CLANTON & ASSOCIATES

LIGHTING DESIGN AND ENGINEERING

Lighting Ordinance Case Studies

City of Fort Collins, Colorado
November 27, 2019

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Executive Summary

Clanton & Associates, Inc has reviewed the exterior lighting for five projects in the City of Fort Collins, all of which have been completed in the last seven years. The goal of this review is to provide a better understanding of the proposed revisions to the outdoor lighting ordinance and how the proposed changes may affect real world projects.

The five case studies were selected by City staff and were selected to show an array of project types. Available project documentation was provided to Clanton & Associates, which typically included documentation required for permits. For each case study, assumptions are stated where used.

Key Conclusions

- The proposed ordinance removes subjective requirements that may allow a design to pass without truly meeting the intent of the ordinance.
- The existing ordinance requires the submission of photometric plans. While this is helpful information for evaluating a design, it was often submitted as incomplete, with certain luminaires missing from the calculation, or certain areas not included. If photometric plans are going to be required moving forward, it is recommended that a complete checklist be provided as part of the permitting process to aid in evaluating these photometric plans. The proposed lighting ordinance does not require the submission of photometric plans, which may reduce the burden on both those submitting and those reviewing such documentation.
- The biggest culprit that is difficult to address with the existing ordinance is glare. The existing ordinance provides no objective evaluation of glare, making it challenging to understand how obtrusive certain luminaires may be. By using an industry-wide recognized metric (the Backlight-Uplight-Glare, or BUG, Rating), the proposed ordinance provides a numerical method for evaluating glare based on tested luminaire performance. Nearly all reviewed designs did not meet the glare requirements of the proposed lighting ordinance. Designers would need to specify less glary lights if compliance with the proposed ordinance were mandatory.
- The lighting context zone makes a huge difference in evaluating designs under the proposed ordinance. Most designs in this review are considered to have a context area of “LZ1” which allows for half the site lumens as a site listed under “LZ2”. 3 of the 5 designs did not comply with the total site lumen allowance. It will need to be considered whether these designs are providing excessive light, or if the total site lumen allowances are too strict.

Project 1: The Elizabeth Hotel

Project Information

Name: The Elizabeth Hotel
Type: Hotel with parking garage and connecting alleyway
Site Area (Hardscape): 61,000 square feet
Lighting Context Classification: LZ3

Type	Description of Exterior Luminaires	Luminaire Lumens	Qty	Mounting Height (MH)	Correlated Color Temperature (CCT)	Backlight-Uplight-Glare Rating
A	Alley String lights	33 lm/ft	300ft	18-ft	Not given	B0-U1-G0
B	Alley pole lights	Not given	6	18-ft	Not given	Not given
C	Pedestrian lights	7,992	8	15-ft	3000K	B3-U0-G1
D	Parking garage lights	9,611	12[1]	20-ft	3000K	B1-U0-G2
E	Landscape lights	85	12	Ground	Not given	Not given

NOTES:
1. 12 parking lot lights are shown on the top floor of the parking garage

Type A	Type B	Type C	Type D	Type E
	Unknown			

Compliance with Existing Ordinance

The existing lighting ordinance lists a number of requirements for compliance. These requirements are listed in Section 3.2.4 – Site Lighting of the City of Fort Collins Land Use Code.

Ordinance Requirement:
Functional and security needs of the project are met in a way that does not adversely affect the adjacent properties or neighborhood.

Subjective. The lighting design primarily consists of pedestrian-scale post top mounted lights and low-output adjustable landscape lighting, with no large flood-lights that are more likely to adversely affect adjacent properties.

Ordinance Requirement:
Light sources shall be concealed and fully shielded and shall feature sharp cut-off capability so as to minimize up-light, spill-light, glare and unnecessary diffusion on adjacent property. Light fixtures shall be attached to poles and buildings by use of nonadjustable angle brackets or other mounting hardware.

The string lights do not comply as they are not fully shielded. String lights are often given exceptions from site lighting ordinances, or restricted to maximum lumen output, especially in gathering spaces. The landscape lights are adjustable, which may not comply depending on interpretation.

Ordinance Requirement:
The style of light standards and fixtures shall be consistent with the style and character of architecture proposed on the site. Poles shall be anodized (or otherwise coated) to minimize glare from the light source.

Subjective. Elements appear to be consistent with the style and character of the architecture. All finishes that are listed are 'black'.

Ordinance Requirement:
Light sources must minimize contrast with the light produced by surrounding uses, and must produce an unobtrusive degree of brightness in both illumination levels and color rendition. Incandescent and high-pressure sodium light sources all can provide adequate illumination with low contrast and brightness and are permitted light sources.

Subjective. Where specified, luminaires in this design have a Correlated Color Temperature (CCT) of 3000K and Color Rendering Index (CRI) of 80+, which is generally considered unobtrusive and appropriate for this environment.

Ordinance Requirement:
Lighting plan submitted

Yes. However, luminaire specifications are incomplete and there is no calculation summary.

Ordinance Requirement:
Meet minimum light level requirements.

Requirement: Walkways along roadside, Commercial area: 0.9-fc average minimum
- Average is not listed. There are some areas, especially around pedestrian lights, where light levels read between 1.0 and 2.0-fc, approximately. Between these spaces, light levels are between 0.1 and 0.3-fc, approximately.

Requirement: Parking Areas: 1.0-fc average minimum
- Average is not listed. Most points shown on the plan are at or above 1.0-fc

Ordinance Requirement:
Background spaces like parking lots shall be illuminated as unobtrusively as possible to meet the functional needs of safe circulation and of protecting people and property & minimize glare:

Subjective. Parking lot light is rated "B1" for a backlight rating, which is relatively unobtrusive.

Ordinance Requirement:
Maximum on-site lighting levels shall not exceed ten (10) foot-candles, except for loading and unloading platforms where the maximum lighting level shall be twenty (20) foot-candles.

Maximum on-site lighting levels do not exceed 10 foot-candles.

