliport for review and comment, project notification, policies, plans, reports, studies and similar information on development, infrastructure and environmental activities within proximity of Fort Campbell/Campbell Army Airfield/Sabre Army Heliport as defined by the established Joint Land Use Study Area of Concern.
3. Consider Army comments as part of local responses or reports.

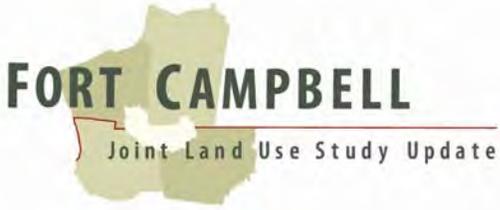
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4. Make information on Joint Land Use Study recommendations, including noise attenuation construction practices and preferred lighting applications readily available to the public.
5. Explore the application of growth management techniques, such as establishing planned growth areas or promoting open space/conservation development to minimize land use incompatibility within the established Joint Land Use Study Area of Concern.
6. Coordinate city/county annexation and public infrastructure extensions to complement the goal of encroachment reduction in established Compatible Use Buffer Areas.
7. Promote compliance with dark-sky approved lighting applications in the Night Vision Device Influence Area
8. Mark all plats in the established JLUS Area of Concern with an "Area of Military Impact Plat Notification" and explore real estate disclosure within the Area of Concern
9. Include Fort Campbell/Campbell Army Airfield/Sabre Army Heliport in the distribution of meeting agendas for, but not limited to:
 - City Council or County Commission Meetings
 - Planning Commission Meetings
 - Zoning Boards of Adjustment
 - Review Board
 - Transportation Studies
 - Public Works Studies

Fort Campbell/Campbell Army Airfield/Sabre Army Heliport agrees to:

1. Submit information to City and County representatives on plans, programs, actions, and projects which may affect the city or county. These may include, but not be limited to, the following:
 - Installation Master Plan
 - Installation Compatible Use Zone Studies
 - Noise Management Studies
 - Changes in existing installation use that may change off-post impacts, such as noise
 - Appropriate data on troop strength and activities for local plans, programs and projects
 - Army Compatible Use Buffer
 - Schedule of training activities when feasible
2. Submit to City and County representatives for review and comment, project notification, policies, plans, reports, studies and similar information on development, infrastructure and environmental activities at Fort Campbell/Campbell Army Airfield/Sabre Army Heliport.
3. Make information on Joint Land Use Study recommendations, noise mitigation and encroachment reduction strategies readily available to the public.



This agreement will remain in effect until terminated by any of the parties. Amendments to this memorandum may be made by mutual agreement of all the parties. Review process details and appropriate forms may be developed to facilitate uniform and efficient exchanges of comments.

This understanding will not be construed to obligate the U.S. Army, the Cities of _____, the Counties of _____ to violate existing or future laws or regulations.

This agreement is approved by:

County

City

Fort Campbell/Campbell Army Airfield/Sabre Army Heliport



SAMPLE MEMORANDUM OF UNDERSTANDING - TIER 2 (BASIC)

Between Fort Campbell/Campbell Army Airfield/Sabre Army Heliport and

The Counties of _____ and

The Cities of _____

This Memorandum of Understanding between Fort Campbell/Campbell Army Airfield/Sabre Army Heliport, the Counties of _____, and the Cities of _____, is enacted to establish a mutually beneficial process that will ensure timely and consistent notification and cooperation between the parties on projects, policies, and activities. These parties have a mutual interest in the cooperative evaluation, review, and coordination of local plans, programs, and projects in the Counties of _____, the Cities of _____, and on Fort Campbell/Campbell Army Airfield/Sabre Army Heliport.

The Cities of _____ and the Counties of _____

_____ agree

to:

1. Designate a single point of contact to interact with Fort Campbell planners and participate in JLUS Partnership forums.
2. Submit information to Fort Campbell/Campbell Army Airfield/Sabre Army Heliport on plans, programs, actions, and projects that may affect Fort Campbell/Campbell Army Airfield/Sabre Army Heliport. This may include, but not be limited to the following:
 - Development proposals
 - Transportation improvements and plans
 - Sanitary waste facilities/wastewater facilities/ water facilities/any infrastructure necessary to support development
 - Open space and recreation
 - Public works projects
 - Land use plans, comprehensive plan, and ordinances

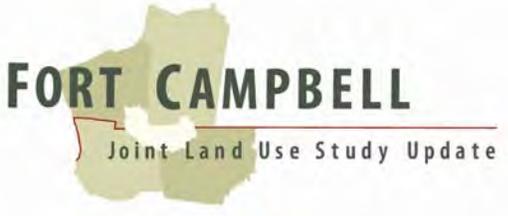
FORT CAMPBELL

Joint Land Use Study Update

- Rezoning and variances
 - School facility siting plan
 - Lighting plans for roadways, subdivision developments, and major commercial/industrial developments
3. Submit to Fort Campbell/Campbell Army Airfield/Sabre Army Heliport for review and comment, project notification, policies, plans, reports, studies and similar information on development, infrastructure and environmental activities within proximity of Fort Campbell/Campbell Army Airfield/Sabre Army Heliport as defined by the established Joint Land Use Study Area of Concern.
 4. Consider Army comments as part of local responses or reports.
 5. Promote compliance with dark-sky approved lighting applications in the Night Vision Device Influence Area
 6. Mark all plats in the established JLUS Area of Concern with an "Area of Military Impact Plat Notification"
 7. Include Fort Campbell/Campbell Army Airfield/Sabre Army Heliport in the distribution of meeting agendas for, but not limited to:
 - City Council or County Commission Meetings
 - Planning Commission Meetings
 - Zoning Boards of Adjustment
 - Review Board
 - Transportation Studies

Fort Campbell/Campbell Army Airfield/Sabre Army Heliport agrees to:

1. Submit information to City and County representatives on plans, programs, actions, and projects which may affect the city or county. These may include, but not be limited to, the following:
 - Installation Master Plan
 - Installation Compatible Use Zone Studies
 - Noise Management Studies
 - Changes in existing installation use that may change off-post impacts, such as noise
 - Appropriate data on troop strength and activities for local plans, programs and projects
 - Army Compatible Use Buffer
 - Schedule of training activities when feasible
2. Submit to City and County representatives for review and comment, project notification, policies, plans, reports, studies and similar information on development, infrastructure and environmental activities at Fort Campbell/Campbell Army Airfield/Sabre Army Heliport.
3. Make information on Joint Land Use Study recommendations, noise mitigation and encroachment reduction strategies readily available to the public.



This agreement will remain in effect until terminated by any of the parties. Amendments to this memorandum may be made by mutual agreement of all the parties. Review process details and appropriate forms may be developed to facilitate uniform and efficient exchanges of comments.

This understanding will not be construed to obligate the U.S. Army, the Cities of _____, the Counties of _____ to violate existing or future laws or regulations.

This agreement is approved by:

County

City

Fort Campbell/Campbell Army Airfield/Sabre Army Heliport



SAMPLE MEMORANDUM OF UNDERSTANDING - DOTs/MPOs/ADDs

Between Fort Campbell/Campbell Army Airfield/Sabre Army Heliport and
The _____ Department of Transportation and the
_____ Area Development District/MPO

This Memorandum of Understanding between Fort Campbell/Campbell Army Airfield/Sabre Army Heliport, the _____ Department of Transportation is enacted to establish a mutually beneficial process that will ensure timely and consistent notification and cooperation between the parties on projects, policies, and activities. These parties have a mutual interest in the cooperative evaluation, review, and coordination of state, regional, local plans, programs, and projects in the Counties of _____, the Cities of _____, and on Fort Campbell/Campbell Army Airfield/Sabre Army Heliport.

The _____ Department of
Transportation _____ and
the _____ Area Development
District/MPO
agree to:

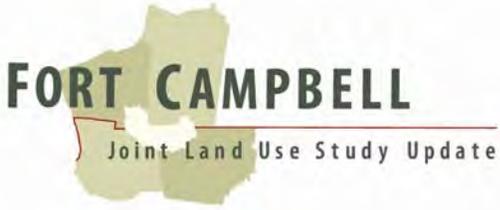
1. Designate a single point of contact to interact with Fort Campbell planners and participate in JLUS Partnership forums.
2. Submit information to Fort Campbell/Campbell Army Airfield/Sabre Army Heliport on plans, programs, actions, and projects that may affect Fort Campbell/Campbell Army Airfield/Sabre Army Heliport. This may include, but not be limited to the following:
 - Statewide Transportation Improvement Plans
 - Statewide Transportation Plan
 - Six Year Highway Plans
 - Regional Long-Range Transportation Plans
 - Regional Transportation Improvement Programs
 - Unified Planning Work Program
 - Access Management Plans



- Concept plans for roadway projects
 - Lighting plans for roadway projects
3. Submit to Fort Campbell/Campbell Army Airfield/Sabre Army Heliport for review and comment, roadway plans and projects within proximity of Fort Campbell/Campbell Army Airfield/Sabre Army Heliport as defined by the established Joint Land Use Study Area of Concern.
 4. Consider Army comments as part of local project design or reports.
 5. Include Fort Campbell/Campbell Army Airfield/Sabre Army Heliport in the distribution of meeting agendas for, but not limited to:
 - Transportation study meetings
 - Meetings, public hearings, and public comment periods related to state and regional transportation plan development
 - MPO Executive Board and MPO Technical Coordinating Committee meetings
 - Regional Planning Organization board and committee meetings
 6. Seek to install fully shielded luminaires for street lighting applications on new roadways or as part of the scheduled replacement of existing street lighting on roadways in the established Night Vision Device Influence Area
 7. Coordinate with Fort Campbell military planners on the placement of new roads or projects to enhance the capacity of existing roads in the established JLUS Area of Concern and seek to minimize the expenditure of public funds on roadway projects that may induce incompatible growth in the established Compatible Use Buffer Area and compromise Fort Campbell's function as a strategic deployment platform.
 8. Modify Metropolitan Planning Organization to include the Kentucky and Tennessee Military Affairs Commissions and integrate Fort Campbell requirements into their regional transportation planning.

Fort Campbell/Campbell Army Airfield/Sabre Army Heliport agrees to:

1. Submit information to transportation representatives on plans, programs, actions, and projects which may affect surface transportation and regional access. These may include, but not be limited to, the following:
 - Installation Master Plan
 - Changes in existing installation use that may change off-post impacts, such as troop movement on surface roads
 - Appropriate data on troop strength and activities for local plans, programs and projects
 - Transportation plans
 - Changes to gate access
2. Submit to transportation representatives for review and comment, project notification, policies, plans, reports, studies and similar information on development, infrastructure and environmental activities at Fort Campbell/Campbell Army Airfield/Sabre Army Heliport.



3. Make information on Joint Land Use Study recommendations, noise mitigation and encroachment reduction strategies readily available to the public.

This agreement will remain in effect until terminated by any of the parties. Amendments to this memorandum may be made by mutual agreement of all the parties. Review process details and appropriate forms may be developed to facilitate uniform and efficient exchanges of comments.

This understanding will not be construed to obligate the U.S. Army, _____ Department of Transportation and the _____ Area Development District or MPO to violate existing or future laws or regulations.

This agreement is approved by:

Department of Transportation

ADD/MPO

Fort Campbell/Campbell Army Airfield/Sabre Army Heliport



SAMPLE MEMORANDUM OF UNDERSTANDING - UTILITIES

Between Fort Campbell/Campbell Army Airfield/Sabre Army Heliport and

The _____ (Name of Utility)

This Memorandum of Understanding between Fort Campbell/Campbell Army Airfield/Sabre Army Heliport, the _____ (Name of Utility) is enacted to establish a mutually beneficial process that will ensure timely and consistent notification and cooperation between the parties on projects, policies, and activities. These parties have a mutual interest in the cooperative evaluation, review, and coordination of state, regional, local plans, programs, and projects in the Counties of _____, the Cities of _____, and on Fort Campbell/Campbell Army Airfield/Sabre Army Heliport.

The _____ (Name of

Utility) agrees to:

1. Designate a single point of contact to interact with Fort Campbell planners and participate in JLUS Partnership forums.
2. Submit information to Fort Campbell/Campbell Army Airfield/Sabre Army Heliport on plans, programs, actions, and projects that may affect Fort Campbell/Campbell Army Airfield/Sabre Army Heliport. This may include, but not be limited to the following:
 - Capital Improvement Plans
 - Master Plans and Service Area Plans
 - Information on treatment capacities
3. Submit to Fort Campbell/Campbell Army Airfield/Sabre Army Heliport for review and comment, infrastructure and utility plans and projects within proximity of Fort Campbell/Campbell Army Airfield/Sabre Army Heliport as defined by the established Joint Land Use Study Area of Concern.
4. Consider Army comments as part of local project design or reports.

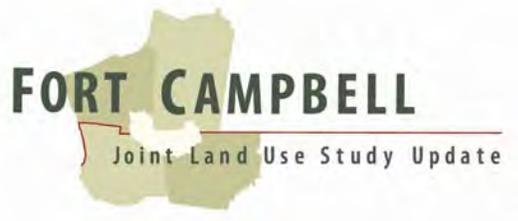


5. Include Fort Campbell/Campbell Army Airfield/Sabre Army Heliport in the distribution of meeting agendas for, but not limited to:
 - Utility Authority meetings
 - Meetings, public hearings, and public comment periods related to regional and utility plan development
6. Promote the use of fully shielded light fixtures for customers seeking security/agricultural lighting in the four county area of Christian, Clarksville-Montgomery, Trigg and Stewart Counties.
7. Coordinate with Fort Campbell military planners on the placement of new infrastructure, particularly wastewater treatment, and plans to enhance the capacity of existing facilities in the established JLUS Area of Concern and seek to minimize the expenditure of public funds on infrastructure projects that may induce incompatible growth in the established Compatible Use Buffer Area.

Fort Campbell/Campbell Army Airfield/Sabre Army Heliport agrees to:

1. Submit information to transportation representatives on plans, programs, actions, and projects which may affect public service demand. These may include, but not be limited to, the following:
 - Installation Master Plan
 - Appropriate data on troop strength and activities for local plans, programs and projects
2. Submit to utility representatives for review and comment, project notification, policies, plans, reports, studies and similar information on development, infrastructure and environmental activities at Fort Campbell/Campbell Army Airfield/Sabre Army Heliport.
3. Make information on Joint Land Use Study recommendations, noise mitigation and encroachment reduction strategies readily available to the public.

This agreement will remain in effect until terminated by any of the parties. Amendments to this memorandum may be made by mutual agreement of all the parties. Review process details and appropriate forms may be developed to facilitate uniform and efficient exchanges of comments.



This understanding will not be construed to obligate the U.S. Army, _____
_____ (Name of Utility) to violate existing or future laws or
regulations.

This agreement is approved by:

Utility

Fort Campbell/Campbell Army Airfield/Sabre Army Heliport



APPENDIX F: SAMPLE COMPREHENSIVE PLAN LANGUAGE

Marion County, GA

COMMUNITY ASSESSMENT: POTENTIAL ISSUES AND OPPORTUNITIES 110-12-1-.03(2)(a)

The following is a list of issues and opportunities based on the State Planning Goals and Objectives that are pertinent to Marion County:

Economic Development Opportunities

Fort Benning, which shares the western boundary for a portion of Marion County, is of significant economic value to the County and the region. As a result of the Base Realignment and Closure process and other military re-organization efforts, Fort Benning will expand, resulting in approximately 30,000 additional military personnel and supporting civilian jobs relocating to the region. Especially during construction phases, Marion County and the Valley Partnership have the opportunity to work closely with Fort Benning and civilian contractors to locate offices and other construction services within Marion County.

Land Use Issues

Noise, dust and other impacts generated by training activities on Fort Benning will affect properties in Marion County within close proximity to the military installation. Concomitantly protecting the health safety and welfare of County as well as the military readiness mission requires that the development of incompatible land uses be prevented. The County will incorporate the Fort Benning Areas of Concerns as established in the Fort Benning Joint Land Use Study into the Community Agenda of the Comprehensive Plan, the zoning ordinance, the subdivision ordinance, and all capital improvement plans.

In addition, the County will evaluate all development proposals for property located within the Fort Benning Areas of Concerns to ensure compatibility and to protect the military installation from encroachment of incompatible land uses.

Intergovernmental Issues

Communication between the County and Fort Benning needs to be strengthened to offer residents of the County optimal opportunities to understand potential noise and prescribed burning events on the military installation. The County will post all communications from Fort Benning prominently in the County main offices and on the County website.

Coordination and consultation between the County and Fort Benning needs to occur on all rezoning and subdivision activities within the Fort Benning Areas of Concern, as described in the Fort Benning Joint Land Use Study. The County will request Fort Benning to review and make recommendations on all rezoning and subdivisions for properties within the Areas of Concern. In addition, the County will consult with military command for any future land use changes within the Areas of Concern for potential negative impacts on the military installation.

COMMUNITY ASSESSMENT: ANALYSIS OF EXISTING DEVELOPMENT PATTERNS, AREAS REQUIRING SPECIAL ATTENTION 110-12-1-.03(2)(b)(ii)

This component consists of an evaluation of existing land use patterns and trends for the purpose of identifying areas requiring special attention.

Areas with other unique pressures



Fort Benning military reservation abuts the County's western boundary. Noise, dust and other impacts generated by training activities on Fort Benning will be experienced on properties nearest to the military installation. Marion County participated in the Fort Benning Joint Land Use Study to address encroachment and identify Areas of Concern, land which will feel the greatest impact from the expanded military activities. The northwestern and western portions of the County are located within several Areas of Concern including the Primary Protection, Secondary Protection, Influence Area, Conservation Area, and Benning Land Use Planning Zone (LUPZ). Furthermore, these are the areas that have historically seen the most development and subdivision of property, aggravating the encroachment of incompatible land uses.

The Fort Benning Joint Land Use Study recommended various encroachment reduction and mitigation tools such as the adoption of land use guidelines, a military planning zoning overlay district, consultation with Fort Benning on development activities for properties within the Areas of Concern, and mandatory real estate disclosures to potential land buyers and renters. As part of the Comprehensive Plan, Marion County will review and adopt those recommendations that are most appropriate for the County.

COMMUNITY ASSESSMENT: ANALYSIS OF EXISTING DEVELOPMENT PATTERNS, RECOMMENDED CHARACTER AREAS 110-12-1-.03(2)(b)(iii)

A Character Area is a specific geographic area within the community that, among other options, requires special attention due to unique development issues. The County may wish to update their Character Area Map with the Areas of Concern, as mapped in the Fort Benning Joint Land Use Study.

COMMUNITY ASSESSMENT: ANALYSIS OF CONSISTENCY WITH QUALITY COMMUNITY OBJECTIVES 110-12-1-.03(2)(c)

The following text describing the Quality Community Objectives is a statement of the development patterns and options that will help preserve unique cultural natural and historic resources while looking simultaneously to maximize future development potential. This assessment is intended to serve as a tool to evaluate progress towards sustaining a livable community, much like a more detailed and conventional demographic analysis or land use map.

Regional Identity

Fort Benning is a major economic engine for the surrounding region including Marion County. The operations at Fort Benning generate substantial revenues to the local economy through salary payments to military and civilian employees, construction contractor payments, operating costs and non-construction contracts. During Fiscal Year (FY) 2005 (Oct. '04 - Sept. '05) the installation circulated over \$2.2 billion through the local economy. Though the installation is self-sustaining, personnel and their dependents make considerable use of the retail and service facilities in the surrounding communities. Purchases in the area by the more than 32,000 military personnel assigned to Fort Benning and their family members contribute significantly to local retail and service segments. During FY 2005 direct payroll disbursed to active duty military personnel exceeded \$798,925,000. Contract and civilian employees on the installation brought in over \$255,289,000 in gross pay. By FY 2012, when BRAC is fully implemented, direct payroll to military personnel is expected to reach \$1.3 billion annually and contract and civilian payroll will reach a yearly total of \$500 million.

Appropriate Businesses

The existing industries in Marion County do not offer the community much in terms of higher-skilled employment opportunities. The community has joined forces with a consortium of counties with the intended purpose of increasing economic development activity around Columbus-Muscogee County and Fort Benning, called the Valley Partnership. County representatives will continue to work with the



Valley Partnership to encourage the relocation of construction jobs and other military related employment centers into Marion County.

Environmental Protection

In addition to the efforts made by the county in the area of stormwater and watershed protection ordinances, Marion County also recognizes the Army Compatible Use Buffer (ACUB) program as a tool to protect the concentration of plant and animal species of special concern as mapped and documented in the *Areas Requiring Special Attention* section of this plan on page 10. The County will continue to support the Nature Conservancy in its implementation of the ACUB as necessary.

COMMUNITY AGENDA: COMMUNITY VISION, DEFINING NARRATIVE 110-12-1-.05(2)(a)(iii)

Within the Benning Area of Concern Character Area, only low intensity uses shall be encouraged. Open spaces, environmentally protected lands, and timber uses dominate the area. Low density residential, typically at one dwelling unit per five acres or greater, is the typical residential development pattern that characterizes this area. The purpose of establishing this character area is to discourage encroachment to Fort Benning and threatening the military mission while simultaneously protecting the health safety and welfare of Marion County residents. The following narrative illustrates the land uses, intensities and patterns of development that are encouraged in the Benning Areas of Concern Character Area as shown on the Marion County Future Land Use and Character Area Map.

Specific Land Uses allowed within the Fort Benning Character Area

Primary Protection Area

- Utilities and roads
- Mining
- Manufacturing and Warehouse uses
- Wholesale trades
- Vehicle repair services and heavy commercial uses
- Forestry and Timber
- Agriculture, but not livestock
- Cemeteries

Secondary Protection Area

- Utilities and roads
- Mining
- Manufacturing and Warehouse uses
- Wholesale trades
- Vehicle repair services and heavy commercial uses
- General retail
- General services, but not hospitals or clinics
- General government uses, but not schools
- Outdoor sporting fields
- Forestry and Timber
- Agriculture
- Cemeteries
- Low density residential at densities of no more than 1 dwelling unit per 5 acres



FORT CAMPBELL

Joint Land Use Study Update

Influence Area and Benning Land Use Planning Zone (LUPZ)

- All land uses except noise-sensitive uses such as schools, churches and hospitals. These uses should be evaluated on a case-by-case basis
- Low and medium density residential, but multi-family uses are not recommended



APPENDIX G: MODEL LIGHTING ORDINANCE/TECHNICAL GUIDELINES

Sample Lighting Ordinance - Tier 2 (Basic)

"Chapter xx OUTDOOR LIGHTING

xx.1. Title.

This chapter is entitled Outdoor Lighting Code of the (governing unit).

xx.2 Purpose.

The purpose of this Code is to provide regulations for outdoor lighting that will:

1. Minimize the impact of lighting on night aircraft operations;
2. Permit reasonable uses of outdoor lighting for nighttime safety, utility, security, productivity, enjoyment and commerce; and
3. Minimize discomfort and disability glare

xx.3 Applicability

1. This article is applicable to:

- a. Installation of new lighting systems,
- b. Modifications of existing lighting systems;
- c. Replacement of lighting fixtures, or
- d. Installation or replacement of any other lighting equipment, whether attached to structures, poles, the earth, or any other location, including lighting systems installed on private or public property by any third party such as an electric utility.

2. Exemption. The following lighting systems are EXEMPT from these requirements.

- a. Interior lighting.
- b. Internally illuminated signs.
- c. Externally illuminated signs.
- d. Temporary lighting for theatrical, television, and performance areas.
- e. Lighting in swimming pools and other water features governed by Article 680 of the National Electrical Code.
- f. Code required exit signs.
- g. Lighting specifically for stairs and ramps.
- h. Temporary and seasonal lighting provided that individual lamps are 10 watts or less.
- i. Lighting required and regulated by the Federal Aviation Administration, U.S. Coast Guard, or other federal or state agency.
- j. Single-family and two-family dwelling uses are encouraged but not required to comply with this ordinance, with the exception that all exterior pole lighting shall use full-cutoff lighting fixtures.
- k. Agricultural uses outside of the Night Vision Device Influence Area are encouraged but not required to comply with this ordinance



xx.4 Definitions.

For the purposes of this Code certain terms and words are defined as follows: the words "used for" include "designed for" and vice-versa; words used in the present tense include the future, the singular tense includes the plural and vice-versa; the word "shall" is always mandatory; the word "may" is discretionary; the masculine gender includes the feminine gender, except as otherwise provided. If a term is not defined herein, but is defined by the IESNA, the IESNA definition shall be utilized, unless the context of the word indicates otherwise. The following terms shall mean:

Artificial Sky Glow. The brightening of the night sky attributable to man made sources of light.

Authority. The person(s) holding the position of (designees).

Canopy. A roof-like covering over an area, in or under which a lighting fixture is mounted.

Common Residential Areas.

- Areas shared in common by residents of two or more dwelling units, i.e. common open space, play area, trash receptacle area, "common property" under a subdivision or partition declaration, etc.
- Two or more open parking spaces, either abutting or within 10 feet of each other and not separated by a wall or other physical barrier between the two parking spaces, designated or set aside for use by the two or more dwelling units, regardless whether the parking space is assigned for exclusive use of each dwelling unit or non-exclusively used by two or more dwelling units, and are either commonly owned or were developed for the purpose of serving the parking needs of "multiple dwellings" or multiple attached single-family dwellings, as defined in the Community Development Code.

Code or Lighting Code. The provisions of this Chapter xx.

Duplex. A building on a lot designed to contain two dwelling units and used for residential purposes.

Dwelling, Multiple - A building on one or more lots designed to contain three or more dwelling units that share common walls or floor/ceilings with one or more units. The land underneath the structure is not divided into separate lots. Multiple dwelling includes structures commonly called garden apartments, apartments and condominiums.

Dwelling, Single-Family - A detached dwelling unit designed and used for that purpose or an attached dwelling unit, located on its own lot, that shares one or more common or abutting walls with one or more dwelling units. The common or abutting wall shall consist of a structural wall which shared for at least 25 percent of the length of the side of the dwelling. An attached house does not share common floor/ceilings with other dwelling units. An attached house is also called a rowhouse, townhouse, or a common-wall house.

Façade. The exterior wall or elevation of a building.

Glare. Light that causes visual discomfort or disability, and the wattage and/or light distribution is excessive for the purposes for which the illumination is necessary.

Intersection. A place where two or more public or private rights-of-way (serving vehicular and/or pedestrian traffic) cross. For purposes of this Code, an "intersection" requires the presence of a street name sign and traffic control sign.

Landscape Lighting. Luminaires attached to structures, mounted on poles or otherwise, or at grade (luminaire not to exceed 3 feet above grade) and used for solely for landscape rather than area lighting.

LED means Light Emitting Diodes.

Light Source: The actual bulb or lamp that emits the light.

Lighting System. One or more luminaires, together with associated wires, conduits, poles, etc that constitute the illumination system on the parcel.

Mounting Height. The vertical distance between the lowest part of the luminaire and the ground surface directly below the luminaire.

Non-residential Use: Commercial, Industrial, or any other non-residential use defined in the (name applicable document).

Obtrusive Light. Glare and light trespass.

Ornamental or Accent Lighting. Outdoor lighting that is installed mainly or entirely for its decorative effect or to accent an object or a feature, rather than as an aid to visibility.

Shielding.

- Directional. A luminaire designed to be aimed or pointed.
- Fully Shielded. A luminaire emitting no more than 0.5 percent of its luminous flux above the horizontal plane, including any luminaire rated "full cut off" according to IESNA RP-8-01.
- Partly Shielded. A luminaire emitting no more than 10 percent of its total luminous flux above the horizontal plane, including any luminaire rated "semi-cutoff" according to IESNA RP-8-01.
- Shielded. A luminaire emitting no more than 2 percent of its total luminous flux above the horizontal plane, including any luminaire rated "cutoff" according to IESNA RP-8-01.
- Unshielded. A luminaire that may emit its flux in any direction.

Temporary Lighting. Lighting installed with temporary wiring and operated for less than 60 days in any calendar year.

xx.5. Lighting Systems Standards for Approval.

1. Non-residential Uses and Common Residential Areas shall meet all of the following requirements.
 - a. The light source of outdoor lighting fixtures shall be fully shielded and downward facing so as not to allow any light above the horizontal, as measured at the luminaire.
 - b. Outdoor lighting fixtures shall be placed so as to not cause excessive glare or light trespass.
 - c. On-site parking areas shall be constructed of asphalt, dyed concrete or other non-reflective paving surfaces.
 - d. All light fixtures that are required to be shielded shall be installed and maintained in such a manner that the shielding is effective
 - e. Gas station canopy lighting shall be designed to conceal the illumination source and the lighting fixture shall not extend below the canopy skirt.
 - f. Exterior sign lights shall be shielded and oriented downward with respect to the sign.



2. Special Permit for Specific Lighting Fixtures and Systems and When Exceeding Lighting Requirements.
 - a. Upon special permit issued by the (Authority), lighting systems not complying with the technical requirements of this ordinance may be installed, maintained, and replaced.
 - b. The (Authority) shall review each such application. A permit may be granted if, upon review, the (Authority) finds that the proposed lighting will not create excessive glare, sky glow, or light trespass beyond that which can be reasonably expected by application of best lighting practices, available technology. The (Authority) may impose conditions of approval to mitigate any negative impacts resulting to the abutting parcel, based on best lighting practices and available lighting technology. The (Authority) may charge a review fee and may, at the (Authority)'s option, employ the services of a qualified professional civil or electrical engineer to review such submittals, and the cost thereof shall be an additional fee charged to the applicant.

xx.6 Non-Conforming Uses.

Outdoor lighting fixtures lawfully existing prior to the adoption of this Ordinance that do not conform to the provisions of this Ordinance shall be deemed to be a lawful nonconforming use and may remain.

1. New or Changed Uses, New Structures, Major Additions or Modifications.

- a. New Uses or Structures, or Change of Use. Whenever there is a new use or upon a property or the use on the property is changed after [effective date of this Ordinance], all outdoor lighting on the property shall be brought into compliance with this Code before the new or changed use commences.
- b. Major Additions. If a major addition occurs on a property, the entire property shall comply with the requirements of this Code. For purposes of this section, the following are considered to be major additions:
 - c. Additions of 25 percent or more in terms of additional dwelling units, gross floor area, seating capacity, or parking spaces, either with a single addition or with cumulative additions after [effective date of this Ordinance].
 - d. Single or cumulative additions, modification or replacement of 25 percent or more to installed outdoor lighting luminaires existing as of [effective date of this Ordinance].

2. Minor Modifications, Additions, or New Lighting Fixtures for Non-residential and Multiple Dwellings

- a. For non-residential and multiple dwellings, all additions, modifications, or replacement of less than 25% of outdoor lighting fixtures existing as of [effective date of this Ordinance] shall require the submission of a complete inventory and site plan detailing all existing and any proposed new outdoor lighting.
- b. Any new lighting on the site shall meet the requirements of this Code.



3. Resumption of Use after Abandonment.

If a property or use with non-conforming lighting is abandoned for a period of six months or more, then all outdoor lighting shall be brought into compliance with this Code before any further use of the property occurs.

4. Repair of Existing Lighting.

When existing lighting equipment requires any repairs other than relamping, it shall be modified so as to comply with the shielding requirements of this Ordinance.

xx.7 Submittal Requirements

The owner or owners of a tract of land within the lighting review area shall submit to the Authority Planning Office a site plan for the development and use of such tract meeting the requirements set forth in Authority Zoning Ordinance. Subdivisions shall comply with the Authority Subdivision Guidelines.

1. A lighting plan shall be included as part of the required site plan submittal or subdivision construction drawings which shall contain but not be limited to the following:

- a. The location of the site where the outdoor light fixtures will be installed;
- b. Plans indicating the location on the premises of each outdoor light fixture, both proposed and any already existing on the site, and the types of outdoor light fixtures;
- c. A description of the outdoor light fixtures including but not limited to manufacturer's catalog cuts and drawings;
- d. If any subdivision proposes to have installed street or other common or public area outdoor lighting, a lighting plan shall also be submitted for all such lighting.
- e. For any property that contains restrictive avigational easements owned by the United States of America, the owner or owners shall also submit a copy of the lighting plan to Fort Campbell, or its agent, and obtain their written approval before any building permits shall be issued by the Authority.



Sample Interim National Model Lighting Ordinance - Tier 1 (Advanced)

LIGHTING ORDINANCE

This ordinance is intended for use by communities anticipating the National Model Lighting Ordinance (MLO) now being developed jointly by the Illuminating Engineering Society and the International Dark Sky Association. Adaption of the MLO is recommended when available.

“Chapter xx OUTDOOR LIGHTING

xx.1. Title.

This chapter is entitled Outdoor Lighting Code of the (governing unit).

xx.2 Purpose.

The purpose of this Code is to provide regulations for outdoor lighting that will:

4. Minimize the impact of lighting on night aircraft operations;
5. Permit reasonable uses of outdoor lighting for nighttime safety, utility, security, productivity, enjoyment and commerce; and
6. Minimize discomfort and disability glare

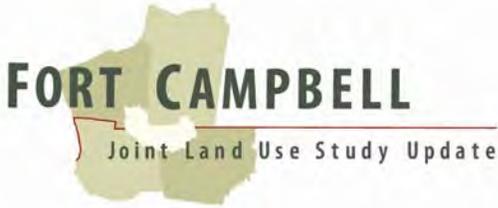
xx.3 Applicability

3. This article is applicable to:

- a. Installation of new lighting systems,
- b. Modifications of existing lighting systems;
- c. Replacement of lighting fixtures, or
- d. Installation or replacement of any other lighting equipment, whether attached to structures, poles, the earth, or any other location, including lighting systems installed on private or public property by any third party such as an electric utility.

4. Exemption. The following luminaires and lighting systems are EXEMPT from these requirements.

- a. Interior lighting.
- b. Internally illuminated signs.
- c. Externally illuminated signs.
- d. Temporary lighting for theatrical, television, and performance areas.
- e. Lighting in swimming pools and other water features governed by Article 680 of the National Electrical Code.
- f. Code required exit signs.
- g. Lighting specifically for stairs and ramps.
- h. Temporary and seasonal lighting provided that individual lamps are 10 watts or less.
- i. Lighting required and regulated by the Federal Aviation Administration, U.S. Coast Guard, or other federal or state agency.
- j. Single-family and two-family dwelling uses are encouraged but not required to comply with this ordinance, with the exception that all exterior pole lighting shall use full-cutoff lighting fixtures.



- k. Agricultural uses outside of the Night Vision Device Influence Area are encouraged but not required to comply with this ordinance

Cross-reference: See the Sign Code for illumination requirements relating to permanent signs.

xx.4 Definitions.

For the purposes of this Code certain terms and words are defined as follows: the words "used for" include "designed for" and vice-versa; words used in the present tense include the future, the singular tense includes the plural and vice-versa; the word "shall" is always mandatory; the word "may" is discretionary; the masculine gender includes the feminine gender, except as otherwise provided. If a term is not defined herein, but is defined by the IESNA, the IESNA definition shall be utilized, unless the context of the word indicates otherwise. The following terms shall mean:

Artificial Sky Glow. The brightening of the night sky attributable to man made sources of light.

Authority. The person(s) holding the position of (designees).

BUG. A luminaire classification system that is used in the Prescriptive method for evaluating optical distribution of outdoor luminaires that denotes levels of backlight (B), uplight (U) and glare (G).

Candela. The unit of luminous intensity of a lighting source emitted into a given direction.

Canopy. A roof-like covering over an area, in or under which a lighting fixture is mounted.

Canopy (structure). A canopy under which a business provides some service to a customer, such as food service, a bank transaction, or the like.

Common Residential Areas.

- Areas shared in common by residents of two or more dwelling units, i.e. common open space, play area, trash receptacle area, "common property" under a subdivision or partition declaration, etc.
- Two or more open parking spaces, either abutting or within 10 feet of each other and not separated by a wall or other physical barrier between the two parking spaces, designated or set aside for use by the two or more dwelling units, regardless whether the parking space is assigned for exclusive use of each dwelling unit or non-exclusively used by two or more dwelling units, and are either commonly owned or were developed for the purpose of serving the parking needs of "multiple dwellings" or multiple attached single-family dwellings, as defined in the Community Development Code.

Code or Lighting Code. The provisions of this Chapter xx.

Drip Line Area. The area on the ground enclosed by vertical planes extending downward from the outer solid edge of a structure's canopy.

Duplex. A building on a lot designed to contain two dwelling units and used for residential purposes.

Dwelling, Multiple - A building on one or more lots designed to contain three or more dwelling units that share common walls or floor/ceilings with one or more units. The land underneath the structure is not divided into separate lots. Multiple dwelling includes structures commonly called garden apartments, apartments and condominiums.

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Dwelling, Single-Family - A detached dwelling unit designed and used for that purpose or an attached dwelling unit, located on its own lot, that shares one or more common or abutting walls with one or more dwelling units. The common or abutting wall shall consist of a structural wall which shared for at least 25 percent of the length of the side of the dwelling. An attached house does not share common floor/ceilings with other dwelling units. An attached house is also called a rowhouse, townhouse, or a common-wall house.

Façade. The exterior wall or elevation of a building.

Glare. Light that causes visual discomfort or disability, and the wattage and/or light distribution is excessive for the purposes for which the illumination is necessary..

Hardscape Permanent improvements to a site, including but not limited to, parking lots, driveways, streets, plazas, sidewalks, walkways, bikeways, abutments, stairs, ramps, and architectural features, such as fountains, sculptures, and the like.