Ordinance Requirement:
Light levels measured twenty (20) feet beyond the property line of the development site (adjacent to residential uses or public rights-of-way) shall not exceed one-tenth (0.1) foot-candle as a direct result of the on-site lighting.

Not indicated on site lighting plan

Ordinance Requirement:
Outdoor display lots for vehicles sales and leasing (as those terms are defined in Article 5) shall comply with the requirements of this section. In addition, display fixture illumination shall be reduced within thirty (30) minutes after closing so that the remaining illumination levels are sufficient for security purposes only; provided, however, that any illumination used after 11:00 p.m. shall be reduced to levels sufficient for security purposes only.

N/A

Ordinance Requirement:
Exposed L.E.D. (light emitting diode) lighting shall be limited to a maximum of one thousand (1,000) candela per square meter (nits).

No exposed LED

Ordinance Requirement:
All lighting shall have a nominal correlated color temperature (CCT) of no greater than three thousand (3,000) degrees Kelvin.

All luminaires where this information is available are listed as 3000K.

Summary of Compliance with Existing Ordinance
The lighting design appears to meet most elements of the existing lighting ordinance, though many items are subjective and different reviewers may have differing opinions. The lighting may not meet minimum footcandle requirement for walkways, or stay below the maximum footcandle requirement 20-ft beyond the property line, but this cannot be verified.

Compliance with Proposed Ordinance

The proposed ordinance outlines specific, numerical requirements for reducing obtrusive and excessive light. To verify compliance with the proposed ordinance, a worksheet is used to identify each component and address the lighting design's compliance.

(A) **Total Site Lumen Limit**.

Determine the total site lumen limit. Site is classified as LZ3.

Hardscape Area	61,000 square feet	
Base Allowance *(select multiplier based on lighting zone)*	**0.5**	lumens per square foot of hardscape area for LZ0
	1.25	lumens per square foot of hardscape area for LZ1
	2.5	lumens per square foot of hardscape area for LZ2
	5	lumens per square foot of hardscape area for LZ3
Total Allowance *(multiply the hardscape area by the multiplier selected above*)*	**305,000** lumens	
	** See Table 3.2.4-5 in the lighting ordinance for additional allowances that may be used in certain circumstances.*	

Determine the total amount of lumens used.

Luminaire	Quantity	Initial Lumens Each	Total Initial Lumens
A	300	33	9,900
B	6	?[1]	?[1]
C	8	7,992	63,936
D	12	9,611	115332
E	12	85	1,020
		TOTAL	**190,188**

Is the total amount of initial lumens less than the total site lumen allowance?

__**x**[1]__ Yes (**Pass**) _____ No (**Fail**)

NOTES:

1. Not enough information to access. Assuming Luminaire 'B' (Alley luminaire) does not exceed 19,000 lumens per luminaire, which is extremely unlikely, then this design passes.

(B) **Limits to Off-Site Impacts - Compliance with Backlight-Uplight-Glare (BUG) rating**

Determine each luminaire's BUG Rating.

Luminaire	B	U	G
A	0	1	0
B	?[1]	?[1]	?[1]
C	3	0	1
D	1	0	2
E	?[2]	?[2]	?[2]

NOTES:
1. Not enough information to access.
2. Since this luminaire is adjustable, the BUG rating cannot be determined as it is dependent on aiming angles. Backlight and Glare ratings are less meaningful for a low-output landscape light, but the Uplight may still be notable.

Determine the Allowed Backlight Rating and Compliance.

Luminaire	Given B-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed B-Rating in Zone	Complies?
A	0	18-ft	36-ft	Yes	5	**Yes**
B	?[4]	18-ft	22-ft	No[2]	n/a	?[4]
C	3	15-ft	14-ft	Yes	3	**Yes**
D	1	20-ft[1]	90-ft	n/a[3]	5	**Yes**
E	?[4]	1-ft	16-ft	Yes	5	**Likely**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*

NOTES:
1. Since the parking lot luminaire is mounted on the top level of a parking garage, the actual mounting height is closer to 45-ft.
2. This luminaire is mounted such that, at the luminaire location closest to the property line, the luminaire faces that property line. As such, evaluating the impact of the backlight rating does not provide valuable information for off-site impacts.
3. This luminaire is not ideally oriented but is mounted greater than 2 times its mounting height from the nearest property line.
4. Not enough information to access.

Determine the Allowed Uplight Rating

Luminaire	Given U-Rating	Allowed U-Rating in Zone	Complies?
A	1	3	**Yes**
B	?[1]	3	?[1]
C	3	3	**Yes**
D	1	3	**Yes**
E	?[1]	3	**Likely**

NOTES:
1. Not enough information to access

Determine the Allowed Glare Rating

Luminaire	Given G-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed G-Rating in Zone	Complies?
A	0	18-ft	36-ft	Yes	2	**Yes**
B	?[2]	18-ft	22-ft	No	1	**Unknown**
C	1	15-ft	14-ft	Yes	1	**Yes**
D	2	20-ft[1]	90-ft	No	2	**Yes**
E	?[2]	1-ft	16-ft	Yes	2	**Unknown**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*

NOTES:
1. Since the parking lot luminaire is mounted on the top level of a parking garage, the actual mounting height is closer to 45-ft.
2. Not enough information to access

Do all luminaires comply in all categories?

__x[1]__ Yes (**Pass**) _____No (**Fail**)

NOTES:
1. Assuming Luminaire 'B' (Alley luminaire) does not exceed a BUG Rating of B5-U3-G1, then this design passes.

(4) Additional Compliance

- All lighting shall have a nominal correlated color temperature (CCT) of no greater than 3000 Kelvin.
  - Yes
- Light poles shall be anodized (or otherwise coated) to minimize glare from the light source
  - Yes
- Required lighting controls and curfews:
  - Unable to evaluate

Conclusions

With the noted assumptions made, the design passes most components of both the existing site lighting ordinance and the new proposed ordinance. As such, it is likely that implementing the new ordinance would not see significant changes in the design. Since the new proposed lighting ordinance requires more information on each specified luminaire to review compliance, plans submitted for permit review might be encouraged to provide a higher level of detail.