House Side Shield. For fully shielded luminaires only, an internal shield designed and installed by the luminaire manufacturer that significantly attenuates candlepower in the back photometric hemisphere at all angles greater than 30 degrees relative to nadir.

IESNA. The Illuminating Engineering Society of North America (see www.iesna.com).

Intersection. A place where two or more public or private rights-of-way (serving vehicular and/or pedestrian traffic) cross. For purposes of this Code, an "intersection" requires the presence of a street name sign and traffic control sign.

Landscape Lighting. Luminaires attached to structures, mounted on poles or otherwise, or at grade (luminaire not to exceed 3 feet above grade) and used for solely for landscape rather than area lighting.

LED means Light Emitting Diodes.

Light Source: The actual bulb or lamp that emits the light.

Light Trespass. Spill light that because of quantitative, directional, or spectral content causes light level at the property line that is greater than as provided on Table 4 of this Code.

Lighting System. One or more luminaires, together with associated wires, conduits, poles, etc that constitute the illumination system on the parcel.

Lighting Zone. An area established by the (governing body), pursuant to Code xx.5. A description and boundaries of these five lighting zones is given in Appendix xx

Lumen. The unit of luminous flux: a measure of the amount of light emitted by a lamp.

Luminaire (or "Light Fixture"). A complete lighting unit consisting of one or more electric lamps, the lamp holder, reflector, lens, ballast, and/or other components and accessories.

Luminance. The amount of light emitted in a given direction from a surface by the light source or by reflection from a surface. The unit is candela per square meter.

Luminous Flux. A measure of the total light output from a source, the unit being the lumen.

Mounting Height. The vertical distance between the lowest part of the luminaire and the ground surface directly below the luminaire.

Nadir. The downward direction; exactly vertical, directly below a luminaire.

NITS. A measurement of the intensity for LED signs as expressed in candelas per square meter,



Non-residential Use: Commercial, Industrial, or any other non-residential use defined in the (name applicable document).

Obtrusive Light. Glare and light trespass.

Ornamental or Accent Lighting. Outdoor lighting that is installed mainly or entirely for its decorative effect or to accent an object or a feature, rather than as an aid to visibility.

Shielding.

- Directional. A luminaire designed to be aimed or pointed.
- Fully Shielded. A luminaire emitting no more than 0.5 percent of its luminous flux above the horizontal plane, including any luminaire rated "full cut off" according to IESNA RP-8-01.
- Partly Shielded. A luminaire emitting no more than 10 percent of its total luminous flux above the horizontal plane, including any luminaire rated "semi-cutoff" according to IESNA RP-8-01.
- Shielded. A luminaire emitting no more than 2 percent of its total luminous flux above the horizontal plane, including any luminaire rated "cutoff" according to IESNA RP-8-01.
- Unshielded. A luminaire that may emit its flux in any direction.

Sports Lighting. Lighting installed specifically for lighting of athletic fields for play at levels exceeding 5 footcandles, average, including but not limited to lighting for baseball, softball, football, soccer, tennis, and golf .

Temporary Lighting. Lighting installed with temporary wiring and operated for less than 60 days in any calendar year.

xx.5. Lighting Zones.

1. The designated Lighting Zone for a parcel or project shall determine the limitations for lighting systems and fixtures as specified in this ordinance.

2. Establishing Lighting Zones. The (Authority) shall recommend to the (governing body), and the (governing body) shall establish by resolution Lighting Zones (LZ) within the boundaries of the Night Vision Device Influence Area.

3. The Lighting Zones shall be:

- a. *LZ 2.* Low-density suburban and urban neighborhoods and suburban commercial districts. This zone is intended to be the default condition for urban and suburban areas.
- b. *LZ 3.* Medium to high-density urban neighborhoods and districts, shopping and commercial districts, industrial parks and districts. This zone is intended to apply only to Central Business District(s) and areas having unique character such as auto malls.

4. Modification of Lighting Zones.

Upon recommendation of the (who) the (governing body) may modify the designated Lighting Zones of one or more parcels if the (governing body) finds that the original Lighting Zone was in error or a change in circumstances has occurred since the existing designation was established .



5. The (Authority) shall maintain the current Lighting Zone map and provide public access to the map upon request.

xx.6 Lighting Systems Standards for Approval.

3. Non-residential Uses and Common Residential Areas.

- a. All outdoor lighting shall meet all of the following requirements according to Lighting Zone.
- b. The maximum luminaire lamp wattage and shielding shall comply with Table 1.
- c. The maximum pole or mounting height shall be consistent with Table 2.
- d. All luminaires for non-residential Uses shall be rated and installed according to Table 3, (Maximum Allowable Backlight, Uplight and Glare (BUG) Ratings).
- e. On-site parking areas shall be constructed of asphalt, dyed concrete or other non-reflective paving surfaces.
- g. Gas station canopy lighting shall be designed to conceal the illumination source and the lighting fixture shall not extend below the canopy skirt.
- h. Lighting at publicly owned and privately owned outdoor sports facilities shall be shielded to reduce glare, safety hazards, light trespass and light pollution, and shall provide levels of illuminance consistent with nationally recognized standards such as the Illuminating Engineering Society of North America (IESNA).
- i. Exterior sign lights shall be shielded and downward facing. No more than 6 exterior sign lights shall be used as part of the lighting application.

EXCEPTION: upward-facing lighting exclusively for signs and not exceeding 50 rated lamp watts per luminaire. Light sources shall be shielded by orientation with respect to the sign, luminaire construction, and/or louvers or other means of preventing glare.



Additional Provision: intended to minimize light trespass on adjacent properties

Each luminaire shall be set back from all property lines shall be at least 3 times the mounting height of the luminaire.

EXCEPTION 1: If the subject property is abutting a parcel which is zoned "Commercial" or "Industrial" by the Community Development Code, no setback from the common lot lines of the commercial or industrial property is required.

EXCEPTION 2: If the subject property is abutting a parcel which is zoned other than "Commercial" or "Industrial," the luminaire shall be setback three times the mounting height of the luminaire, measured from the abutting parcel's side yard setback. (Any variance, adjustment, of exception to the abutting parcel's side yard setback shall not be considered in the distance calculation.)

EXCEPTION 3: If the luminaire is used for the purpose of street, parking lot or public utility easement illumination purposes and is located less than 3 mounting heights from the property line, the luminaire shall employ a house side shield (opposite the direction of any public right-of-way nearest the luminaire)

EXCEPTION 4: If the subject property includes an exterior column, wall or abutment within 25 feet of the property line, a luminaire partly shielded or better and not exceeding 60 lamp watts may be mounted onto the building façade or under or within an overhang or canopy attached thereto.

4. Special Permit for Specific Lighting Fixtures and Systems, Portable Installations and When Exceeding Lighting Requirements.

Upon special permit issued by the (Authority), lighting systems not complying with the technical requirements of this ordinance may be installed, maintained, and replaced for lighting that exceeds the maximums permitted by this Code, e.g., Aerial Lasers, Searchlights, Sports lighting systems (including but not limited to, sport fields and stadiums, such as baseball field and football field lighting, tennis court lighting, and swimming pool area lighting), other very intense lighting defined as having a light source exceeding 200,000 lumens or an intensity in any direction of more than 2,000,000 candelas, construction lighting for public infrastructure and similar projects, emergency construction project that require construction at night, bridges, building façade lighting to light portions of buildings over two stories high, and public monuments.

To obtain such a permit, applicants shall demonstrate that the proposed lighting installation:

- a. Has received every reasonable effort to mitigate obtrusive light and artificial sky glow, supported by a signed statement from a registered civil or electrical engineer describing the mitigation measures. Such statement shall be accompanied by calculations indicating the light trespass levels (horizontal and vertical at ground level) at the property line.

- b. The (Authority) shall review each such application. A permit may be granted if, upon review, the (Authority) finds that the proposed lighting will not create excessive glare, sky glow, or light trespass beyond that which can be reasonably expected by application of best lighting practices, available technology. The (Authority) may impose conditions of approval to mitigate any negative impacts resulting to the abutting parcel, based on best lighting practices and available lighting technology. The (Authority) may charge a review fee and may, at the (Authority)'s option, employ the services of a qualified professional civil or electrical engineer to review such submittals, and the cost thereof shall be an additional fee charged to the applicant.
- c. A portable sign may be permitted for a period not to exceed three (3) weeks total in any six (6) month period. The user shall notify the (Authority) of how long the portable sign is to be utilized and when it will be removed.

TABLE 1

MAXIMUM WATTAGE AND REQUIRED SHIELDING

Lighting Zone	Fully Shielded	Shielded	Partly Shielded	Unshielded
LZ 2	100	35	39	Low voltage landscape lighting 50 watts or less
LZ 3	250	100	70	Landscape and façade lighting 100 watts or less; ornamental lighting on private streets of 39 watts and less

TABLE 2

MAXIMUM LIGHTING MOUNTING HEIGHT IN FEET

Lighting Zone	Lighting for Private Roads, Driveways, Parking, Bus Stops and other Transit Facilities	Lighting for Walkways, Bikeways, Plazas and other Pedestrian Areas	All Other Lighting
LZ 2	40	18	8
LZ 3	40	18	16

Lighting mounted onto buildings or other structures shall not exceed a mounting height greater than 4 feet higher than the tallest part of the building or structure at the place where the lighting is installed, nor higher than 33.33 percent of the horizontal distance of the light from the nearest property line, whichever is less.

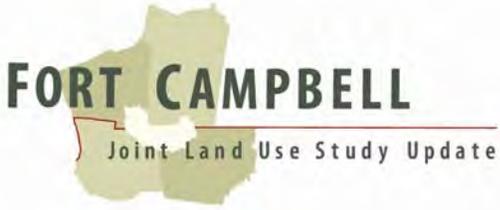
**TABLE 3
MAXIMUM ALLOWABLE BACKLIGHT, UPLIGHT AND GLARE (BUG) RATINGS**

	LZ 2	LZ 3
Allowed Backlight Rating		
>2 mounting heights from property line	B2	B3
1 to 2 mounting heights from property line and properly oriented*	B2	B3
0.5 to 1 mounting height to property line and properly oriented*	B1	B2
<0.5 mounting height to property line adjacent to a street and properly oriented*	B1	B2
<0.5 mounting height to property line and properly oriented*	B0	B1
Allowed Uplight Rating	U2	U3
Allowed Glare Rating	G2	G3

A luminaire may be used if it is rated as follows according to the Lighting Zone of the site. If the luminaire is installed in other than the intended manner, the rating shall be determined to account for the actual photometric geometry. Luminaires equipped with adjustable mounting devices permitting alteration of luminaire aiming in the field shall not be permitted. LED Signs

5. LED signs are allowed with the following standards:
 - a. The maximum brightness of electronic signs shall not exceed 5,000 nits (candelas per square meter) during daylight hours, or of 500 nits (candelas per square meter) between dusk to dawn. The sign must have an automatic dimmer control which produces a distinct illumination change from a higher allowed illumination level to a lower allowed level for the time period between one half hour before sunset and one half hour after sunrise.
 - b. Any image or message or portion thereof displayed on the sign shall have a minimum duration of fifteen seconds and shall be static display.
 - c. LED signs are prohibited within the Accident Potential Zones and approach/departure zones of Campbell Army Airfield and Sabre Army Heliport.

6. Street Lighting.
 - a. Luminaires shall be fully shielded.
 - b. Luminaires shall employ internal house side shields unless located in plan at least 3 mounting heights from the any building, structure, or site upon which a building or structure may legally be located within 3 mounting heights of any luminaire.



Additional Provisions: intended to regulate the luminescence of street lighting applications

- c. Street lighting installations shall achieve criterion values listed in Table 4.

Exception: Federal or State requirements that require a higher illumination value than required by this Code.
- d. Unless otherwise approved by the (Authority) street lighting systems shall be designed using the IESNA "Classical" horizontal footcandle method per IESNA/ANSI RP-8-01, and as described below.
- e. The applicant shall submit to (Authority) for approval point-by-point calculations assuming 65 percent light loss factor for metal halide and LED and 80 percent for high pressure sodium, tungsten, fluorescent and induction lamp sources. Submitted street lighting plans shall indicate luminaire types and locations and provide isocandle plots including statistical summaries of roadway lighting.



TABLE 4

STANDARD CRITERIA FOR STREET AND ROADWAY LIGHTING
(footcandles - fc)

	LZ 2	LZ 3
Local streets	Intersections only*	
Avg: Light Level		0.4 fc
Avg: Min Uniformity	0.3 fc	6:1
Max: Min Uniformity	6:1 40:1	40:1
Neighborhood Collectors	Intersections only*	
Avg: Light Level		0.6 fc
Avg: Min Uniformity	0.4 fc	4:1
Max: Min Uniformity	4:1 20:1	20:1
Major Collector / Minor Arterial		
Avg: Light Level	0.4 fc	0.6 fc
Avg: Min Uniformity	4:1	4:1
Max: Min Uniformity	20:1	20:1
Major Arterials		
Avg: Light Level	1.0 fc	1.5 fc
Avg: Min Uniformity	4:1	3:1
Max: Min Uniformity	20:1	10:1

* Luminaires only within 150 feet of the centerpoint of an intersection. Intersections may include significant driveways or site roads as permitted by the Authority.

xx.7 Non-Conforming Uses.

Outdoor lighting fixtures lawfully existing prior to the adoption of this Ordinance that do not conform to the provisions of this Ordinance shall be deemed to be a lawful nonconforming use and may remain.

5. New or Changed Uses, New Structures, Major Additions or Modifications.

- a. New Uses or Structures, or Change of Use. Whenever there is a new use or upon a property or the use on the property is changed after [effective date of this Ordinance], all outdoor



lighting on the property shall be brought into compliance with this Code before the new or changed use commences.

- b. Major Additions. If a major addition occurs on a property, the entire property shall comply with the requirements of this Code. For purposes of this section, the following are considered to be major additions:
- c. Additions of 25 percent or more in terms of additional dwelling units, gross floor area, seating capacity, or parking spaces, either with a single addition or with cumulative additions after [effective date of this Ordinance].
- d. Single or cumulative additions, modification or replacement of 25 percent or more to installed outdoor lighting luminaires existing as of [effective date of this Ordinance].

6. Minor Modifications, Additions, or New Lighting Fixtures for Non-residential and Multiple Dwellings

- a. For non-residential and multiple dwellings, all additions, modifications, or replacement of less than 25% of outdoor lighting fixtures existing as of [effective date of this Ordinance] shall require the submission of a complete inventory and site plan detailing all existing and any proposed new outdoor lighting.
- b. Any new lighting on the site shall meet the requirements of this Code.

7. Resumption of Use after Abandonment.

If a property or use with non-conforming lighting is abandoned for a period of six months or more, then all outdoor lighting shall be brought into compliance with this Code before any further use of the property occurs.

8. Repair of Existing Lighting.

When existing lighting equipment requires any repairs other than relamping, it shall be modified so as to comply with the shielding requirements of this Ordinance.

xx.8 Submittal Requirements

The owner or owners of a tract of land within the lighting review area shall submit to the Authority Planning Office a site plan for the development and use of such tract meeting the requirements set forth in Authority Zoning Ordinance. Subdivisions shall comply with the Authority Subdivision Guidelines.

2. A lighting plan shall be included as part of the required site plan submittal or subdivision construction drawings which shall contain but not be limited to the following:

- a. The location of the site where the outdoor light fixtures will be installed;
- b. Plans indicating the location on the premises of each outdoor light fixture, both proposed and any already existing on the site, and the types of outdoor light fixtures;



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- c. A description of the outdoor light fixtures including but not limited to manufacturer's catalog cuts and drawings;
- d. If any subdivision proposes to have installed street or other common or public area outdoor lighting, a lighting plan shall also be submitted for all such lighting.
- e. For any property that contains restrictive avigational easements owned by the United States of America, the owner or owners shall also submit a copy of the lighting plan to Fort Campbell, or its agent, and obtain their written approval before any building permits shall be issued by the Authority.



Sample Lighting Nuisance Ordinance

PUBLIC NUISANCES

LIGHTING STANDARDS.

Purpose. The purpose of this section is to protect the health, safety and welfare of the public by encouraging lighting practices and systems that will minimize glare, light trespass, and light pollution, while maintaining nighttime safety, utility, security and productivity, curtailing the degradation of the nighttime visual environment, and minimizing the impact of lighting on night aircraft operations.

Applicability.

New Uses, Buildings and Major Additions or Modifications. For all proposed new land uses, developments, buildings, and structures that require a building permit or other authorization from the County, all outdoor lighting fixtures shall meet the requirements of this Ordinance. All building additions or modifications of twenty (25) percent or more in terms of additional dwelling units, gross floor area, or parking spaces, either with a single addition or with cumulative additions subsequent to the effective date of this provision, shall be subject to the requirements of this Ordinance for the entire property, including previously installed and any new outdoor lighting.

Existing Uses. Existing uses shall be exempted from the provisions of this Ordinance. Existing uses and lighting which substantially deviate from the Purpose and Intent set forth above, and which are brought to the attention of the Town Board by an aggrieved party, may constitute a public nuisance under Sec. X-X, and subject to abatement or other relief.

Resumption of Use after Abandonment. If a property or use with non-conforming lighting is abandoned as defined below, then all outdoor lighting shall be reviewed and brought into compliance with this Ordinance before any use is resumed.

Roadways. Lighting for public roadways is exempt from the provisions of this Ordinance.

Definitions.

As used in this Ordinance unless the context clearly indicates otherwise, certain words and phrases shall mean the following:

(1) **Development project.** Any residential, commercial, industrial or mixed use subdivision plan of development plan which is submitted to the County for approval.

(2) **Diffuse.** To spread or scatter widely, or thinly.

(3) **Direct illumination.** Illumination resulting from light emitted directly from a lamp or luminaire, not light diffused through translucent signs or reflected from other surfaces such as the ground or building surfaces.

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(4) Fully Shielded Light Fixture. A lighting fixture constructed in such a manner that all light emitted by the fixture, 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 as determined by a photometric test or certified by the manufacturer. Any structural part of the light fixture providing this shielding must be permanently affixed.

(5) Glare. The sensation produced by a bright source within the visual field that is sufficiently brighter than the level to which the eyes have adapted to cause annoyance, discomfort, or loss in visual performance and visibility. The magnitude of glare depends on such factors as the size, position, brightness of the source, and on the brightness level to which the eyes have become adapted.

(6) Installed. The attachment, or assembly fixed in place, whether or not connected to a power source, of any outdoor light fixture.

(7) Light Pollution. Any adverse effect of manmade light.

(8) Light Trespass. Light from an outdoor luminaire falling on an adjacent property as observed at four feet above ground at the property line.

(9) Lumen per Acre Cap. The upper limit, or most light allowed. Lower lighting levels are encouraged.

(10) Luminaire. The complete lighting assembly, less the support assembly.