A photometric plan is not required for compliance with the new proposed ordinance. The existing ordinance does require a photometric plan, but the submitted plan did not provide a calculation summary, so compliance was difficult to assess.

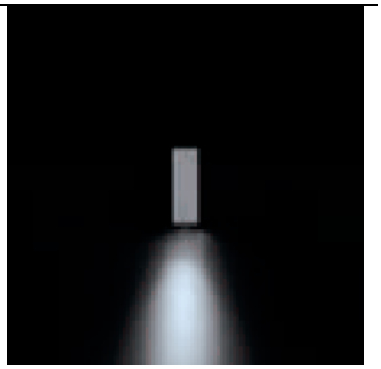
Project 2: Eye Center of Northern Colorado

Project Information

Name: Eye Center of Northern Colorado
Type: Medical Office
Site Area (Hardscape): 91,922 square feet
Lighting Context Classification: LZ1

Type	Description of Exterior Luminaires	Luminaire Lumens	Qty	Mounting Height (MH)	Correlated Color Temperature (CCT)	Backlight-Uplight-Glare Rating
A	Parking lot area lights	5,800	27	?[1]	3000K	B1-U0-G1
B	Wall pack	4,028	2	6-ft 8-in	3000K	B1-U0-G1
C	Wall sconce[2]	270	22	8-ft	3000K[3]	Not Given

NOTES:
1. Not listed in documentation.
2. Luminaire submittal contains note: "Fixture will have down light only, no up lighting will be used to meet the dark sky requirements."
3. Assumption, not listed in documentation

Type A	Type B	Type C
		

Compliance with Existing Ordinance

The existing lighting ordinance lists a number of requirements for compliance. These requirements are listed in Section 3.2.4 – Site Lighting of the City of Fort Collins Land Use Code.

Ordinance Requirement:
Functional and security needs of the project are met in a way that does not adversely affect the adjacent properties or neighborhood.

Subjective. The lighting design consists of parking lot area lights and two styles of wall sconces mounted to the exterior of the building. All of the specified luminaires are of an appropriate lumen output for the application. There is not an excessive quantity of lights, and parking lot area lights are mounted facing away from neighboring properties.

Ordinance Requirement:
Light sources shall be concealed and fully shielded and shall feature sharp cut-off capability so as to minimize up-light, spill-light, glare and unnecessary diffusion on adjacent property. Light fixtures shall be attached to poles and buildings by use of nonadjustable angle brackets or other mounting hardware.

All luminaires specified are designed such that the light is directed downwards. There is no specified external shielding to reduce glare and backlight onto adjacent properties.

Ordinance Requirement:
The style of light standards and fixtures shall be consistent with the style and character of architecture proposed on the site. Poles shall be anodized (or otherwise coated) to minimize glare from the light source.

Subjective. Elements appear to be consistent with the style and character of the architecture. Luminaire finishes are not listed in documentation.

Ordinance Requirement:
Light sources must minimize contrast with the light produced by surrounding uses, and must produce an unobtrusive degree of brightness in both illumination levels and color rendition. Incandescent and high-pressure sodium light sources all can provide adequate illumination with low contrast and brightness and are permitted light sources.

Subjective. Where specified, luminaires in this design have a CCT of 3000K and CRI of 80+, which is generally considered unobtrusive and appropriate for this environment.

Ordinance Requirement:
Lighting plan submitted

Lighting plan is submitted with calculation summary.

Ordinance Requirement:
Meet minimum light level requirements.

Requirement: Building surrounds (nonresidential): 1.0-fc average minimum
- Walkways directly surrounding building are not shown on calculation grid.

Requirement: Parking Areas: 1.0-fc average minimum
- Average is 1.4-fc which meets the requirement.

Ordinance Requirement:
Background spaces like parking lots shall be illuminated as unobtrusively as possible to meet the functional needs of safe circulation and of protecting people and property & minimize glare:

Subjective. Parking lot light is rated “B1” for a backlight rating, which is relatively unobtrusive.

Ordinance Requirement:
Maximum on-site lighting levels shall not exceed ten (10) foot-candles, except for loading and unloading platforms where the maximum lighting level shall be twenty (20) foot-candles.

Maximum on-site lighting levels do not exceed 10 foot-candles.

Ordinance Requirement:
Light levels measured twenty (20) feet beyond the property line of the development site (adjacent to residential uses or public rights-of-way) shall not exceed one-tenth (0.1) foot-candle as a direct result of the on-site lighting.

Grid 20-ft beyond property line does not exceed 0.1-fc.

Ordinance Requirement:
Outdoor display lots for vehicles sales and leasing (as those terms are defined in Article 5) shall comply with the requirements of this section. In addition, display fixture illumination shall be reduced within thirty (30) minutes after closing so that the remaining illumination levels are sufficient for security purposes only; provided, however, that any illumination used after 11:00 p.m. shall be reduced to levels sufficient for security purposes only.

N/A

Ordinance Requirement:
Exposed L.E.D. (light emitting diode) lighting shall be limited to a maximum of one thousand (1,000) candela per square meter (nits).

No exposed LED

Ordinance Requirement:
All lighting shall have a nominal correlated color temperature (CCT) of no greater than three thousand (3,000) degrees Kelvin.

All luminaires where this information is available are listed as 3000K.

Summary of Compliance with Existing Ordinance
The lighting design appears to meet nearly all requirements of the existing lighting ordinance. Many items are subjective and different reviewers may have differing opinions. The design appears unobtrusive and there is no excessive lighting, which meets the intention of the current lighting ordinance.

Compliance with Proposed Ordinance

The proposed ordinance outlines specific, numerical requirements for reducing obtrusive and excessive light. To verify compliance with the proposed ordinance, a worksheet is used to identify each component and address the lighting design's compliance.