(11) Outdoor Light Fixture. An outdoor illuminating device, outdoor lighting or reflective surface, lamp or similar device, permanently installed or portable, used for illumination or advertisement. Such devices shall include, but are not limited to lights used for:

- Parking lot lighting;
- Buildings and structures;
- Recreational areas;
- Landscape lighting;
- Billboards and other signs (advertising or other);
- Product display area lighting;
- Illuminating building overhangs and open canopies.

(12) Outdoor Recreation Facility. An area designed for active recreation, whether publicly or privately owned, including, but not limited to, baseball diamonds, soccer and football fields, golf courses, tennis courts and swimming pools.

(13) Person. Any individual, tenant, lessee, owner, or any commercial entity including but not limited to firm, business, partnership, joint venture, corporation, or limited liability company.

(14) Sign, Externally Illuminated. A sign illuminated by light sources from outside the sign surface.

(15) Sign, Internally Illuminated. A sign illuminated by light sources enclosed entirely within the sign cabinet and not directly visible from outside the sign.



(16) Sign, LED. A sign that uses light-emitting diodes that emit light when an electrical current is applied in the forward direction of the device

(17) Sign, Neon. A sign including luminous gas-filled tubes formed into text, symbols or decorative elements and directly visible from the outside of the sign cabinet.

(18) Sky Glow. The brightening of the night sky that results from the scattering of artificial visible radiation by the constituents of the atmosphere.

(19) Temporary Lighting. Lighting which does not conform to the provisions of this Ordinance and which will not be used for more than one consecutive thirty day period within a calendar year, with one consecutive thirty-day extension. Temporary lighting is intended for uses which by their nature are of a limited duration; for example holiday lighting decorations, civic events, or construction projects.

(20) Translucent. Permitting light to pass through but diffusing it so that persons, objects, etc., on the opposite side are not clearly visible.

(21) Use, Abandonment of. The relinquishment of a property, or the cessation of a use or activity by the owner or tenant for a continuous period of twelve months, excluding temporary or short term interruptions for the purpose of remodeling, maintaining or rearranging a facility. A use shall be deemed abandoned when such use is suspended as evidenced by the cessation of activities or conditions which constitute the principal use of the property.

Shielding and Outdoor Lighting Standards.

The following lighting standards are hereby imposed:

(1) All nonexempt outdoor lighting fixtures shall be fully shielded.

(2) All nonexempt outdoor lighting fixtures shall be placed so as to not cause light trespass, or light glare.

(3) All nonexempt outdoor lighting fixtures shall be of a type and placed so as to not allow any light above the horizontal, as measured at the luminaire.

(4) All light fixtures that are required to be shielded shall be installed and maintained in such a manner that the shielding is effective.

(5) Residential uses shall not exceed 5500 lumens per acre. Commercial or business zoned uses shall not exceed 70,000 lumens per property.

(f) Outdoor Advertising Signs.

External illumination for signs shall conform to all provisions of this Ordinance. All upward directed lighting is prohibited.

Exemptions.

1. Single-family and two-family dwelling uses
2. Agricultural uses



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3. State and Federal Facilities
4. Emergency Lighting
5. Swimming Pool and Fountain Lighting
6. Flags, Lighted
7. Holiday lighting

Appeals.

Any person substantially aggrieved by any decision of the designated official made in administration of this Ordinance has the right and responsibilities of appeal to the County Board.

Law Governing Conflicts.

Where any provision of federal, state, county, township, or city statutes, codes, or laws conflict with any provision of this Ordinance, the more restrictive shall govern unless otherwise regulated by law.

Violation and Penalty.

It shall be a civil infraction for any person to violate any of the provisions of this Ordinance. Each and every day or night during which the violation continues shall constitute a separate offense. A fine shall be imposed of not less than fifty dollars nor more than seven hundred dollars for any individual or not less than 100 dollars nor more than ten thousand dollars for any corporation, association, or other legal entity for each offense. The imposition of a fine under this Ordinance shall not be suspended.

Severability.

If any of the provisions of this Ordinance or the application thereof are held invalid, such invalidity shall not affect other provisions or applications of this Ordinance which can be given effect, and to this end, the provisions of this Ordinance are declared to be severable.



Lighting Regulation Narrative

(Adopting Agency or Community Name)
Outdoor Lighting Ordinance

On xxx, the (adopting agency) passed into law a new, state of the art lighting ordinance. Its goals are to permit all necessary and reasonable uses of outdoor lighting, while reducing wasted energy and light pollution. A key consideration is preserving the nighttime visual environment for Night Vision Device training activity at Campbell Army Airfield and Sabre Army Heliport.

The law applies to all new outdoor lighting, including new lighting, replacement lighting and additions to new lighting. Single-family houses and two-family dwelling units are among the exempted uses. The ordinance only governs lighting applications within the established Night Vision Device Influence Area in proximity to Fort Campbell and its airfields.

Basic Principles

Light pollution is a broad term describing the undesirable side effects of outdoor lighting. The most negative effects of outdoor lighting include:

- *Artificial sky glow*, the illumination of clouds and airborne particles, causing the sky to glow and preventing astronomy and star gazing;
- *Light trespass*, the unwanted illumination caused by light from neighboring properties.
- *Glare*, when lighting causes discomfort or visual disability
- *Circadian Interruption*, when lighting causes unwanted changes in the circadian cycles of living organisms
- Other impacts to flora and fauna, particularly those causing changes in habitat or behavior

Most light pollution is the result of carelessly applied lighting. This Ordinance helps prevent most light pollution by limiting the wattage of lighting that can be used, by requiring most lighting to be shielded, and requiring lighting to be installed thoughtfully with respect to mounting height, setback, and in some critical cases, additional shielding. In addition, while the Ordinance does not absolutely prohibit incandescent lighting, preference is given for energy efficient lighting, and for most installations, the use of energy efficient sources is strongly urged.

Demonstrating Compliance with the Ordinance

Lighting for Homes Multi-family buildings with common areas such as parking garages or lots will be treated as commercial buildings for purposes of lighting standards.

Private Non-Residential Uses The Ordinance governs all new lighting as well as replacement lighting and expansions of existing lighting systems. The law is strict; even if a

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luminaire is broken, it must be replaced with a complying luminaire. For new installations including major additions and alterations, lighting plans including schedules and cutsheets must be supplied complete with calculations showing compliance. Lighting plans with fixture schedules and calculations must be submitted for approval, along with compliance documentation forms (*compliance documentation forms can be downloaded from the _____ website*).

Special Permit Applications Some lighting systems, such as sports lighting or searchlights, cannot comply with the Ordinance. A special permit will be required. Applicants may be required to submit detailed calculations and to pay for an independent engineering review.

Street Lighting Applications In addition to demonstrating compliance with the Ordinance's power and shielding requirements, plans for street lighting systems must be submitted using point-by-point calculations to demonstrate compliance with street lighting criteria contained in the Ordinance.

Multi-Family Residential Lighting Requirements

In general, lighting for homes must be:

- Limited to 40 watts per luminaire (light fixture) and designed so that the lamp (light bulb) can't be seen from a neighboring property. Examples of appropriate luminaires are posted on the (fill in) website. Also check the International Dark Sky Association website (www.darksky.org) for appropriate luminaires. Luminaires don't have to be fully shielded, but they must hide the lamp sufficiently to prevent glare and obtrusive light onto adjacent properties
- **Energy Star** rated, which generally means uses compact fluorescent lamp(s).
- Mounted at or lower than the eave line, or 12 feet above the ground, whichever is *lower*.



A fully shielded wall lantern

There are three *exceptions*.

- You can use PAR-lamp directional luminaires with halogen PAR lamps up to 100 watts. But they must be aimed away from neighboring properties. These fixtures are commonly used for residential security lighting.
- You can use fully shielded luminaires up to 100 watts, and they can be mounted up to 25' feet above grade as long as they are at least 3 times the mounting height away from the property line. These fixtures are generally used for dusk-to-dawn area lighting, especially for rural and agricultural sites.
- You can install low voltage landscape lighting, except in lighting zone 0 and 1A.



A fully shielded dusk to dawn luminaire

Non-Residential Lighting Requirements

Most community complaints about lighting involve commercial or industrial sites. Poorly designed and/or wasteful lighting causes off-site glare and detracts from the night time beauty of the community. For this reason, all new and replacement lighting from now on must meet the following rules:

Lighting Zones

For lighting, the Night Vision Device Influence Area is divided into two zones. A current map of the lighting zones is available from the (fill in) website. Zones are set by the (Authority).

Lighting Zone	Condition	Typical Parts of the (Area)
LZ2	Areas where man-made lighting is used in modest amounts for safety, security and traditional uses	Urban neighborhoods and most commercial districts
LZ3	Areas where man-made lighting is an important aspect of a district of night activity, or where security or safety are especially important	Central Business District

Mounting Height

The mounting height of luminaires is limited according to Table 1 below. If luminaires are mounted to poles, the pole height may be taller as long as the highest part of the luminaire's optics is mounted at or below the appropriate value from the table below. These mounting height limits apply whether the luminaire is mounted to a pole, building or other structure and is measured relative to the grade directly below the luminaire. If there are excessive changes in grade on the site, be sure to adjust the design to prevent off site impacts for lower adjacent properties.

Table 1
MAXIMUM LIGHTING MOUNTING HEIGHT IN FEET

Lighting Zone	Lighting for Private Roads, Driveways, Parking, Bus Stops and other Transit Facilities	Lighting for Walkways, Bikeways, Plazas and other Pedestrian Areas	All Other Lighting
LZ 0	20	8	4
LZ 1	25	12	4
LZ 2	40	18	8
LZ 3	40	18	16
LZ 4	Height limit to be determined by Special Use Permit Only		

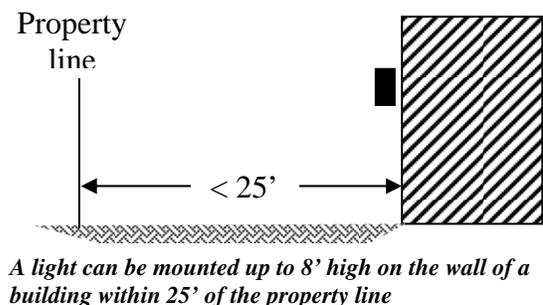
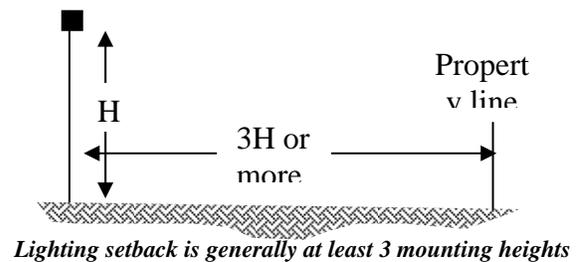
The Prescriptive Method

This method requires simple hand calculations and installations must follow specific rules, but detailed lighting calculations are not required. This method is recommended for most outdoor lighting installations, especially those undertaken by persons with little or no lighting expertise.

Prescriptive Method Setback Requirements (Note this provision is identified as optional in the Ordinance)

Setback, when combined with other prescriptive requirements, helps minimize off-site impacts. The setback requirements are fairly simple:

- As a general rule, luminaires must be at least 3 times their mounting height from the property line.
- If your property abuts a property zoned “industrial”, then luminaires can be mounted anywhere on your property relative to that property line.
- If your property abuts a property zoned other than industrial or commercial, then luminaires must be mounted at least 3 times their mounting height from the abutting property’s side yard setback line.
- If a luminaire on your property is used for the purpose of street, parking lot or public utility easement illumination purposes, it can be located less than 3



mounting heights from the property line, but it must employ a house side shield and the luminaire must be aimed away from the property line. A house side shield is an internal component available for most suitable luminaires. External shields added after the fact are not permitted.

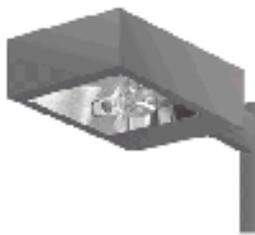
- If a building or structure is mounted within 25 feet of the property line, then shielded or fully shielded luminaire(s) can be mounted onto the structure at a mounting height not to exceed 8 feet above grade at the foundation. Lighting recessed into a canopy or enclosed by an awning or similar structure can also be used,

Prescriptive Method Luminaire Requirements

In order to prevent luminaires from being too bright and causing glare, the rated wattage is limited according to lighting zone and shielding by Table 2. Better shielding allows more power per luminaire, within the limits for each lighting zone.

**Table 2
MAXIMUM WATTAGE AND REQUIRED SHIELDING**

Lighting Zone	Fully Shielded	Shielded	Partly Shielded	Unshielded
LZ 2	100	35	39	Low voltage landscape lighting 50 watts or less
LZ 3	250	100	70	Landscape and façade lighting 100 watts or less; ornamental lighting on private streets of 39 watts and less



Fully shielded means that light is not emitted above the horizontal plane, and that the amount of light emitted at high angles is limited.



Shielded means that a small amount of light may be emitted above the horizontal plane, but that the source is still shielded and most of the light is downward.



Partly shielded means that the light source is hidden and that there is a solid top to prevent upward light; but light is radiated sideways as well as downward.



Unshielded means that light is emitted indiscriminately, or is purposely aimed upwards.



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Prescriptive Method Total Lighting Limits

The primary cause of light pollution is the *amount* of electric light, as light from even the most shielded light sources bounces up when it hits the ground. For non-residential sites (including multiple residences with common areas) calculate the maximum allowed lighting power as follows:

1. Refer to Table 3.
2. Note which lighting that is EXEMPT. You do not have to include exempt lighting in any way. It is unregulated and you can use as much as you want.
3. With the exception of building entrances, determine the allowed lighting power for each application by multiplying the area in plan by the allowed lighting power density for the lighting zone of the property. Only one lighting power allowance can be claimed for any area.
4. Count up the number of building entrances and multiply by the allowance per entrance.
5. Add all of the values calculated in (3.) and (4.). The actual lighting rated lamp watts must be equal to or less than this sum.

Table 3
ALLOWED LIGHTING POWER
(watts per square foot (w/ft²) unless otherwise noted)

Lighting Application	Allowed Area	LZ 0	LZ 1	LZ 2	LZ 3	LZ 4
Hardscape	Watts per square foot of paved or improved area	0.04	0.06	0.08	0.1	0.2
Building entrances	Per Door (stated values are watts, not watts per square foot).	13	18	26	32	70
Building entry, drive-up sales, and general use canopies	Drip line area under canopy.	0	0.1	0.2	0.4	0.7
Vehicle Service Station Canopy	Drip line area under canopy	0	0.30	0.60	1.2	2.4
Outdoor Sales, Service or Industrial Lot	Portion of uncovered hardscape used exclusively for display of vehicles or other merchandise for sale, for the service of vehicles, aircraft or watercraft, or for exterior manufacturing.	0	0.25	0.45	0.9	1.8
Ornamental Lighting	Entire site	0	0	0.01	0.02	0.04
Landscape Lighting	Landscaped area	Exempt	Exempt	Exempt	Exempt	Exempt
Building Façade Lighting	Non-Residential and Multiple Dwelling	Exempt	Exempt	Exempt	Exempt	Exempt
ATM Security Lighting	Within 5 feet of ATM facility	Exempt	Exempt	Exempt	Exempt	Exempt
Flagpole lighting	Illuminating flags on flagpole	Exempt	Exempt	Exempt	Exempt	Exempt

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Example

An office building in LZ3 has a parking lot, driveways and sidewalks with two main entrances (4 doors each), a loading dock with door and two emergency exits. Using AutoCAD, the paved area is 48,000 square feet.

The allowed power is

$48,000 \text{ sf} \times .1 \text{ w/sf} = 4,800 \text{ watts}$

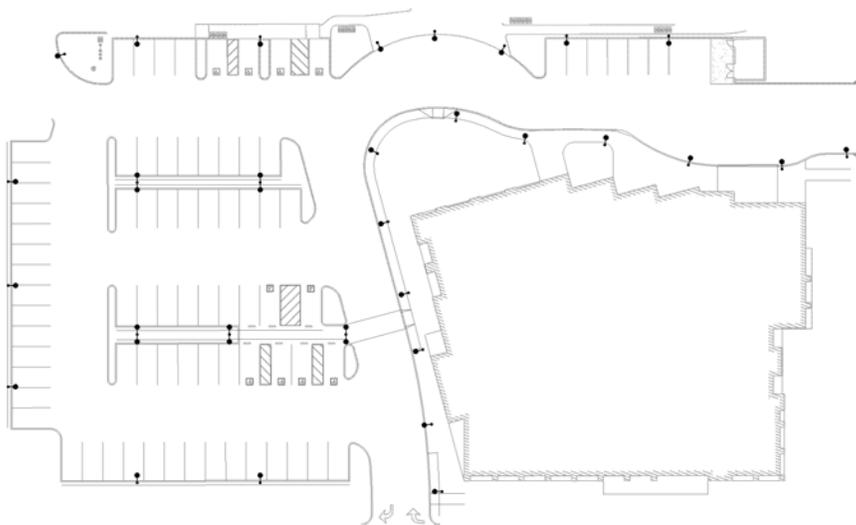
$11 \times 32 = 352 \text{ watts}$

Total Allowed = 5,152 watts

The design has (35) 100 watt pole lights and (16) 26 watt wall lights. The design is 3,916 and meets the ordinance.

Exempt Lighting and Street Lighting

Most lighting can be designed and implemented within the explicit terms of the Ordinance. But there are a few special cases that can't, and need to be addressed in special ways.



Exempt Lighting

The following lighting systems are generally not regulated. However, if they are used in lieu of regulated lighting to circumvent the ordinance, there may be ramifications:

- a. Interior lighting.
- b. Temporary lighting for theatrical, television, and performance areas.
- c. Lighting in swimming pools and other water features governed by Article 680 of the National Electrical Code.
- d. Code required exit signs.
- e. Lighting specifically for stairs and ramps.



- f. Temporary and seasonal lighting provided that individual lamps are 10 watts or less.
- g. Lighting required and regulated by the Federal Aviation Administration, U.S. Coast Guard or other federal or state agency.

In addition, sign lighting is not regulated in this section, but it regulated under the Sign Ordinance.

Street Lighting

Developers are generally responsible for installing street lighting before turning streets over to the (authority). New Street Lighting systems are required to meet the requirements of the Ordinance. In general:

- In Lighting Zone 2 and above, lighting is provided for all streets and roads

Lighting levels in all applications must meet requirements contained in Table 3 of the Ordinance. Note that these lighting levels are much lower than many current installations, and will require lower wattage lamps than in the past. In addition, fully shielded luminaires are required with internal house side shielding in most situations.