(A) **Total Site Lumen Limit**.
Determine the total site lumen limit. Site is classified as LZ1.

Hardscape Area 91,922 square feet

Base Allowance *(select multiplier based on lighting zone)*

0.5	lumens per square foot of hardscape area for LZ 0
1.25	lumens per square foot of hardscape area for LZ 1
2.5	lumens per square foot of hardscape area for LZ 2
5	lumens per square foot of hardscape area for LZ 3

Total Allowance *(multiply the hardscape area by the multiplier selected above*)* **114,902** lumens

** See Table 3.2.4-5 in the lighting ordinance for additional allowances that may be used in certain circumstances.*

Determine the total amount of lumens used.

Luminaire	Quantity	Initial Lumens Each	Total Initial Lumens
A	27	5,800	156,600
B	2	4,028	8,056
C	22	270	5,940
		TOTAL	**170,596**

Is the total amount of initial lumens less than the total site lumen allowance?

____ Yes (**Pass**) __**x**__ No (**Fail**)

(B) **Limits to Off-Site Impacts - Compliance with Backlight-Uplight-Glare (BUG) rating**

Determine each luminaire's BUG Rating.

Luminaire	B	U	G
A	1	0	1
B	1	0	1
C	?[1]	?[1]	?[1]

NOTES:
1. Not enough information to access.

Determine the Allowed Backlight Rating and Compliance.

Luminaire	Given B-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed B-Rating in Zone	Complies?
A	1	?[1]	3.5-ft	Yes	0	**No**
B	1	6-ft 8-in	135-ft	No	3	**Yes**
C	?[2]	8-ft	40-ft	No	3	**Likely**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*
NOTES:
1. Not enough information to access. On the south side, the luminaire is mounted very close to the property line. Unless the luminaire is mounted below 7-ft (which is extremely unlikely), then it will require a Backlight Rating of '0'
2. Not enough information to access.

Determine the Allowed Uplight Rating

Luminaire	Given U-Rating	Allowed U-Rating in Zone	Complies?
A	0	0	**Yes**
B	0	0	**Yes**
C	?[1]	0	**Likely**

NOTES:
1. Not enough information to access

Determine the Allowed Glare Rating

Luminaire	Given G-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed G-Rating in Zone	Complies?
A	1	?[1]	3.5-ft	Yes	0	**No**
B	1	6-ft 8-in	135-ft	No	0	**No**
C	?[1]	8-ft	40-ft	No	0	**Unknown**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*

NOTES:
1. Not enough information to access

Do all luminaires comply in all categories?

____ Yes (**Pass**) __x__ No (**Fail**)

(4) Additional Compliance

- All lighting shall have a nominal correlated color temperature (CCT) of no greater than 3000 Kelvin.
  - Yes
- Light poles shall be anodized (or otherwise coated) to minimize glare from the light source
  - Unknown
- Required lighting controls and curfews:
  - Unable to evaluate

Conclusions

In reviewing the available information for this site, the design passes under the old lighting ordinance, but would not under the new lighting ordinance. The design fails the new ordinance on three accounts:

1. Total site lumen allowance is exceeded. In an effort to meet the required minimum illumination levels of the old ordinance, the parking lot is brighter than necessary for the lighting context zone (LZ1).
2. The parking lot luminaire exceeds the backlight rating allowed at locations where the luminaire is very close to the property line. This could be mitigated by specifying a luminaire with a house-side shield.
3. The parking lot luminaire exceeds the glare rating allowed.

Project 3: Maverik Convenience Store

Project Information

Name: Maverik Convenience Store
Type: Retail / Gas Station
Site Area (Hardscape): 36,956 square feet
Lighting Context Classification: LZ2

Type	Description of Exterior Luminaires	Luminaire Lumens	Qty	Mounting Height (MH)	Correlated Color Temperature (CCT)	Backlight-Uplight-Glare Rating
A	Wall sconce	1,420	15	11-ft	3000K	Not Given
B	Recessed downlight	1,800	8	14-ft	3000K	B1-U0-G0[1]
C	Canopy downlight	8,438	20	16-ft	3000K	B3-U0-G1
D	Parking lot light, 25ft	16,000	1	25-ft	3000K	B2-U0-G3
E	Parking lot light, 25ft	10,000	4	25-ft	3000K	B1-U0-G2
F	Accent, 8ft long	6,000	8	25-ft	3000K	Not Given[2]
G	Accent, 4ft long	3,000	3	25-ft	3000K	Not Given[2]

NOTES:
1. BUG Rating for exact specification is unavailable, but estimated BUG Rating is provided for similar luminaire from manufacturer.
2. BUG Rating will depend on mounting direction.

Type A	Type B	Type C	Type D & Type E	Type F & Type G
				

Compliance with Existing Ordinance

The existing lighting ordinance lists a number of requirements for compliance. These requirements are listed in Section 3.2.4 – Site Lighting of the City of Fort Collins Land Use Code.

Ordinance Requirement:
Functional and security needs of the project are met in a way that does not adversely affect the adjacent properties or neighborhood.

Subjective. The lighting design consists of parking lot area lights, canopy lights for fueling area, and two types of façade lighting. Lights are all downward facing and do not pointed at adjacent properties.

Ordinance Requirement:
Light sources shall be concealed and fully shielded and shall feature sharp cut-off capability so as to minimize up-light, spill-light, glare and unnecessary diffusion on adjacent property. Light fixtures shall be attached to poles and buildings by use of nonadjustable angle brackets or other mounting hardware.

All luminaires specified are designed such that the light is directed downwards. No lights are adjustable. The parking lot lights are specified with a house-side shield which should limit spill-light.

Ordinance Requirement:
The style of light standards and fixtures shall be consistent with the style and character of architecture proposed on the site. Poles shall be anodized (or otherwise coated) to minimize glare from the light source.