The BUG System

BUG stands for "Backlight", "Uplight" and "Glare." The acronym describes the types of stray light escaping from an outdoor lighting luminaire. "B" stands for backlight, or the light directed in back of the mounting pole. "U" stands for uplight, or the light directed above the horizontal plane of the luminaire, and "G" stands for glare, or the amount of light emitted from the luminaire at angles known to cause glare. These additional measurements provide a much more accurate picture of lumen distribution and the overall efficiency of a luminaire.

It is expected that BUG values will be published by luminaire manufacturers so lighting specifiers, designers or purchasers can tell at a glance how well a certain luminaire controls stray light or compares with other luminaires under consideration for an installation.

The BUG system was developed by the Illuminating Engineering Society (IES) to make comparing and evaluating outdoor luminaires fast, easy and more complete than older systems.

This system divides the sphere around a luminaire into zones assigning values according to expected environmental impact. This rating system offers the most complete evaluation of the total light emitted from luminaires to date.

Refer to Table 4 for maximum allowable backlight, uplight and glare (BUG) ratings.

Backlight, which creates light trespass onto adjacent sites. The B rating takes into account the amount of light in the BL, BM, BH and BVH zones, which are direction of the luminaire OPPOSITE from the area intended to be lighted.

Uplight, which causes artificial sky glow. Lower uplight (zone UL) causes the most sky glow and negatively affects professional and academic astronomy. Upper uplight (UH) is mostly energy waste. The U rating accounts the amount of light into the upper hemisphere with greater concern for the lower uplight angles in UL.

Glare, which can be annoying or visually disabling. The G rating takes into account the amount of frontlight in the FH and FVH zones as well as BH and BVH zones.

**TABLE 4
MAXIMUM ALLOWABLE BACKLIGHT, UPLIGHT AND GLARE (BUG) RATINGS**

	LZ 2	LZ 3
Allowed Backlight Rating		
>2 mounting heights from property line	B2	B3
1 to 2 mounting heights from property line and properly oriented*	B2	B3
0.5 to 1 mounting height to property line and properly oriented*	B1	B2
<0.5 mounting height to property line adjacent to a street and properly oriented*	B1	B2
<0.5 mounting height to property line and properly oriented*	B0	B1
Allowed Uplight Rating	U2	U3
Allowed Glare Rating	G2	G3

Sample Lighting Applications

Sample Compliant Lighting Applications for the Night Vision Device Influence Area Gas Stations

In lighting a gas station, there are three main areas to be considered; lighting under the pump canopy, lighting around the convenience store or office, and lighting for the apron areas including drives, parking and service areas that aren't under the canopy, such as air or water stations. For lighting under the canopy, the most basic design is a grid of metal halide downlights. Use flat lens fixtures, evenly spaced, with the maximum allowed "fully shielded" lamp watts. Employ 2 luminaires per car to meet IESNA recommended light levels, but fewer fixtures may be considered for conservation purposes. Apron lighting should be performed using fully shielded pole luminaires, with the mounting height generally 20 feet or less. Lighting "in" from the perimeter is normally used to keep poles away from the drive areas. Using the maximum lamp watts allowed for fully shielded luminaires, lay-out type III

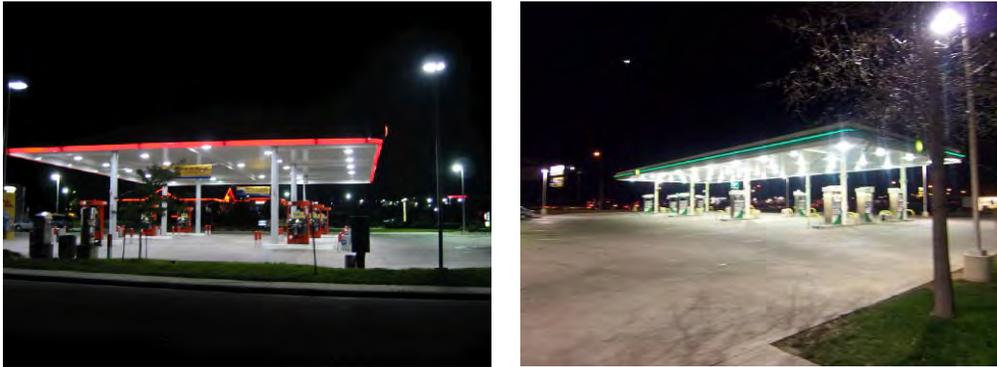


Figure 1 -(Left) Gas station with fully shielded lighting and (right) with ordinary drop lens lighting. The reduced glare and light pollution of fully shielded lighting is required by the Ordinance (*Benya Lighting Design*)

distribution luminaires with a least 300-500 square feet of apron (not under canopy) per fixture.

Note: because recommended light levels for service areas are much higher than for ordinary parking, it may be necessary to put two or more fixtures on each pole to reduce the number of poles.



Figure 2 - detail of fully shielded canopy lighting (*Monrad Engineering, Inc.*)

Lighting for the building needs to be coordinated with lighting for the apron. In general, the apron lighting will meet the safety and security needs of the building, so additional lighting will generally be limited to a compact fluorescent fixture at each door. Special lighting should be provided for ATMs on site.

Figure 3 - Sample Canopy Design

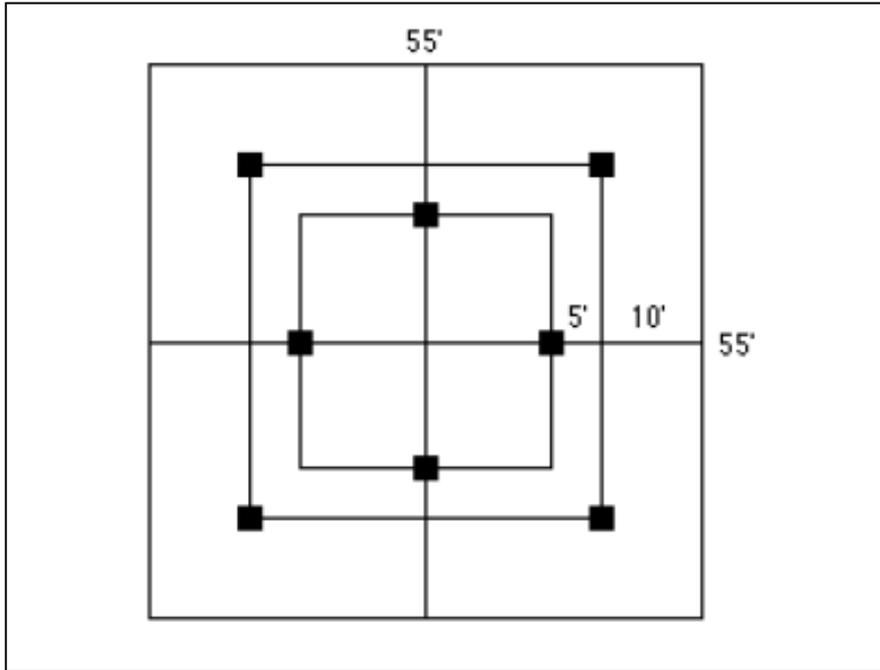


Figure 4 - Every Other Row Option Parking Lot with Fully Shielded Luminaires (*Monrad Engineering, Inc.*)



Large area - pole mounted

To light a large area such as a parking lot, there are two very important “rules of thumb” design options:

- **All Rows Option** Luminaires atop 17-20 foot poles must be mounted at every bumper line (about 65-70 feet across) and 50-80 feet on center. Single-headed luminaires should be used around the edge of the lot with double-headed luminaires in the center. Employ flat lens fixtures with type III distribution and use the maximum allowed lamp watts.



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- **Every Other Row Option** Luminaires atop 35 foot poles should be mounted at every other bumper line (about 120-130 feet) and 80-100 feet on center. Employ 2 luminaires per pole at the edge and use four luminaires per pole in the center. Employ flat lens fixtures with type III distribution and use the maximum allowed lamp watts.

High pressure sodium lamps produce more lumens per watt than metal halide, and have better lumen maintenance. However, metal halide lamps have superior color and appear brighter. Choose between these lamps depending on project conditions.

Decorative Lighting



Lanterns, sconces and other types of luminaires are often mounted on buildings to light doorway areas as well as to reinforce an architectural style. In other cases, traditionally styled globes and “acorns” are mounted atop poles or posts. Unfortunately, most traditional luminaires are unshielded and create a great deal of glare and light pollution. The Ordinance restrictions permit traditional luminaires but depending on shielding, the lamp watts are often very restricted. For this reason, it’s probably best to avoid using unshielded or semi shielded decorative lighting, especially for area lighting on posts or poles.



If decorative lighting is very important to the design, investigate the new generation of fully shielded decorative lighting. The lamp is hidden in the top of the luminaire and casts light downward, but the shape of the luminaire is still traditional. There are a number of styles and periods available, making good lighting for these projects possible while maintaining a traditional or historic daytime appearance. Using pole lights of this type, follow the design suggestions for street lights or parking lots.

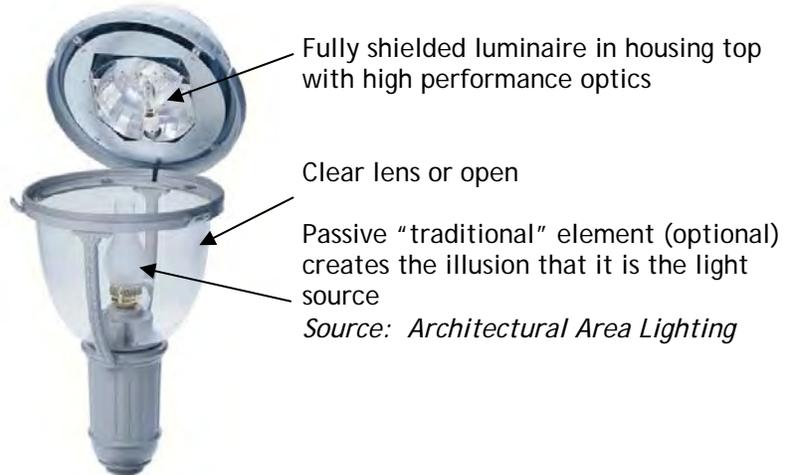


Figure 4 - Anatomy of a high performance decorative "fully shielded" luminaire

Figure 3 - Fully shielded high performance decorative lighting. *Top*, flat lens wall lanterns (Lumec); *Bottom*, post luminaire (GE)

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Externally lighted billboards and signs

To minimize impacts to the environment, it is necessary to light billboards and signs “top down” with full shielding. Good results can be obtained with either linear fluorescent or several HID luminaires designed with the special wide throw needed for signs. Most manufacturers provide good information on how to use their products. However, maximum lamp watts are regulated, which will tend to favor fluorescent systems in Zones 1 and 2.



Figure 5 - Several luminaires for top lighting of building signs



Figure 6 - Top Mounted, fully shielded sign luminaires. Note shielding in the direction of the viewer is critical as well as shielding for potential spill light over the top of the sign (*Monrad Engineering Inc.*)

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Sports Lighting

Sports lighting causes such significant light pollution that extra care must be taken in designing, installing, aiming and maintaining sports lighting systems. Sports lighting should use the tallest practical poles and luminaires should be aimed mostly downward. Because high light levels must be used even in the most sensitive lighting zones, there are no lamp wattage limits, and most systems will use metal halide lamps up to 2000 watts. Instead, the use of sports lighting will be limited to sports applications, and hours will be strictly limited.



Figure 7 - A Tale of Two Ballparks. *Left* Ordinary unshielded sports lighting *Right* State of the art sports lighting (*Monrad Engineering, Inc.*)

In addition, designers should seek modern sports systems with sophisticated shielding and avoid low cost systems that tend to be extremely glaring. A simple top shield does not do much. A new generation of extremely well shielded sports products is now available, and to meet the intent of the Ordinance, their use is required.

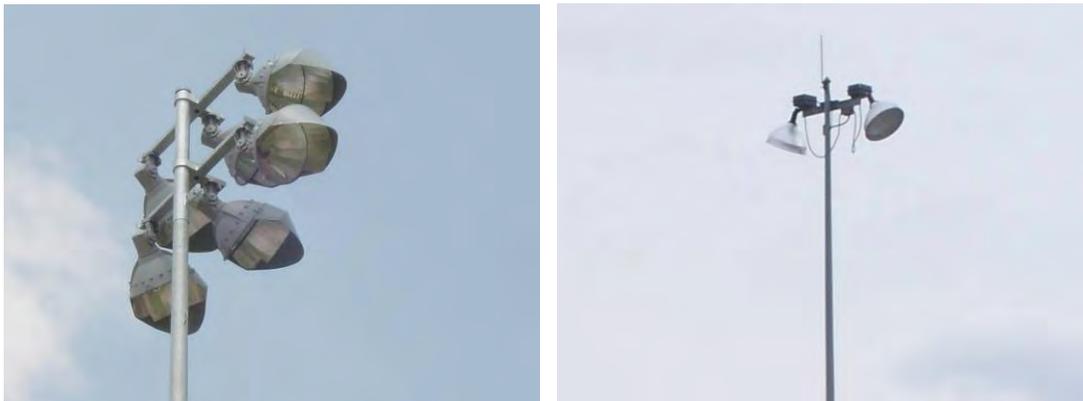


Figure 8 -*Left* State of the Art Sports Lighting (Musco) *Right* generic unshielded sports lighting (*Musco and Benya Lighting Design*)

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Roadway/Highway



Figure 9 - Street and Roadway lighting systems (*Monrad Engineering, Inc. and AAL*)

The largest cause of light pollution is roadway lighting. Even if the light is properly shielded, the light reflected by pavement and cars is significant. So as a preliminary consideration, always ask the question whether lighting is really required. There are many streets and roads that don't require lighting; there are others that require lighting at intersections but not continuously. The Ordinance includes regulations for new developments and streets, including "when to light" and appropriate light levels.

It is common for municipalities and utility companies to have "standard" lighting systems and performance requirements. Many of these employ improperly shielded lighting and/or overly high wattage lighting. These standards should be revised as quickly as possible to meet the Ordinance. For existing street lighting, there is huge potential to reduce overall light pollution by changing existing systems to conform with the Ordinance, especially if light level and watts are reduced.

Note that street light design using "full cut off" luminaires is required by the Ordinance. For maximum energy efficiency and minimum maintenance, high pressure sodium lighting is generally preferred. Pole height is not restricted, but as a general rule street lights should be between 20 and 35 feet above grade. Poles are generally mounted 5-6 mounting heights apart along the roadway.

For reasons of cost and maintenance, the most common street lights are "cobra head" style, and both traditional and upscale designs are available in fully shielded flat lens types. For downtown streets and historic districts, consider using decorative fully shielded luminaires as their performance is similar.

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Landscape and Façade Lighting

The ordinance treats these two types of lighting similarly. Both generally are mounted on the ground and light upwards, an obvious concern for controlling light pollution. Neither façade lighting nor landscape lighting are permitted in lighting zones LZ0 and LZ1a, but in all other zones the use of low voltage landscape lighting up to 50 watts is not restricted. For most applications, this is plenty of lighting for trees and landscape features, as well as being affordable and attractive. Also note that path lighting can use fully shielded lights, even though they are not required. High wattage landscape lighting and façade lighting is only permitted in lighting zones 3 and 4, limited to 100 watts in lighting zone 3 and 250 watts in lighting zone 4.



Figure 10- Installations using high wattage floodlights are only allowed in lighting zones 3 and 4. (*Left*) building façade lighting and (*right*) commercial landscape lighting (Kim Lighting)



Figure 11 - Lighting equipment for accent lighting (*left*) above grade PAR (*center*) above grade low voltage MR16 (*right*) high wattage HID (*Hydrel*)

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Pedestrian and Walkway Lighting

Like street lighting, there are many situations where no lighting or only occasional lighting is required. As a general rule, first evaluate whether continuous lighting is actually required. Once lighting is determined to be needed, use pole lights or bollards meeting the design conditions. Note that the height of pole lights is limited and for all luminaires, lamp watts are limited by lighting zone and shielding.



Figure 12- Walkway lighting with (*left*) bollards and (*right*) short pole lights (AAL)

The most common choice is often between bollards and short poles (<12'). With current technology, a wide variety of fixture choices are available meeting the Ordinance's "fully shielded" and "shielded" requirements. In lighting zones 3 and 4 it may also be possible to provide some lighting using ornamental, unshielded luminaires, although the watts are restricted.

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Lighting for Monuments, Flagpoles, and Public Art

There are a number of special cases where the basic lighting regulations don't work. In the case of poles flying the Flag of the United States, when the Flag flies at night it is to be lighted. Such lighting is not permitted in Lighting Zone 0, but is permitted in all other lighting zones. Because only a small amount of the light actually illuminates the Flag, the amount of power is limited to 40 watts in lighting zone 1A and to 70 watts in zones 1-4. There are other exemptions such as lighting for ATM machines, because lighting for these machines is frequently controlled by banking laws.



Figure 13 - Lighting for Public Art, Monuments, and Statuary is allowed but a special permit is required to ensure that the lighting is designed to mitigate light pollution (*Hydrel*)

Monuments and public art including statuary, bridges and other important community structures are among a number of lighting situations where lighting is needed and can't meet the more stringent requirements for more ordinary projects. For these situations, a formal special permitting process is provided. Applicants must demonstrate that the lighting is appropriate and designed to mitigate light pollution. Communities are encouraged to hire consultants to check the designs for compliance.

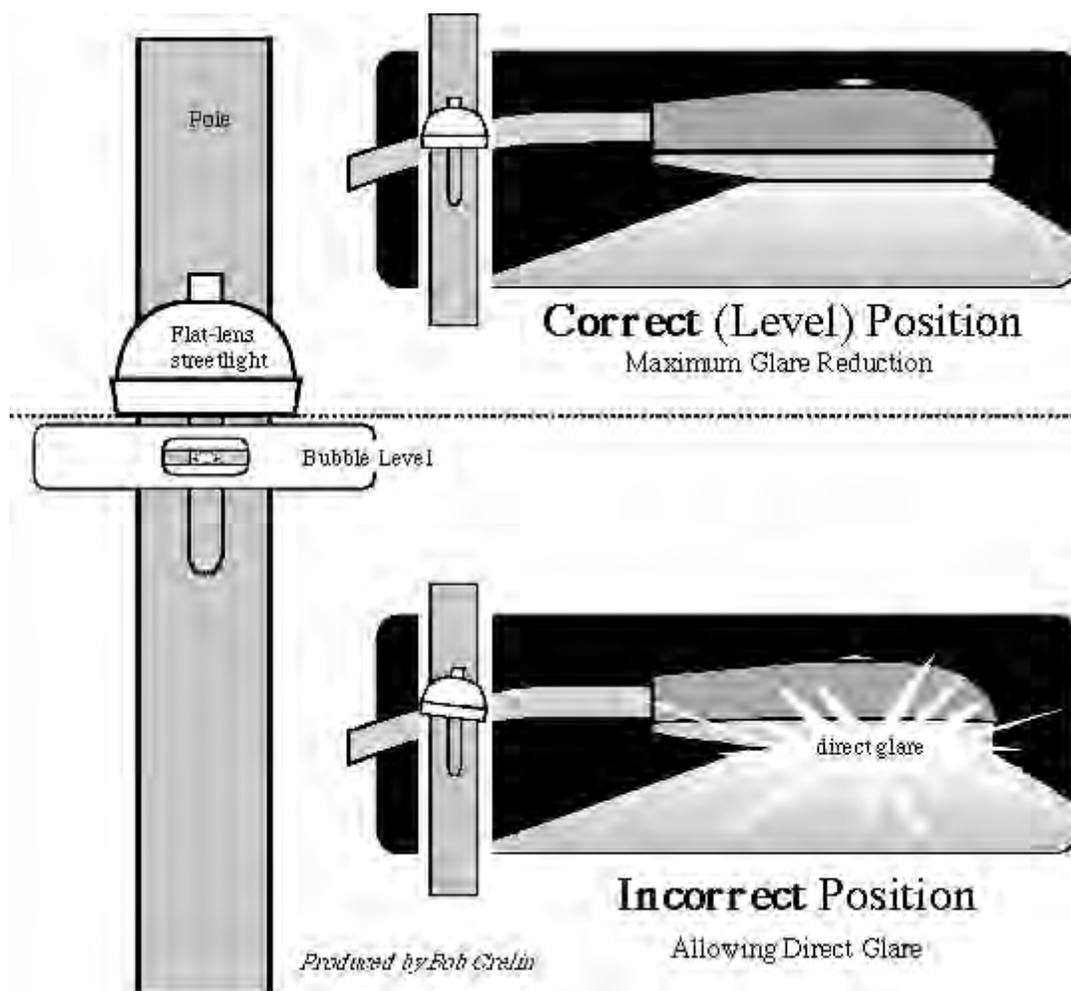
Note: a list of lighting manufacturers approved by the International Dark Sky Association is available at <http://www.darksky.org/mc/page.do?sitePagelId=56423&orgId=idsa>

11/98

 International Dark-Sky Association -- Information Sheet 144

Leveling Flat-Lens Cobrahead Streetlights for Optimum Glare Reduction

One of the most important benefits of the flat-lens, full-cutoff cobrahead streetlight is the reduction of direct glare to drivers, pedestrians, and nearby homeowners. The correct positioning of the flat-lens cobrahead is key to achieving optimum glare reduction and performance. Using a bubble level across the base (glass-lens side) of the fixture and parallel to the roadway during installation (as shown below) will determine the proper position before tightening in place. Even a slight tilt in either direction can cause some unnecessary glare, so achieving a level position for the flat-lens cobrahead is desired.



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International Dark-Sky Association -- Information Sheet 151

A Solution to Canopy Overlighting

Summary

The Flagstaff and Coconino County outdoor lighting codes limit the amount of light, measured in initial raw output lumens, per net acre of development projects. The limits address the issues of excessive outdoor lighting, energy waste, the resulting sky glow from light reflected into the sky, and glare.

Lights used beneath canopies or under roof overhangs have a reduced impact on sky brightening compared to lights mounted on poles, since the canopy or overhang prevents some of the light reflecting off the ground from reaching the sky. Because of this effect, such lighting counts less toward the lumen per acre caps in these codes. Luminaires located on poles or under a canopy and within five feet of the canopy or overhang edge count fully toward the cap; those located between five and ten feet count at one-quarter, and those further than ten feet count at one-tenth (for a discussion of canopy uplight impacts, see IDA Information Sheet 150, *Uplight Impacts of Canopy Lighting*).

Using these factors, lighting is included toward the lumens per acre caps in approximate proportion to the amount of light they direct into the sky ("uplight"), without requiring an involved analysis for each installation.

Another obtrusive aspect of canopy lighting, not addressed by uplight considerations described above, is the excessive illumination levels that are increasingly seen under service station canopies. Illumination levels exceeding ten and even twenty times the level recommended by professional lighting designers are becoming common. Such overlighting with its attendant glare, besides contributing unnecessarily to the brightening of our night skies and wasting substantial amounts of energy resources, can interfere with the safe use of adjacent property and safe operation of motor vehicles on nearby roadways, particularly for those entering and leaving these areas.

To address this issue, the amount of light permitted under service station canopies is capped at a level consistent with Illuminating Engineering Society of North America (IESNA) recommendations of five and ten footcandles. (See publication IESNA RP-33-99, *Recommended Practice for Lighting for Exterior Environments*, and IDA Information Sheet 152 describing this publication and how to obtain it.) To achieve this goal without requiring planning staff to evaluate lighting designs in detail or measurement of actual average illumination levels, an approach parallel to the overall lumens per acre cap for outdoor lighting in the Flagstaff and Coconino lighting codes is taken. Limits of 40 initial raw lamp output lumens per square foot of canopy lead to initial illuminance of 15 to 20 footcandles (fc), which will dim to about 9-11 fc average when the lamps are old. Half this amount, or 20 initial raw output lumens per square foot of

canopy, will give an average illuminance of about 10 fc initially, dimming to 5 fc.

Calculations for the Model

Illumination under service station canopies has been modeled using a commercially available software package (POINT Version 7, by Lighting Analysts, Inc.) and photometric information for five flat-glass (fully shielded) luminaires appropriate for canopy illumination. The summarized designs assume luminaire heights of fifteen feet, 175 watt metal halide lamps, and the canopy dimensions and luminaire positions shown in Figure 1. Eight 175 watt metal halide lamps, with initial lamp outputs of 15,000 lumens each, give a total lumen budget of 120,000 lumens; for the 55 x 55 foot canopy, this is just under 40 lumens per square foot of canopy. Designs to achieve the lower value of 20 lumens per square foot can be achieved either by using four 175 watt lamps, or by using a design including sixteen 50 watt metal halide lamps with 3450 initial lumens each.

The five luminaires listed in Table 1 were evaluated, and the average initial and end-of-life illuminances and uniformity ratios are shown in Table 2. The two values for the average illuminance reflect the fact that metal halide lamps become dimmer as they age, due principally to deterioration in the lamps and dirt accumulation within the luminaire. A conservative estimate for these effects will bring the lamp intensity at "end of life" to 60% of the initial value, and this figure is used to show the lowest level that should be encountered during the lifetime of the lamps. Uniformity ratios are not affected by this deterioration.

Table 1: Luminaires Analyzed

Manufacturer / Model	Photometric Specification	Table 2 Abbreviation
Huntington-I	Spaulding HTI-M175-FG	HTI
JPL 8 Surface Luminaire	JPL8-M-2-V-R-C73 Luminaire	JPL8
JPL 9 Surface Luminaire	JPL 9 Surface JPL9-M-7-V-R-C73	JPL9
SCM-175	General Electric SCMM17M0A1GMCS	GE
Pappi MiniSquare	MSQL-MH-208-VR-LG	MSQL

Table 2: Illumination Summary

Luminaire	Ave fc initial	Ave fc end of life	Uniformity Ave/Min
HTI	19	11	4.6
JPL8	18	11	3.9
JPL9	20	12	3.6
GE	18	11	2.8

MSQL

15

9

2.3

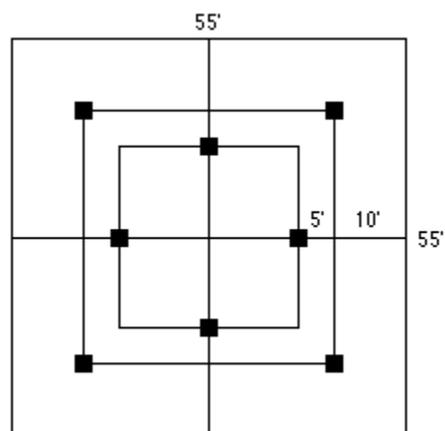


Figure 1: Canopy Design

Written by Christian B. Luginbuhl
U.S. Naval Observatory Flagstaff Station
25 November 1998

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Billboards

Some Comments on Billboard Lighting

Billboards are controversial, and some persons would no doubt like to see them all banned. However, others feel that billboards provide a valuable advertising service for small and large businesses and welcome information for the weary traveler. IDA has no organizational policy concerning billboards as long as they do not contribute to light trespass and light pollution. Many billboards are illuminated all night and are ridiculously overlit with bottom-mounted lighting, the major part of which ends up in the sky rather than on the billboard. Billboard and roadway sign lighting can be effective and unobtrusive if it is done in the right manner.

Top-lit signs with well-shielded fixtures save energy and contribute little to light pollution. Yet, there are all sorts of objections raised to suggestions that billboards be designed in this fashion. Most, if not all, of these objections are fallacious. The majority of the billboards in the Tucson, Arizona area are top-lit, and all interstate roadway signs in southern Arizona are lit from the top. This has caused no problems, resulted in better sign lighting, probably saves money, and helps keep unwanted light out of the sky. A well-designed top-lit billboard is cheaper to run—a relatively low-wattage fluorescent fixture, for example, provides more than enough light to give the billboard easy visibility.

We have not noticed any objectionable shadows in the daytime caused by the lighting system being mounted at the top of the billboard. This is an objection often raised by opponents of top-lit billboards. They also complain that top-mounted fixtures are more difficult to service. This may be true in some cases, but in most instances in Tucson the billboards are quite large and are difficult to change or service no matter where the lights are located.

There is little doubt that changing a lighting system for a billboard may be expensive. It is probably impractical to ask for all billboard owners to retrofit the lighting systems for bottom-lit signs. A first approach would be to ask for all new billboards to be top-lit. Older billboards could be left as they were for some time until they would ordinarily undergo major renovation due to their age.

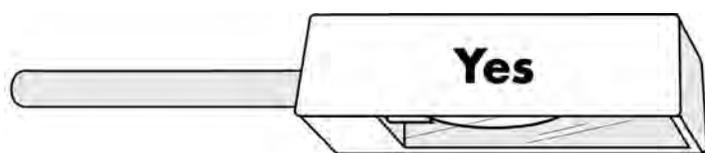
There is also the question of whether a billboard needs to be lit at all when the business being advertised is not open. Most billboards and other advertising signs should be turned off after 10:30 or 11:00 p.m. We should point out to the sign owner, or better yet the business doing the advertising, how much coal is being burned (and wasted) to light the night sky. These individuals probably do not realize that in addition to light pollution they are also contributing to air pollution and possibly global warming. Most electricity comes from coal-burning power plants.

It does not take very much light to make a sign visible at night. The next time you are at an airport notice how dim the taxi and runway lights are. Nevertheless, they are easily seen. In your efforts to produce changes in the way signs are lit in your area, be reasonable and work with the sign owners and billboard companies. A well-constructed top-lit sign is easy to see at night and yet it contributes little to light pollution. We know it can be done because we see good examples in many places. Changing billboard and sign lighting will not be easy and it will take years to bring about a large scale transformation. It will not by itself stop light pollution but it will surely help and is a worthwhile goal to work toward.

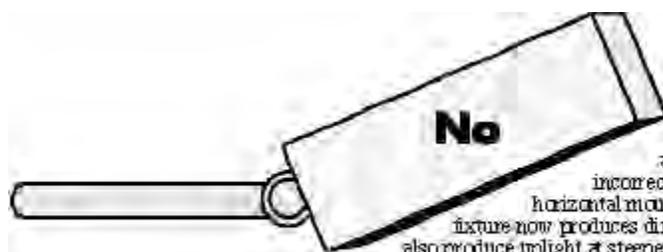
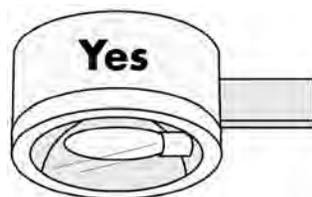
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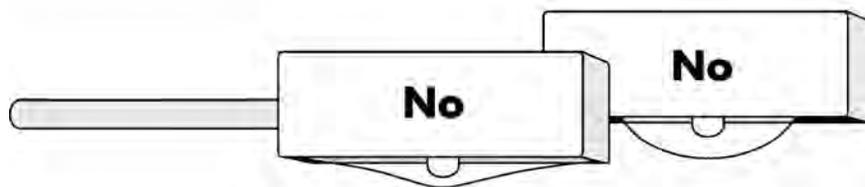
What is a True "Full Cutoff" Outdoor Lighting Fixture?



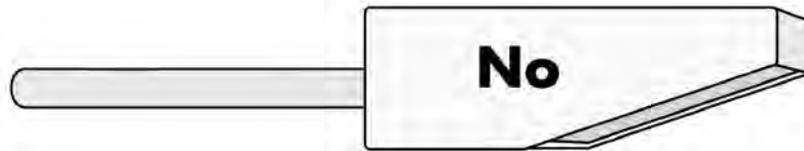
Flat glass lens, eliminates or minimizes direct glare, no upward throw of light. The housing for these fixtures is available in many styles.



Same fixture as above mounted incorrectly—defeating the horizontal mounting design. The fixture now produces direct glare, and can also produce uplight at steeper mounting angles.



Known as just "Cutoff". Center "drop" or "sag" lens with or without exposed bulb, produces direct glare.



Forward-Throw Style. Exposed bulb in the forward direction produces some direct glare.

Produced by Bob Crelin

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Sports and Recreational Area Lighting

As our populations have grown, many people have an increasing amount of leisure time. They are looking for healthy recreational opportunities for themselves, for their children, and for senior citizens. One way of meeting this demand is to provide illumination for existing parks and play areas. When new facilities are built, they usually include a night lighting system. These facilities bring pleasure to many, but they also bring irritation and annoyance to those who live nearby. The lighting systems are visible for miles around and produce a substantial amount of sky glow and light pollution. Lighted sports facilities are the most commonly mentioned system when people discuss light pollution in the nighttime environment.

Many cities have large outdoor professional sports venues. It is essentially impossible to mitigate the impact these types of facilities have on the surrounding areas. The amount and type of illumination are driven by television broadcasting requirements, and glare control of the luminaires is essentially impossible or not effective. However, these large, professional facilities do not normally operate every night of the week and are usually located some distance from the residential areas of the city.

This is not the case with the many recreational areas that have night lighting systems. The facilities are normally in or near residential areas and are operated several nights a week and year around or as long as weather permits. The off-site impact of these facilities can be reduced to some extent by utilizing several options. One of the most important is proper mounting heights of the luminaires. Many people think that low mounting heights help reduce the off-site impacts of the illumination system. This is exactly the opposite of the actual effect. The lower the mounting height, the higher the aiming angle and the more light that is delivered off site. This emphasizes the importance of having the facility designed by an

experienced sports lighting professional. These systems need to be installed by a licensed electrical contractor in most jurisdictions, so design should be done by a licensed engineer. A selection process should be used to ensure that the best qualified and most experienced person is picked for this.

The Illuminating Engineering Society of North America (IESNA) has a Sports and Recreational Areas Lighting Committee. This committee develops standards and design criteria for various sports, both indoor and outdoor. This information is published as "Recommended Practice for Sports and Recreational Area Lighting," (IESNA RP-6-01). The criteria are divided into several major sections plus five annexes, an extensive glossary of lighting terms, and a reference/bibliography pertaining to sports lighting design. While the RP covers recommendations for both indoor and outdoor sports, this summary will only cover outdoor sports.

RP-6 has established four classes of facilities, based mainly on the number of spectators, and provided illumination recommendations for each. They are as follows:

- Class I: Competition play before larger groups, from 5,000 to 10,000 or more spectators. The design criteria may not fully cover this type of facility, whose vertical and horizontal needs may be defined by individual sports and/or broadcasting organizations.
- Class II: Competition play with facilities for up to 5,000 spectators.
- Class III: Competition play with some spectator facilities.
- Class IV: Competition or recreational play only, with no provision for spectators.

continued

In general, the recommendations for Class IV are normally sufficient for most recreational sports facilities. When spectator facilities are added and the distance from the spectators to the field becomes greater, the illumination levels need to be increased. These higher levels are for the spectators; the lower levels are considered sufficient for the players.

Multidirectional aerial sports are those in which players and spectators view the playing object from many positions and angles. These sports require vertical illuminance over the height of the entire playing area and horizontal illuminance at ground level. Direct glare at the most frequent viewing directions must be avoided. These sports include badminton, baseball, basketball, football, handball, jai alai, ski jumping, soccer, squash, tennis, and volleyball.

Unidirectional aerial sports, in which the playing object is viewed in the air from a fixed position on the ground, require horizontal illuminance where the playing object starts and vertical illuminance where the playing object lands or is intercepted. Such sports are golf at a driving range and skeet and trap shooting.

In *multidirectional ground level* sports the players and spectators view the playing object from multiple positions, normally downward, horizontally, and occasionally upward. These sports include boxing, curling, field and ice hockey, skating, swimming and wrestling.

The playing object in *unidirectional ground level* sports is aimed at a fixed target, usually in a vertical position, near ground level. These sports include archery, bowling, skiing, and target shooting.

Fundamentals of Good Illumination

The goal of good sports lighting is to provide a luminous environment that contributes to the contrast of the playing object (ball), the competitors, and the surrounding backgrounds. Contrast is a function of the luminance of both the target and

the background. Good design takes into consideration direct and reflected glare, color rendering, and color contrast.

The lighting recommendations also seek to minimize spill light, or light trespass, in areas near the sports facility. The lighting fixtures commonly used for sports lighting may be huge sources of direct glare, affecting not only nearby areas and those at considerable distances from the sports field, but also spectators and players using the facility. The brightest single source of light visible in a city nighttime landscape is often a sports facility. It is, then, no surprise that such lighting is usually the single greatest source of complaints and neighborhood tension. Designing excess light increases construction, operating, and maintenance costs and wastes energy.

Equipment and Design Factors

RP-6 covers light sources and equipment commonly used in sports lighting, along with their characteristics and typical applications.

The two light sources commonly used for sports facilities are high-intensity discharge (HID) and fluorescent. HID lamps, which are long lived and have high efficacy, may be metal halide or high-pressure sodium (HPS). However, when these lamps are turned on or restarted, they have a time delay, followed by a slow buildup of light output.

While fluorescent lamps provide relatively high efficacy, long lamp life, low brightness, and good color rendering, their physical length gives poorer optical control and they are very temperature-sensitive.

Luminaires offer a wide choice of optical characteristics. Based on their optical performance and mounting at the correct height and position, luminaires provide a lighting system with the desired characteristics. Luminaire designations explain how light from the lamp is controlled by the optical system and describe the fabrication of the complete unit. Since indoor and outdoor applications involve unique problems, lighting equipment is distinctly classified and designated accordingly.

continued

Indoor sports applications have similar design and calculations as those of any interior system. The walls and ceilings provide a means to control background luminances and assist in diffusing the available light.

Outdoor lighting choices are more limited, usually made up of direct distribution floodlights aimed at the playing surface. Full cutoff optical systems are now available for most recreational level sports applications. In fact, the full cutoff optical systems actually provide superior visibility for the players as well as the expected reduction in off-site impacts. HID sources (metal halide or high-pressure sodium) are the choice for most outdoor sports locations.