Subjective. Elements appear to be consistent with the style and character of the architecture. Poles are coated to minimize glare.

Ordinance Requirement:
Light sources must minimize contrast with the light produced by surrounding uses, and must produce an unobtrusive degree of brightness in both illumination levels and color rendition. Incandescent and high-pressure sodium light sources all can provide adequate illumination with low contrast and brightness and are permitted light sources.

Subjective. Luminaires in this design have a CCT of 3000K, which is generally considered unobtrusive and appropriate for this environment.

Ordinance Requirement:
Lighting plan submitted

Lighting plan is submitted with calculation summary and complete luminaire schedule.

Ordinance Requirement:
Meet minimum light level requirements.

Requirement: Building surrounds (nonresidential): 1.0-fc average minimum
- Walkways directly surrounding building are not shown on calculation grid.

Requirement: Parking Areas: 1.0-fc average minimum
- Average is 0.74-fc which is below the requirement.

Requirement: Under-canopy area (maintained maximum): 20.0-fc maximum
- Maximum is 20.34-fc with a light loss factor of 1.00. The maintained maximum will be lower after initial installation.

Requirement: Under-canopy area (initial installation maximum): 26.0-fc maximum
- Maximum is 20.34-fc with a light loss factor of 1.00, which meets the requirement.

Ordinance Requirement:
Background spaces like parking lots shall be illuminated as unobtrusively as possible to meet the functional needs of safe circulation and of protecting people and property & minimize glare:

Subjective. Parking lot lights are specified with a house-side shield which should reduce spill-light.

Ordinance Requirement:
Maximum on-site lighting levels shall not exceed ten (10) foot-candles, except for loading and unloading platforms where the maximum lighting level shall be twenty (20) foot-candles.

Maximum on-site lighting levels exceed 10 foot-candles, but do not exceed the maximum light level requirements for fueling canopies, which is listed in the existing lighting ordinance as 26.0-fc maximum at initial installation.

Ordinance Requirement:
Light levels measured twenty (20) feet beyond the property line of the development site (adjacent to residential uses or public rights-of-way) shall not exceed one-tenth (0.1) foot-candle as a direct result of the on-site lighting.

Grid 20-ft beyond property line exceeds 0.1-fc in a couple of locations, though not excessively. The highest reading is 0.17-fc.

Ordinance Requirement:
Outdoor display lots for vehicles sales and leasing (as those terms are defined in Article 5) shall comply with the requirements of this section. In addition, display fixture illumination shall be reduced within thirty (30) minutes after closing so that the remaining illumination levels are sufficient for security purposes only; provided, however, that any illumination used after 11:00 p.m. shall be reduced to levels sufficient for security purposes only.

N/A

Ordinance Requirement:
Exposed L.E.D. (light emitting diode) lighting shall be limited to a maximum of one thousand (1,000) candela per square meter (nits).

No exposed LED

Ordinance Requirement:
All lighting shall have a nominal correlated color temperature (CCT) of no greater than three thousand (3,000) degrees Kelvin.

All luminaires have a CCT less than 3000K.

Summary of Compliance with Existing Ordinance
The lighting design appears to meet almost all requirements of the existing lighting ordinance, though it exceeds the illuminance limit 20-ft beyond the property line, and does not meet the mandatory minimum average illuminance for parking lots. Many other items are subjective and different reviewers may have differing opinions. The design appears unobtrusive and there is no excessive lighting, which meets the intention of the current lighting ordinance.

Compliance with Proposed Ordinance

The proposed ordinance outlines specific, numerical requirements for reducing obtrusive and excessive light. To verify compliance with the proposed ordinance, a worksheet is used to identify each component and address the lighting design's compliance.

(A) **Total Site Lumen Limit**.

Determine the total site lumen limit. Site is classified as LZ2.

Hardscape Area 36,956 square feet

Base Allowance *(select multiplier based on lighting zone)*

0.5	lumens per square foot of hardscape area for LZ 0
1.25	lumens per square foot of hardscape area for LZ 1
2.5	lumens per square foot of hardscape area for LZ 2
5	lumens per square foot of hardscape area for LZ 3

Total Allowance *(multiply the hardscape area by the multiplier selected above*)* **92,390** lumens

** See Table 3.2.4-5 in the lighting ordinance for additional allowances that may be used in certain circumstances.*

Additional Site Allowance for vehicle service stations: 8,000 lumens per pump.

- 8,000 lumens x 20 pumps = 160,000 lumens
- Total Allowance: **252,390** lumens

Determine the total amount of lumens used.

Luminaire	Quantity	Initial Lumens Each	Total Initial Lumens
A	15	1,420	21,300
B	8	1,800	14,400
C	20	8,438	168,760
D	1	16,000	16,000
E	4	10,000	40,000
F	8	6,000	48,000
G	3	3,000	9,000
		TOTAL	**317,460**

Is the total amount of initial lumens less than the total site lumen allowance?

____ Yes (**Pass**) __**x**__ No (**Fail**)

(B) **Limits to Off-Site Impacts - Compliance with Backlight-Uplight-Glare (BUG) rating**

Determine each luminaire's BUG Rating.

Luminaire	B	U	G
A	?[1]	?[1]	?[1]
B	1	0	0
C	3	0	1
D	2	0	3
E	1	0	2
F	?[1]	?[1]	?[1]
G	?[1]	?[1]	?[1]

NOTES:
1. Not enough information to access.

Determine the Allowed Backlight Rating and Compliance.

Luminaire	Given B-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed B-Rating in Zone	Complies?
A	?[1]	11-ft	12-ft	Yes	3	**Likely**
B	1	14-ft	50-ft	Yes	4	**Yes**
C	3	16-ft	63-ft	Yes	4	**Yes**
D	2	25-ft	7-ft	No	n/a[2]	**Yes**
E	1	25-ft	20-ft	Yes	2	**Yes**
F	?[1]	25-ft	90-ft	Unknown	4	**Unknown**
G	?[1]	25-ft	20-ft	Unknown	2	**Unknown**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*

NOTES:
1. Not enough information to access.
2. This luminaire is mounted such that, at the luminaire location closest to the property line, the luminaire faces that property line. As such, evaluating the impact of the backlight rating does not provide valuable information for off-site impacts.