In the past, fixtures, lighting designs, and the general level of the sports lighting state of the art often left little choice for communities and designers seeking to minimize spill and glare in sports lighting. Many facilities, especially older ones, continue to produce enormous amounts of light spill into adjacent areas, as well as direct and reflected light into the sky.

Recently, several luminaire manufacturers have begun to produce well-shielded - even fully shielded - luminaires suitable for sports lighting, particularly for the most commonly needed levels of lighting. These designs provide major reductions in off-site spill and can reduce or even eliminate direct uplight. This equipment must be carefully applied to provide the visibility to the players necessary for softball, football, and similar sports where the ball must be seen well above

the playing surface. Proper mounting heights and mounting locations help these designs deliver improved lighting quality for the players on the field.

With quality designs using up-to-date fixtures, the obtrusive effects of lighting can be considerably reduced, but the huge amounts of light required in certain situations will always produce some negative impacts, even with the best design.

Illumination Recommendations for Outdoor Sports

Recommendations for illuminance values, uniformity ratios, and design considerations in facilities for specific outdoor sports are given for many sports.

The five annexes cover illuminance calculations, field measurement and performance evaluations, floodlight aiming, light loss and maintenance, and lighting economics.

Communities need to be aware of the potential impacts of a sports facility, and its location and alignment should be carefully considered. Technical specifications for sports lighting can be included in a lighting code that requires fully shielded lighting where possible and professional design and post-installation certification to ensure that standards are followed.

The RP is available from IESNA (www.iesna.org) and is a must for anyone interested in sports and recreational lighting.



Unshielded sports lighting



Fully shielded sport lighting

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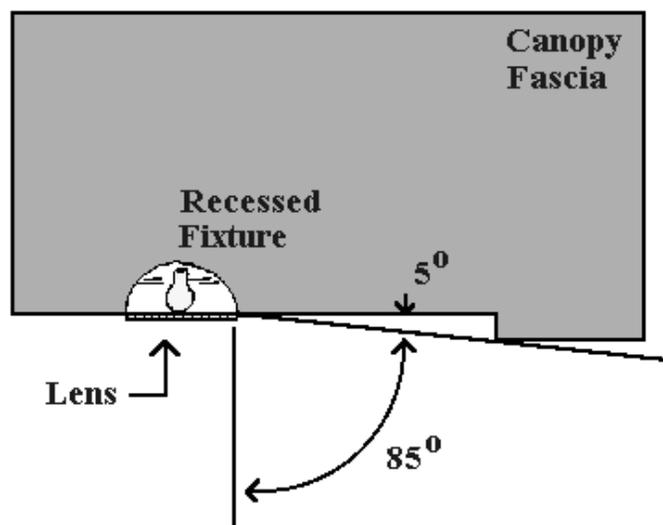
Service Station / Convenience Store Lighting

Many new or recently refurbished gasoline pump islands are being illuminated at three to four times the illumination level that was used only a few years ago. Why? Advertising! Many convenience stores and service stations are attempting to attract customers by making their canopy area the most brightly lit object in the neighborhood by far. The problem is in doing so, they are breaking nearly every rule of good lighting. The first rule of good lighting is use the right amount of light, not overkill. A good rule of thumb is that no retail establishment should have an illumination level that is more than 10 times the illumination level of the surrounding area. Since average illumination levels for roadways range between 0.3 and 1.6 footcandles (fc) and for parking lots between 0.8 and 3.6 fc, it is clear that canopies lit at between 80 and 110 fc are completely excessive. Such high light levels are simply not needed for safety, security, or visibility. It is advertising, plain and simple, and should be regulated as such.

When a business like a convenience store illuminates their property at extremely high light levels, surrounding areas that used to look adequately lit now appear too dark by comparison. This occurs because the human eye adapts to the brightest object in its visual field. If an area is too bright, then one's pupils close down a little and normal night vision is impaired (through depletion of the photochemical rhodopsin in the eyes' rod receptors). Add to this the substantial sideways glare produced by many canopy light fixtures, and the problem grows even worse. The next time a neighboring business or the city streetlighting department upgrades their lighting system, they will often feel compelled to increase the light level. This phenomenon is called *ratcheting*, and results in ever-increasing light levels. Ratcheting has been going on for years, and the pace is accelerating. Have you noticed?

The Illuminating Engineering Society of North America (IESNA) has established that an illumination level of 20 fc is all that is needed for service station pump islands with dark surroundings, and 30 fc for pump islands with bright surroundings. As a general rule, bright surroundings will refer to service stations located in a designated commercial area. If the service station is located in a rural or residential area, then the dark surroundings illumination level should apply.

Another rule of good lighting is "hide the source, light the subject". In other words, avoid glare. Glare is always bad, and efforts should always be made to minimize it. Most new service station and convenience store canopies employ light fixtures which produce an enormous amount of glare, made all the more worse because the light source used is the harsh (at these levels), bluish-white light of metal halide. Glare can be substantially reduced by using fixtures that are completely recessed up into the canopy so the bottom of each light fixture is flush with the ceiling of the canopy. Additionally, a "skirt" around the edge of the canopy can be used to provide additional glare control, as shown below.

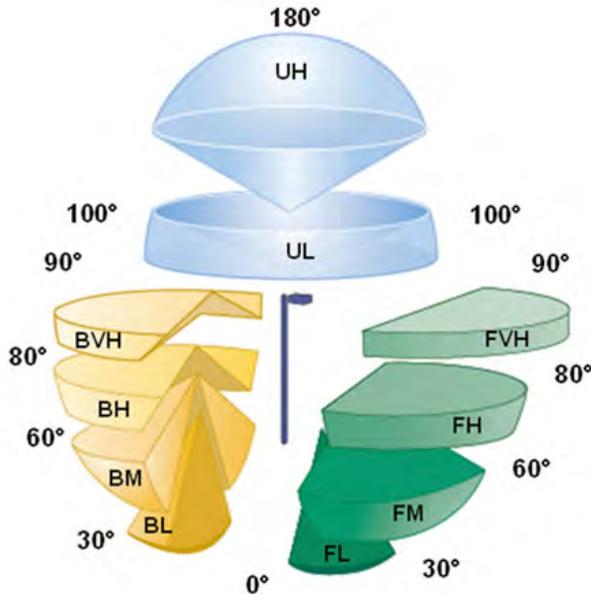


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Specifier Bulletin

for Dark Sky Applications

VOLUME 2: ISSUE 1 : 2009 — [International Dark-Sky Association](http://www.darksky.org)



A Classification System
for Lighting Zones

The BUG System—A New Way To Control Stray Light from Outdoor Luminaires





For more information on FSA approved luminaires please visit the IDA Web site www.darksky.org.

BUG STANDS FOR “Backlight”, “Uplight” and “Glare.” The acronym describes the types of stray light escaping from an outdoor lighting luminaire. “B” stands for backlight, or the light directed in back of the mounting pole. “U” stands for uplight, or the light directed above the horizontal plane of the luminaire, and “G” stands for glare, or the amount of light emitted from the luminaire at angles known to cause glare.

It is expected that BUG values will be published by luminaire manufacturers so lighting specifiers, designers or purchasers can tell at a glance how well a certain luminaire controls stray light or compares with other luminaires under consideration for an installation.

The BUG system was developed by the Illuminating Engineering Society (IES) to make comparing and evaluating outdoor luminaires fast, easy and more complete than older systems.

Work on the BUG system started in 2005 when the IES upgraded the roadway shielding classification system. The original system, which included the ratings full cutoff, cutoff, semi-cutoff and non cutoff, had been designed as a rating system solely for street lighting. However, increasing demand for control of glare and light trespass extended these terms to all types of outdoor lighting, and the IES realized that a more comprehensive system was needed.

The Lighting Research Center, acting as an IES contractor, developed a new classification concept that addresses light emitted from the luminaire in all directions, not just up into the sky. This system, released to the public as IES Technical Memorandum TM-15, technically replaced the old system. It divides the sphere around a luminaire into zones assigning values according to expected environmental impact. This rating system offers the most complete evaluation of the total light emitted from luminaires to date. A point to

The BUG System

remember, however, is that while the values assigned by the new system are good indicators, they may not in all cases directly correlate to light pollution. *It still depends upon the site, the application and how the luminaire is installed.*

A fundamental component of the Model Lighting Ordinance (MLO), currently under public review, divides lighting requirements into lighting zones according to environmental impact. **See Appendix A.** The joint IDA/IES task force in charge of drafting the MLO reviewed TM-15 and realized that it could be modified to serve as a key measure of all forms of light pollution related to shielding and the direction of light, becoming an important tool to determine which luminaires are appropriate for each zone. Modifications were made, including subdividing the TM-15 upright zone to better address artificial sky glow, and subdividing the upper downlight zone to better address glare. The IES accepted these adjustments and released TM-15-07 (revised). **See Figure 1.**

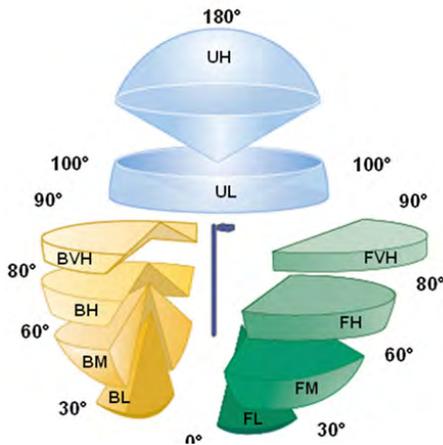


Figure 1: the revised outdoor luminaire distribution measuring system from TM-15-07 (revised)

After reviewing hundreds of candidate luminaires, the MLO task force established the three composite (BUG) ratings based on TM-15-07 (revised):

Backlight, which creates light trespass onto adjacent sites. The B rating takes into account the amount of light in the BL, BM, BH and BVH zones, which are direction of the luminaire OPPOSITE from the area intended to be lighted.

Uplight, which causes artificial sky glow. Lower uplight (zone UL) causes the most sky glow and negatively affects professional and academic astronomy. Upper uplight (UH) is mostly energy waste. The U rating accounts the amount of light into the upper hemisphere with greater concern for the lower uplight angles in UL.

Glare, which can be annoying or visually disabling. The G rating takes into account the amount of frontlight in the FH and FVH zones as well as BH and BVH zones.

Appendix A:

Lighting Zone Definitions: The Lighting Zone shall define the limitations for outdoor lighting as specified in this ordinance. The policymaking body is able to designate areas according to the following descriptions, thereby creating a custom lighting plan according to local needs, functions, and geography.

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. Little or no lighting is expected. 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, security and/or 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, security and/or 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.

Figure 1: the revised (or BUG) outdoor luminaire distribution measuring system from TM-15-07 (revised)

The resulting rating system, called BUG for obvious reasons, is a comprehensive system that takes into account uplight shielding, glare shielding and backlight shielding as well as limiting lamp lumens to values appropriate for the lighting zone. BUG is a simple system consisting of a table of consensus acceptable values against which any luminaire having photometric data can be judged. A luminaire's numerical rating is the LOWEST light zone number in which it can be used. BUG will be part of the latest IES outdoor lighting system update.

The BUG rating system is a principal component of the Model Lighting Ordinance (MLO). The MLO is also a simple system that considers BUG ratings in the context of total lumens allowed per site, which the total site lumens are restricted. Use of the BUG system as the measuring tool for the MLO creates a straightforward system of controlling light pollution that can be implemented by persons having minimal experience or education in outdoor lighting design.

BUG FAQs

Are BUG luminaire ratings better than using the old full cut off, semi cut off, non cut off, etc. designations for shielding?

Yes, because BUG ratings provide backlight and glare information as well as how well the luminaire controls uplight. These additional measurements provide a much more accurate picture of lumen distribution and the overall efficiency of a luminaire.

Does BUG allow any uplight?

BUG requires downlight only with low glare (better than full cut off) in lighting zones 0, 1 and 2, but allows a minor amount of uplight in lighting zones 3 and 4. In lighting zones 3 and 4, the amount of allowed uplight is enough to permit the use of very well shielded luminaires that have a decorative drop lens or chimney so that dark sky friendly lighting can be installed where in places that traditional-appearing fixtures are required.

Will all outdoor lighting manufacturers rate their luminaires according to BUG?

Not at first. Since BUG is designed to prevent bad lighting practices, a lot of current outdoor products won't pass BUG, so there will be no point in rating them. But it is expected that manufacturers will rate their "good" luminaires and make changes to current products to improve BUG ratings.

Will BUG apply to residential lighting?

No. BUG can't be used for residential luminaires because they generally are not photometrically tested. The IDA Fixture Seal of Approval Program can be used to rate residential outdoor luminaires.

Is BUG as strict as the toughest anti-light pollution ordinances in effect today?

BUG, by itself, is a luminaire rating tool. It can easily be applied more stringently by using the zonal factors in response to community choices of lighting zones. While lighting zone determinants are clearly outlined in the MLO, the community decides upon zone placement. If a community adopts the MLO and chooses all lighting zones LZ0 and LZ1, the MLO with BUG is actually more restrictive than any of the toughest ordinances. However, zone assignment will always remain at the discretion of the community.

Addendum A for IES TM-15-07: Backlight, Uplight, and Glare (BUG) Ratings

Text, charts, and photograph from IES TM-15-07:

<http://www.iesna.org/PDF/Erratas/TM-15-07BUGRatingsAddendum.pdf>

The following **Backlight**, **Uplight**, and **Glare** ratings may be used to evaluate luminaire optical performance related to light trespass, sky glow, and high angle brightness control. These ratings are based on a zonal lumen calculations for secondary solid angles defined in TM-15-07. The zonal lumen thresholds listed in the following three tables are based on data from photometric testing procedures approved by the Illuminating Engineering Society for outdoor luminaires (LM-31 or LM-35).

Notes to Tables **A-1**, **A-2**, and **A-3**:

1. Any one rating is determined by the maximum rating obtained for that table. For example, if the BH zone is rated B1, the BM zone is rated B2, and the BL zone is rated B1, then the backlight rating for the luminaire is B2.
2. To determine BUG ratings, the photometric test data must include data in the upper hemisphere unless no light is emitted above 90 degrees vertical (for example, if the luminaire has a flat lens and opaque sides), per the IES Testing Procedures Committee recommendations.
3. It is recommended that the photometric test density include values at least every 2.5 degrees vertically. If a photometric test does not include data points every 2.5 degrees vertically, the BUG ratings shall be determined based on appropriate interpolation.
4. A “quadrilateral symmetric” luminaire shall meet one of the following definitions:
 - a. Type V luminaire is one with a distribution that has circular symmetry, defined by the IES as being essentially the same at all lateral angles around the luminaire.
 - b. Type VS luminaire is one where the zonal lumens for each of the eight horizontal octants (0-45, 45-90, 90-135, 135-180, 180-225, 225-270, 270-315, 315-360) are within ± 10 percent of the average zonal lumens of all octants.

Table A-1: Backlight Ratings (maximum zonal lumens)

		Backlight Rating					
Secondary Solid Angle		B0	B1	B2	B3	B4	B5
Backlight / Trespass	BH	110	500	1000	2500	5000	>5000
	BM	220	1000	2500	5000	8500	>8500
	BL	110	500	1000	2500	5000	>5000

Table A-2: Uplight Ratings (maximum zonal lumens)

		Uplight Rating					
Secondary Solid Angle		U0	U1	U2	U3	U4	U5
Uplight / Skyglow	UH	0	10	100	500	1000	>1000
	UL	0	10	100	500	1000	>1000
	FVH	10	75	150	>150		
	BVH	10	75	150	>150		

Table A-3: Glare Ratings (maximum zonal lumens)

		Glare Rating for Asymmetrical Luminaire Types (Type I, Type II, Type III, Type IV)					
Secondary Solid Angle		G0	G1	G2	G3	G4	G5
Glare / Offensive Light	FVH	10	250	375	500	750	>750
	BVH	10	250	375	500	750	>750
	FH	660	1800	5000	7500	12000	>12000
	BH	110	500	1000	2500	5000	>5000
		Glare Rating for Quadrilateral Symmetrical Luminaire Types (Type V, Type V Square)					
Secondary Solid Angle		G0	G1	G2	G3	G4	G5
Glare / Offensive Light	FVH	10	250	375	500	750	>750
	BVH	10	250	375	500	750	>750
	FH	660	1800	5000	7500	12000	>12000
	BH	660	1800	5000	7500	12000	>12000

“BUG” RATING EXAMPLE:

A 250-watt MH area luminaire, Type IV forward throw optical distribution. Based on the photometric test data, the luminaire has the following zonal lumen distribution:

	Lumens	% Lamp Lumens
Forward Light		
FL (0–30 degrees)	1618	5.9%
FM (30–60 degrees)	6093	22.2%
FH (60–80 degrees)	3748	13.6%
FVH (80–90 degrees)	27	0.1%
Backlight		
BL (0–30 degrees)	985	3.6%
BM (30–60 degrees)	930	3.4%
BH (60–80 degrees)	136	0.5%
BVH (80–90 degrees)	16	0.1%
Uplight		
UL (90–100 degrees)	0	0.0%
UH (100–180 degrees)	0	0.0%

**Backlight Rating:**

Determine the lowest rating where the lumens for all of the secondary solid angles do not exceed the threshold lumens from **Table A-1**. In this example the backlight rating would be B2 based on the BL lumen limit.

Uplight Rating:

Determine the lowest rating where the lumens for all of the secondary solid angles do not exceed the threshold lumens from **Table A-2**. In this example the uplight rating would be U1 based on the FVH and BVH lumen limits.

Glare Rating:

Determine the lowest rating where the lumens for all of the secondary solid angles do not exceed the threshold lumens from **Table A-3** for a Type IV distribution. In this example, the glare rating would be G2 based on the FH lumen limit.

Therefore, the BUG rating for this luminaire would be: **B2 U1 G2**

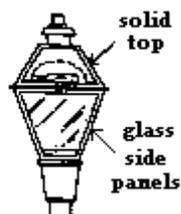
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Examples of Good and Bad Lighting Fixtures



GOOD Even post-top ornamental fixtures, like this Salem Cutoff from GE Lighting, can be cutoff with clear panels and lamp/reflector located above.



GOOD The Yorktown, another ornamental from Emery Fixtures, also has clear panels and bulb located above for maximum glare and spill light control.



BAD Non-cutoff fixtures like this "acorn" ornamental cause light pollution.



GOOD Flat-lens cobra head fixtures, like this American Electric Series 125 Roadway Cutoff luminaire, provide excellent roadway lighting with greatly reduced glare and no uplight.



GOOD This new generation of flat-lens cobra head fixture from American Electric, call the DuraStar 2000, provides superior lighting uniformity at standard mounting heights and spacings.



BAD The ubiquitous drop-lens cobra head luminaire produces a level of glare and uplight that is both unacceptable and unnecessary.