Determine the Allowed Uplight Rating

Luminaire	Given U-Rating	Allowed U-Rating in Zone	Complies?
A	?[1]	0	**Unknown**
B	0	0	**Yes**
C	0	0	**Yes**
D	0	0	**Yes**
E	0	0	**Yes**
F	?[1]	0	**Unknown**
G	?[1]	0	**Unknown**

NOTES:
1. Not enough information to access

Determine the Allowed Glare Rating

Luminaire	Given G-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed G-Rating in Zone	Complies?
A	?[1]	11-ft	12-ft	Yes	0	**Likely**
B	0	14-ft	50-ft	Yes	2	**Yes**
C	1	16-ft	63-ft	Yes	2	**Yes**
D	3	25-ft	7-ft	No	0	**No**
E	2	25-ft	20-ft	Yes	0	**No**
F	?[1]	25-ft	90-ft	Unknown	2	**Unknown**
G	?[1]	25-ft	20-ft	Unknown	0	**Unknown**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*

NOTES:
1. Not enough information to access

Do all luminaires comply in all categories?

____ Yes (**Pass**) __x__No (**Fail**)

(4) Additional Compliance

- All lighting shall have a nominal correlated color temperature (CCT) of no greater than 3000 Kelvin.
  - Yes
- Light poles shall be anodized (or otherwise coated) to minimize glare from the light source
  - Yes
- Required lighting controls and curfews:
  - Unable to evaluate

Conclusions

The lighting design passes most components of the existing site lighting ordinance, but fails a couple of components of the proposed ordinance. The design exceeds the total site lumen limit and does not comply with minimum glare ratings for parking lot lights. A design tailored to the proposed ordinance would need to involve a slight reduction in overall light levels. The fuel canopy is lighted above the Illuminating Engineering Society's recommendation of 10-15 footcandles, so this area would be most appropriate to see a reduction without compromising the safety and security of the parking lot and retail entrance.

Project 4: The Grove

Project Information

Name: The Grove
Type: Multi-family residential apartment complex
Site Area (Hardscape): 149,646 square feet
Lighting Context Classification: LZ1

Type	Description of Exterior Luminaires	Luminaire Lumens	Qty	Mounting Height (MH)	Correlated Color Temperature (CCT)	Backlight-Uplight-Glare Rating
A	HPS[1] Parking lot light	3,616	51	12-ft	1900K	B1-U0-G2

NOTES:
1. High Pressure Sodium

Type A

Compliance with Existing Ordinance

The existing lighting ordinance lists a number of requirements for compliance. These requirements are listed in Section 3.2.4 – Site Lighting of the City of Fort Collins Land Use Code.

Ordinance Requirement:
Functional and security needs of the project are met in a way that does not adversely affect the adjacent properties or neighborhood.

Subjective. This lighting design consists of 12-ft tall parking lot luminaires which provide some illumination for the parking lots of the complex. They are located in the center of parking lots and do not provide high illumination levels, especially along the outer edges of the lots. It is assumed that there are porch lights not included in this documentation that would provide additional lighting at the entrances of the buildings. There is no pedestrian lighting for the pedestrian paths.

Ordinance Requirement:
Light sources shall be concealed and fully shielded and shall feature sharp cut-off capability so as to minimize up-light, spill-light, glare and unnecessary diffusion on adjacent property. Light fixtures

shall be attached to poles and buildings by use of nonadjustable angle brackets or other mounting hardware.

The luminaire information provided indicates that there is full-cutoff shielding, which will minimize uplight.

Ordinance Requirement:
The style of light standards and fixtures shall be consistent with the style and character of architecture proposed on the site. Poles shall be anodized (or otherwise coated) to minimize glare from the light source.

Subjective. Elements appear to be consistent with the style and character of the architecture. Luminaire finishes are not listed in documentation.

Ordinance Requirement:
Light sources must minimize contrast with the light produced by surrounding uses, and must produce an unobtrusive degree of brightness in both illumination levels and color rendition. Incandescent and high-pressure sodium light sources all can provide adequate illumination with low contrast and brightness and are permitted light sources.

Subjective. The High Pressure Sodium (HPS) light sources provide a CCT of 1900K. This warm color temperature is appropriate for residential applications, though color rendition is compromised with a CRI of 22.

Ordinance Requirement:
Lighting plan submitted

Lighting plan is submitted with photometric grid, but there is no calculation summary.

Ordinance Requirement:
Meet minimum light level requirements.

Requirement: Parking Areas: 1.0-fc average minimum

- Average footcandles are not provided. Most points on the photometric grid show values of 0.1-fc or less, so this plan very likely does not meet minimum light level requirements.

Ordinance Requirement:
Background spaces like parking lots shall be illuminated as unobtrusively as possible to meet the functional needs of safe circulation and of protecting people and property & minimize glare:

Subjective. Parking lot light is rated “B1” for a backlight rating, which is relatively unobtrusive. A glare rating of “G2” is high for a low-output luminaire used in a residential application. However, the warmer color temperature of the HPS light source is often perceived as less-glary and may be considered acceptable.

Ordinance Requirement:
Maximum on-site lighting levels shall not exceed ten (10) foot-candles, except for loading and unloading platforms where the maximum lighting level shall be twenty (20) foot-candles.

Maximum on-site lighting levels do not exceed 10 foot-candles.

Ordinance Requirement:
Light levels measured twenty (20) feet beyond the property line of the development site (adjacent to residential uses or public rights-of-way) shall not exceed one-tenth (0.1) foot-candle as a direct result of the on-site lighting.

Where shown, light levels 20-ft beyond the property line are calculated to be 0.0-fc.

Ordinance Requirement:
Outdoor display lots for vehicles sales and leasing (as those terms are defined in Article 5) shall comply with the requirements of this section. In addition, display fixture illumination shall be reduced within thirty (30) minutes after closing so that the remaining illumination levels are sufficient for security purposes only; provided, however, that any illumination used after 11:00 p.m. shall be reduced to levels sufficient for security purposes only.

N/A

Ordinance Requirement:
Exposed L.E.D. (light emitting diode) lighting shall be limited to a maximum of one thousand (1,000) candela per square meter (nits).

No exposed LED

Ordinance Requirement:
All lighting shall have a nominal correlated color temperature (CCT) of no greater than three thousand (3,000) degrees Kelvin.

All luminaires are HPS, which have a CCT less than 3000K.

Summary of Compliance with Existing Ordinance
The lighting design does not meet minimum light level requirements of the existing ordinance. The design meets all other requirements, including concealed light sources, reduced uplight, appropriate color temperature, and maximum light level beyond property line.

Compliance with Proposed Ordinance

The proposed ordinance outlines specific, numerical requirements for reducing obtrusive and excessive light. To verify compliance with the proposed ordinance, a worksheet is used to identify each component and address the lighting design's compliance.

(A) **Total Site Lumen Limit**.
Determine the total site lumen limit. Site is classified as LZ1.

Hardscape Area	149,646 square feet	
Base Allowance *(select multiplier based on lighting zone)*	**0.5**	lumens per square foot of hardscape area for LZ 0
	1.25	lumens per square foot of hardscape area for LZ 1
	2.5	lumens per square foot of hardscape area for LZ 2
	5	lumens per square foot of hardscape area for LZ 3
Total Allowance *(multiply the hardscape area by the multiplier selected above*)*	**187,057.5** lumens	
	** See Table 3.2.4-5 in the lighting ordinance for additional allowances that may be used in certain circumstances.*	

Determine the total amount of lumens used.

Luminaire	Quantity	Initial Lumens Each	Total Initial Lumens
A	51	3,616	184,416
		TOTAL	**184,416**

Is the total amount of initial lumens less than the total site lumen allowance?

__**x**[1]__ Yes (**Pass**) ____ No (**Fail**)

NOTES:
1. This design passes with the information shown. If there are luminaires at each building entrance, then that may exceed the total site lumen limit.

(B) **Limits to Off-Site Impacts - Compliance with Backlight-Uplight-Glare (BUG) rating**

Determine each luminaire's BUG Rating.

Luminaire	B	U	G
A	1	0	2

Determine the Allowed Backlight Rating and Compliance.

Luminaire	Given B-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed B-Rating in Zone	Complies?
A	1	12-ft	60-ft	No	3	**Yes**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*

Determine the Allowed Uplight Rating

Luminaire	Given U-Rating	Allowed U-Rating in Zone	Complies?
A	0	0	**Yes**

Determine the Allowed Glare Rating

Luminaire	Given G-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed G-Rating in Zone	Complies?
A	2	12-ft	60-ft	No	0	**No**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*

Do all luminaires comply in all categories?

____ Yes (**Pass**) __x__ No (**Fail**)

(4) Additional Compliance

- All lighting shall have a nominal correlated color temperature (CCT) of no greater than 3000 Kelvin.
  - Yes
- Light poles shall be anodized (or otherwise coated) to minimize glare from the light source
  - Unknown
- Required lighting controls and curfews:
  - Unable to evaluate

Conclusions

In reviewing the available information for this site, the design does not pass under either ordinance. For the existing ordinance, the lighting design does not meet minimum light level requirements for parking lots, but complies in all other categories. For the proposed ordinance, the lighting design passes in all categories except for the luminaire's glare rating.

Project 5: The Slab

Project Information

Name: The Slab
Type: Apartment Complex
Site Area (Hardscape): 38,124 square feet
Lighting Context Classification: LZ1

Type	Description of Exterior Luminaires	Luminaire Lumens	Qty	Mounting Height (MH)	Correlated Color Temperature (CCT)	Backlight-Uplight-Glare Rating
A	Parking lot light	9,523[1]	11	30-ft	4000K	B1-U0-G2
B	Pedestrian light	9,523[1]	7	15-ft	4000K	B1-U0-G2

NOTES:
1. Luminaire lumens and BUG Rating obtained from manufacturer's website based on listed product number in project documentation. Project documentation lists Luminaire Lumens as "5,890" and does not provide BUG Rating.

Type A & Type B

Compliance with Existing Ordinance

The existing lighting ordinance lists a number of requirements for compliance. These requirements are listed in Section 3.2.4 – Site Lighting of the City of Fort Collins Land Use Code.

Ordinance Requirement:
Functional and security needs of the project are met in a way that does not adversely affect the adjacent properties or neighborhood.

Subjective. The lighting design consists of parking lot area lights and pedestrian lights along a pathway. Some of the lights in the parking lot are located close to the edge of the property line, although these luminaires are correctly facing the property.

Ordinance Requirement:
Light sources shall be concealed and fully shielded and shall feature sharp cut-off capability so as to minimize up-light, spill-light, glare and unnecessary diffusion on adjacent property. Light fixtures shall be attached to poles and buildings by use of nonadjustable angle brackets or other mounting hardware.

All luminaires specified are designed such that the light is directed downwards. There is no specified external shielding to reduce glare and backlight onto adjacent properties.

Ordinance Requirement:
The style of light standards and fixtures shall be consistent with the style and character of architecture proposed on the site. Poles shall be anodized (or otherwise coated) to minimize glare from the light source.

Subjective. Elements appear to be consistent with the style and character of the architecture. Luminaire finishes are listed as “Black”.

Ordinance Requirement:
Light sources must minimize contrast with the light produced by surrounding uses, and must produce an unobtrusive degree of brightness in both illumination levels and color rendition. Incandescent and high-pressure sodium light sources all can provide adequate illumination with low contrast and brightness and are permitted light sources.