GOOD Many existing dusk-to-dawn security lights and residential streetlights can be retrofitted with the Hubbell Skycap.



GOOD The Hubbell Skycap turns any standard Barn Light into a full-cutoff light with wide area coverage.



BAD Barn Light style fixtures are very inefficient, sending about 20% of the light upward and another 20% horizontally outward, creating glare.



GOOD Flat-lens shoebox fixtures come in many forms; square, rectangular, circular, etc. All control the light with internal reflectors. Glare and light trespass are minimized; no uplight is produced.



GOOD Post-top flat-lens shoebox fixtures like this one provide good area illumination without light pollution.



BAD (sometimes) The telltale sag lens gives this luminaire away as a possible problem. If the lens is clear and very shallow, and the bulb wattage is not too high, this type of light can cover a wider area without too much glare or uplight, but beware!



GOOD Full-cutoff wall packs such as this mcPhilben 101 Wall Sconce make excellent entryway and building



GOOD Recessed canister lights built into the eaves or canopy of a house, garage, or other building is the



BAD Wall packs like this should never be used. They produce enormous

perimeter lights, and there is enough forward throw that adequate lighting is provided for near-building parking.

first choice for lighting building exteriors.

glare and uplight.



GOOD If floodlights must be used, they should always have top and side shielding, and be pointed at least 45 ° below the horizontal.



GOOD Even sports lighting can be done well, if one uses cutoff light fixtures such as these from Soft Lighting Systems.



BAD Unshielded floodlights provide a trashy "prison yard" look and should not be used.

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12/97

International Dark-Sky Association -- Information Sheet 130

Communication Tower Lighting

In recent years we have seen a growing number of communication towers with white strobe lights on them. When these white strobes operate at night, the results can be disastrous for the astronomer, recreational stargazer, and anyone who enjoys the serenity of the night. Flashing at a rate of 40 or 60 times a minute - all night long - these white strobes can be exceedingly annoying, can light up the night sky for miles around, and make it impossible to "dark adapt" anywhere within sight of the tower. Even worse, such towers are often located in "pristine" rural areas without other sources of light pollution.

The rapid growth of the cellular phone industry and other communication services will mean many thousands of new communication towers are likely to be constructed in the next few years. Many of these towers will be lighted, often with white strobe lights at night. Hopefully, legislation will be forthcoming requiring communication service providers to share antenna facilities. And we are not alone: aircraft pilots dislike these towers, and many others consider them a blight upon the landscape.

The Federal Aviation Administration (FAA) considers a tower to be an obstruction to air navigation if it is of a height greater than 500 feet above ground level (AGL) and six or more nautical miles from an airport. At five miles this height reduces to 400 ft. AGL; four miles, 300 ft. AGL; three miles, 200 ft. AGL. Greater restrictions apply when a tower is closer than three nautical miles from an airport. If the FAA determines that a tower is an obstruction to air navigation, then obstruction marking (alternating aviation orange and aviation white paint) and/or lighting (red lights or white lights) will be required.

The FAA recognizes the following categories of obstruction lighting:

Type	Description
L-810	Steady-burning red obstruction light
L-856	High intensity flashing white obstruction light, 40 flashes per minute (FPM)
L-857	High intensity flashing white obstruction light, 60 FPM
L-864	Flashing red obstruction light, 20 - 40 FPM
L-865	Medium intensity flashing white obstruction light, 40 FPM
L-866	Medium intensity flashing white obstruction light, 60 FPM
L-855	Flashing red obstruction light, 60 FPM

Obviously, the least obtrusive kind of nighttime tower lighting is type L-810, L-864, or L-855 red lights. Even though white strobes may be required during daylight and twilight, the FAA can often be convinced to require the tower owner to use red lights at night when there are significant environmental concerns. This is called a dual lighting system.

Generally speaking, any tower construction or alteration of more than 200 feet AGL requires FAA approval before construction can begin.

Decisions about tower lighting are made on a case by case basis by the regional FAA office. To contact your regional FAA office, call the FAA Consumer Hotline at 1 800-FAA-SURE and they will give you the appropriate address and phone number.

Often, there is no public hearing during the tower approval process, but there should be. What can you do? Write your local zoning authority, elected officials, regional FAA office, and local aviation authorities and formally request that you be informed about all permit applications for structures that are to have obstruction lighting. Follow up with phone calls. Be sure everyone involved understands your concerns. Medium-intensity flashing white obstruction lights are not normally recommended on structures less than 200 feet AGL.

High-intensity flashing white obstruction lights are not recommended on structures 500 feet AGL or less, unless an FAA aeronautical study concludes otherwise. Also, FCC licensees are required to file an environmental assessment with the FCC when seeking authorization for the use of the high intensity flashing white lighting system.

What can be done for existing towers that use white strobes at night or if a new tower with white lighting suddenly appears without your knowledge? The first thing to check is whether the white strobe light is going to low intensity at night. The FAA requires that white strobe lights have three (in the case of high intensity white lights) or two (in the case of medium intensity white lights) levels as follows:

Type	Peak Intensity (candelas)	
L-856	day	270,000
	twilight	20,000
	night	2,000
L-857	day	140,000
	twilight	20,000
	night	2,000
L-865/866	day/twilight	20,000
	night	2,000

Note that at night all white obstruction lights should have substantially less intensity than during the daytime. Frequently, however, white strobe light systems can be seen flashing at full daytime intensity at night. This is clearly in violation of FAA regulations, so if you see such a tower, contact your regional FAA office giving the tower location and owner (if known), and they will have the situation rectified promptly.

If the white obstruction lights are operating properly at night, but you still find them obtrusive, contact both the FAA and the tower owner to request that a red lighting system be installed for nighttime use.

Sometimes, white obstruction lights are installed on towers when they are not required by the FAA. Such situations could be avoided by passing a local tower ordinance specifically prohibiting tower lighting not required by the FAA. Bloomington, Minnesota is one community with such an ordinance.

You may have wondered why white strobe lights are now used on many towers, when in the past only red lights were used. A major reason is increasing visual clutter (from the pilot's

perspective) due to bright, upward shining light fixtures! Here we find yet another reason to control light pollution. California amateur astronomer and pilot Stuart Home summed it up pretty well when he said,

Red beacons are not readily visible against a backdrop of city lights. Unlike the astronomer, who is looking up, the pilot is looking down on that light, and the red beacon loses visibility in such a circumstance. Perhaps the thing to do is to use red beacons in rural areas and places where city lighting falls below a certain level.

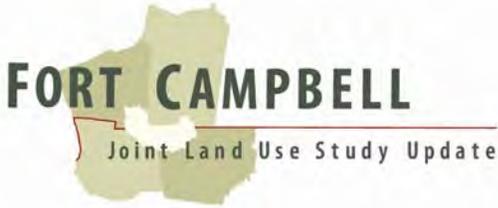
For more information, request the following FAA publications:

Advisory Circular 150/5345-43E, Specification for Obstruction Lighting Equipment (10/19/95)

Advisory Circular 70/7460-1J, Obstruction Marking and Lighting (11/29/95)

Federal Aviation Regulations, Part 77: Objects Affecting Navigable Airspace (March 1993)

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APPENDIX H: MODEL FORT CAMPBELL ACTIVITY ZONE ORDINANCE

Introduction

This document includes land use and design standards for the areas surrounding Fort Campbell.

Summary

The Fort Campbell zoning district is intended to provide for uses and unique design requirements for lands adjacent to and within accident potential zones, airspace zones, and noise zones for Fort Campbell. Site design and other standards are necessary to protect navigable airspace and may include height limitations, smoke limitations, lighting limitations, and other standards necessary to ensure protection of the airspace. Three districts are established for the Fort Campbell Activity Zones (FCAZ): FCAZ I, FCAZ II, and FCAZ III. FCAZ I includes the Clear Zones and Accident Potential Zone I associated with Campbell Army Airfield. FCAZ II includes Accident Potential Zones II and all areas within the noise zone LDN 70. FCAZ III includes all land inside the JLUS Area of Concern.

The official zoning map delineates the boundaries of the FCAZ I, FCAZ II, and FCAZ III districts, based upon the Accident Potential Zones and LDN noise zones.

Site Design Standards for the Fort Campbell Activity Zoning Districts (FCAZ)

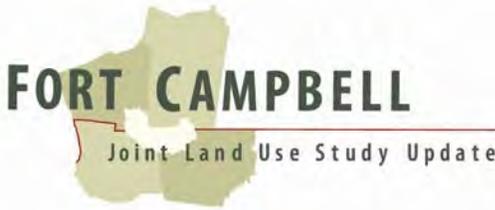
- A. The purpose of the Fort Campbell Activity Zoning Districts (FCAZ I, FCAZ II, and FCAZ III) is to:
1. Ensure safety to people and property within the FCAZ;
 2. Prohibit the establishment of incompatible structures within the designated FCAZ I, II and III;
 3. Protect the airspace, Military Operating Area, approach zones, inner horizontal zones, conical zones, outer horizontal zones, and transitional zones from the establishment of structures or placement of objects that interfere with the safe operation of aircraft;
 4. Limit land uses within the FCAZ to those uses that are compatible with military operations;
 5. Protect people and property from the potential adverse effects of aircraft noise; and aircraft crashes and
 6. Ensure the continued presence of Fort Campbell in _____ County.



FORT CAMPBELL

Joint Land Use Study Update

- B. The following documents are hereby adopted by reference as is fully set forth within this Ordinance:
1. Fort Campbell Joint Land Use Study (JLUS) Report.
 2. JLUS Maps (i.e. Figure 22).
- C. Location of districts within the FCAZ:
1. FCAZ I: Includes all property in the Clear Zones and Accident Potential Zones (APZs) I.
 2. FCAZ II: Includes APZs II and areas within noise zone LDN 70.
 3. FCAZ III: Includes all land in the JLUS Area of Concern.
- D. Development standards within the FCAZ Zoning Districts
1. Within the FCAZ I, the following uses are prohibited:
 - a. Any structures in the Clear Zone
 - b. Any residential uses in Accident Potential Zone 1
 - c. Any uses that concentrates, within a structure on a regular basis, more than 25 people per acre. This limitation applies to: sports stadiums, amphitheaters, auditoriums, clubhouses, churches, schools, hospitals, assisted living and other medical facilities, hotels and motels, restaurants and other eating and drinking establishments built to such a scale that gatherings of more than 25 people per acre would be expected on a regular basis.
 2. Within the FCAZ II, the following uses are prohibited:
 - a. Multi-family residential development; and
 - b. Single-family residential with a density of more than one (1) unit per two (2) acres.
 3. Within all FCAZ areas (except for those areas under easements which set a lower height restriction), buildings, structures, and objects with a height of seventy-five (75) feet or more are prohibited, except where a Representative from Fort Campbell specifically certifies that the proposed height is not a hazard to aircraft take-offs, landings, or flight operations.
 4. Within all FCAZ areas, all lights used in conjunction with streets, parking, signs, and uses of land shall be arranged and operated in such a manner that they do not interfere with pilot vision during take-off, landing, or flight operations (See proposed lighting ordinance).
 5. Within all FCAZ areas, no uses or operations of any type shall produce smoke, glare, birds or other visual interference that will present a hazard to aircraft during take-off, landing, or flight operations. Agricultural uses are exempt.
 6. Within all FCAZ areas, no uses or operations of any type shall produce electronic interference with navigation signals or radio communication between aircraft, the airport, or the air traffic controller.



FORT CAMPBELL

Joint Land Use Study Update

7. Within all FCAZ areas, approval for a permit for residential development shall require a perpetual nonexclusive easement acknowledging that the property is situated in an area that may be subjected to conditions resulting from military training at Fort Campbell.
8. Within all FCAZ areas, all real estate transactions shall include a form disclosing proximity of the site to the military installation. The form shall be affixed to all listing agreements, sales and rental contracts, subdivision plats, and any individual marketing materials, such as brochures, etc. Disclosure is required as soon as practicable, but must be before the execution of a contract, i.e., before the making or acceptance of an offer.
9. The following standards apply to development within the noise impact areas that are 60 dB plus (Note this includes areas near the Land Use Planning Buffer associated with large arms firing):
 - a. All work and operations shall be conducted within buildings or enclosed structures.
 - b. All new development, redevelopment, and building alterations or additions permitted within the noise impact area shall be required to meet the noise attenuation requirements of JLUS Report (See the land use compatibility guidance for noise areas).
 - c. Applications for the approval of development within the noise impact area shall include certification from a qualified acoustical expert that the proposed construction complies with the standards of JLUS Report
2. All applications for rezoning and development approval, including site plans, building permits, subdivision plats, sign permits, temporary use permits, and other permits and plans in the JLUS Area of Concern shall be subject to review by a Representative at Fort Campbell. Such review shall be limited to issues of compatibility with Fort Campbell and issues affecting the safety of persons and property related to aircraft take-offs, landings, and flight operations.



APPENDIX I: STAKEHOLDER INPUT SUMMARY

1) What actions (policies, ordinances, plans, meeting participation, informational materials, etc...) has your organization taken since the original 1996 Joint Land Use Study to promote development compatibility around Ft. Campbell?

- In Oak Grove, plans are sent to Ft. Campbell (FTC) for approval as though it were another city department. The city maintains a close relationship with FTC through a planning/zoning/utilities committee. The utility agenda for Oak Grove is sent to FTC each month.
- The Trigg County Planning Commission has signed an agreement with FTC to attach noise warnings to plats within a set distance.
- In Clarksville, the Sabre Heliport Overlay district ordinance and map has been adopted.
- A Memorandum of Understanding (MOU) has been signed between Clarksville-Montgomery Co. and FTC.
- In Clarksville, FTC now gets site/subdivision review within a one mile buffer of the installation.
- FTC has an exhaustive and recently updated list of actions taken since the initial JLUS.

2) Have recommendations for land use controls and growth management been formally adopted into local code or plans?

- Oak Grove will likely pass a lighting ordinance for 41-A in August. Oak Grove also has a good relationship with Christian County and with Hopkinsville. Ambulance/EMS services are supplied by the county.
- In Christian County, height restrictions have been added to the zoning ordinance.
- In Clarksville, the comprehensive plan has been updated so as to be compatible with FTC (in addition to Sabre Heliport and MOU).
- In Christian County, there is no zoning authority. This could only come with adoption of a zoning ordinance for the entire county, and as of now that has not happened. However, a Memorandum of Agreement (MOA) has been signed with FTC that allows FTC to have review over developments in southern Christian County. The MOA also provides that noise warnings be attached to plats that are in noise zones.

3) Have the actions taken thus far been effective in limiting encroachment?

- In Oak Grove, the city provided a venue for Wal-Mart and Ft. Campbell to meet and negotiate Wal-Mart's plans for the new store at corner of 911 and 41-A. Wal-Mart agreed to build oversized stormwater basins to ensure that runoff would not affect the installation's rail line. The recently built Oak Grove Shopping Plaza was approved by FTC.
- In Clarksville, at least one area that was intended to be a buffer zone was rezoned R-1 to bring it into the urban growth boundary as a projected growth area, thus qualifying it under Tennessee law to have sewer extended. It "slipped through the cracks."
- In Clarksville, the Liberty Parkway subdivision was designed with FTC compatibility in mind.
- There is concern that not many effective actions have been taken in Clarksville, although a number of meetings have taken place.
- Hopkinsville's actions have been somewhat effective.

4) What do you think have been the major obstacles to implementing JLUS recommendations (funding, lack of regulatory tools, communication, or community awareness, etc...)?

- In Oak Grove, the biggest obstacle has been the transition involved in getting a new planner. Community awareness is also not an issue because the city is 80 percent military.
- Some at Pennyriple Area Development District (PADD) noted that there have been a lot of complaints about conflicting information coming from FTC about what can be built and where, especially in easement areas. People often do not know who to talk to at FTC to get answers.
- In Clarksville, politics has been an obstacle, particularly issues surrounding the Exit 1 and Exit 4 growth areas.
- Clarksville is adding 6,000 people per year to the population.
- Hopkinsville/Christian County—political will on part of community and military. Each wants to push land regulation on to the other to avoid takings liability. Communication between community and military is also a problem. Example: Hopkinsville adopted a noise contour map as part of its zoning ordinance, but the contours were updated without the municipality being informed of such. A conflict arose when there was a discrepancy between the adopted map and the updated map.

5) Are there current development trends or planned infrastructure improvements in your community that you think could affect land use patterns around Ft. Campbell?

FORT CAMPBELL

Joint Land Use Study Update

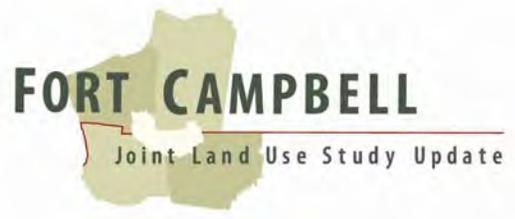
- In Oak Grove, KDOT is designing a project to widen KY 911 to 5 lanes. Development along 911 (Thompsonville Ln.) will be residential with pockets of commercial and Wal-Mart at KY911 and 41-A.
- The main obstacle to growth for Oak Grove is sewer (water is not a problem). They are currently at 64 percent sewer capacity. They are considering connecting their sewer line with Hopkinsville. Permits have been issued for 1,300 new houses in the city.
- In Oak Grove, there is also a project currently in development on Walter Garrett Ln. that will include a walking trail, a playground, a city amphitheater, and a convention center.
- In Hopkinsville, Pennyriple Pkwy is being extended to I-24.
- Also in Hopkinsville, a developer bought a large amount of land around Bell Station Rd (just north CAAF). A lot of the land is easement land and is not sewerded; however, he is trying to get sewer extended to the property.
- In Clarksville-Mont. Co. the Exit 1 and Exit 4 areas are reaching capacity and developers are looking to the PGA just south of FTC for growth.
- Clarksville is in the process of revamping zoning districts to incorporate smart growth. They are looking at density issues in particular.

6) Is your community experiencing any current compatibility issues, such as noise complaints?

- According to Oak Grove, they have received next to no noise complaints. They do have complaints from a handful of property owners who want FTC to purchase their land instead of placing restrictions on it.
- Clarksville is facing the same issue. They are currently being sued by property owners.

7) What would you like to see the updated JLUS add to the 1996 plan recommendations?

- Public meeting just for Oak Grove (to work out property issues)
- NVD Guidelines for lighting ordinance
- Sample zoning overlay ordinances
- A map showing where properties with restrictive easements lie
- A website should be set up by FTC that offers information about what people can do with which properties, etc. The site would be similar to a county or city site where plans and maps could be found that give information about buffer zones and ordinances in place.
- Information on buffers



8) Are there any other tools or approaches that you would like us to explore?

- Plan for terrorism/evacuation/preparation
- Suggestion that extra jurisdictional zoning authority be given to FTC for parts of Christian County so that the County will not have to adopt an ordinance and zone the entire county.