Subjective. Where specified, luminaires in this design have a CCT of 4000K and CRI of 72. 4000K is often perceived as more glary than warmer color temperatures. A CRI of 72 is acceptable in an exterior environment.

Ordinance Requirement:
Lighting plan submitted

Lighting plan is submitted but there is no calculation summary provided.

Ordinance Requirement:
Meet minimum light level requirements.

Requirement: Parking Areas: 1.0-fc average minimum

- Calculation summary is not provided. Most calculation points show a value of 1.0-fc or greater, indicating that the design likely complies.

Ordinance Requirement:
Background spaces like parking lots shall be illuminated as unobtrusively as possible to meet the functional needs of safe circulation and of protecting people and property & minimize glare:

Subjective. The site appears to provide sufficient light for the property. Some lights are located close to the property line, but are correctly oriented towards the property.

Ordinance Requirement:
Maximum on-site lighting levels shall not exceed ten (10) foot-candles, except for loading and unloading platforms where the maximum lighting level shall be twenty (20) foot-candles.

Maximum on-site lighting levels do not exceed 10 foot-candles.

Ordinance Requirement:
Light levels measured twenty (20) feet beyond the property line of the development site (adjacent to residential uses or public rights-of-way) shall not exceed one-tenth (0.1) foot-candle as a direct result of the on-site lighting.

Fails. Grid 20-ft beyond property line shows calculation points as high as 0.44-fc.

Ordinance Requirement:
Outdoor display lots for vehicles sales and leasing (as those terms are defined in Article 5) shall comply with the requirements of this section. In addition, display fixture illumination shall be reduced within thirty (30) minutes after closing so that the remaining illumination levels are sufficient for security purposes only; provided, however, that any illumination used after 11:00 p.m. shall be reduced to levels sufficient for security purposes only.

N/A

Ordinance Requirement:
Exposed L.E.D. (light emitting diode) lighting shall be limited to a maximum of one thousand (1,000) candela per square meter (nits).

No exposed LED

Ordinance Requirement:
All lighting shall have a nominal correlated color temperature (CCT) of no greater than three thousand (3,000) degrees Kelvin.

Fails. All luminaires where this information is available are listed as 4000K.

Summary of Compliance with Existing Ordinance
The lighting design does not meet the requirement for CCT. It appears to meet minimum light level requirements, thought the exact average footcandle calculations were not provided. The lighting design meets uplight requirements and appears to meet more subjective requirements such as minimizing glare from the light source and reducing impact to neighboring properties. The lighting design does not meet the requirement for maximum footcandles 20-ft beyond the property line

Compliance with Proposed Ordinance

The proposed ordinance outlines specific, numerical requirements for reducing obtrusive and excessive light. To verify compliance with the proposed ordinance, a worksheet is used to identify each component and address the lighting design's compliance.

(A) **Total Site Lumen Limit**.

Determine the total site lumen limit. Site is classified as LZ1.

Hardscape Area	38,124 square feet	
Base Allowance *(select multiplier based on lighting zone)*	**0.5**	lumens per square foot of hardscape area for LZ 0
	1.25	lumens per square foot of hardscape area for LZ 1
	2.5	lumens per square foot of hardscape area for LZ 2
	5	lumens per square foot of hardscape area for LZ 3
Total Allowance *(multiply the hardscape area by the multiplier selected above*)*	**47,655** lumens	
	** See Table 3.2.4-5 in the lighting ordinance for additional allowances that may be used in certain circumstances.*	

Determine the total amount of lumens used.

Luminaire	Quantity	Initial Lumens Each	Total Initial Lumens
A	11	9,523	104,753
B	7	9,523	66,661
		TOTAL	**171,414**

Is the total amount of initial lumens less than the total site lumen allowance?

____ Yes (**Pass**) __**x**[1]__ No (**Fail**)

NOTES:

1. If the much lower luminaire lumens provided in the project documentation is used, the design still exceeds the total site lumen allowance.

(B) **Limits to Off-Site Impacts - Compliance with Backlight-Uplight-Glare (BUG) rating**

Determine each luminaire's BUG Rating.

Luminaire	B	U	G
A	1	0	2
B	1	0	2

Determine the Allowed Backlight Rating and Compliance.

Luminaire	Given B-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed B-Rating in Zone	Complies?
A	1	30-ft	5-ft	Yes	0	**No**
B	1	15-ft	32-ft	No[1]	3	**Yes**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*

NOTES:
1. This luminaire is not ideally oriented but is mounted greater than 2 times its mounting height from the nearest property line.

Determine the Allowed Uplight Rating

Luminaire	Given U-Rating	Allowed U-Rating in Zone	Complies?
A	0	0	**Yes**
B	0	0	**Yes**

Determine the Allowed Glare Rating

Luminaire	Given G-Rating	Mounting Height	Distance from Property Line*	Ideally Oriented?**	Allowed G-Rating in Zone	Complies?
A	2	30-ft	5-ft	Yes	0	**No**
B	2	15-ft	32-ft	No	0	**No**

**use the distance of the luminaire located closest to the property line*
***if the luminaire is ideally-oriented, its back is facing the nearest property line*

Do all luminaires comply in all categories?

____ Yes (**Pass**) __**x**__No (**Fail**)

(4) Additional Compliance

- All lighting shall have a nominal correlated color temperature (CCT) of no greater than 3000 Kelvin.
  - No
- Light poles shall be anodized (or otherwise coated) to minimize glare from the light source
  - Unknown
- Required lighting controls and curfews:
  - Unable to evaluate

Conclusions

The submitted lighting design fails both the existing ordinance and proposed ordinance in that the specified lights are listed as 4000K. Due to the subjective nature of the existing ordinance, disregarding the cooler color temperature, the lighting design passed the existing ordinance. The design would have failed the proposed ordinance on several accounts, including excessive total site lumens, high glare, and high backlight rating given the close proximity to the property line.