



Memo

To: West Windsor Township Technical Review Committee
From: Lucas Wihlborg, Atelier Ten

01 April 2021
By Email
Princeton Lake Campus Site Development 2020-03-10

Waiver Request for Light Levels at Parking and Intersections

In response to TRC comments 5.01 and 5.03, the project team is requesting a waiver from the Township ordinance **Article VI § 200-31 K** which prescribes the following footcandle (fc) intensities:

- (1) Parking lots: an average of 0.5 footcandles throughout
- (2) Intersections: 3.0 footcandles

The proposed site lighting has been designed based on industry-accepted recommendations provided by the Illuminating Engineering Society of North America (IESNA) and has the following average horizontal illuminance values:

- (1) Parking lots:
 - a. GSH-Lot A: 0.9 fc
 - b. CUB Yard: 0.8 fc
- (2) Intersections (average horizontal illuminance)
 - a. Washington Road and Innovation Way: 1.7 fc
 - b. Washington Road and Tiger Lane: 1.2 fc
 - c. Innovation Way and Tiger Lane: 1.2 fc
 - d. Innovation Way and Spine Road: 1.7 fc

The waiver for the illumination of parking lots is requested because the site lighting provides average illuminance above the Township ordinance. The minimum illuminances and max/min ratios are within the IESNA recommendations for surface parking lots (see Exhibit A).

The waiver for the illumination of the intersections is requested because the calculated illuminance of intersections is lower than the Township ordinance. The designed illumination accounts for the projected vehicular and pedestrian activity and is within IESNA recommendations (Exhibit B). Additionally, the design recognizes that the National Registry of Historic Places notes, “the absence of street lighting along this portion of Washington Road further contributes to the appearance and feeling of the Washington Road Elm Allee at nighttime.”

Sincerely,

Lucas Wihlborg
Lighting Designer, Atelier Ten

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Exhibit A – Summary of IESNA Recommendations for Parking Lots

IESNA publication **RP-8-18 Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting** | Chapter 17: Parking Lots and Parking Garages, recommends that illumination levels at parking lots be designed to meet minimum illuminance and uniformity targets.

Table 17-2. Recommended Maintained Illuminance Values for Parking Lots (basic requirements, not for security lighting)

Recommended Maintained Illuminance Targets ^(b, c, d)										
APPLICATION TASK/AREA ^(a)	TS = Task Surface: Recommended illuminances are at height of task surface above finished grade (AFG)									
	Horizontal (E _h)					Vertical (E _v)				
	Target E _h @ Height AFF			Uniformity Ratio		Target E _v @ Height AFF			Uniformity Ratio	
	Lux @ m	(Fc @ Ft)	Max Avg Min	Ratio	Basis	Lux @ m	(Fc @ Ft)	Max Avg Min	Ratio	Basis
PARKING LOTS (and Top Floor of Parking Garages)¹										
Drive Aisles / Parking Areas^{2,3,4}										
All Parking Lots	2 @ 0.0	(0.2 @ 0.0)	Min	20:1	Max:Min	1 @ 1.5	(0.1 @ 5.0)	Min	20:1	Max:Min

IESNA RP-8-18 Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting

The surface parking lot GSH-Lot A has the following values:

Minimum: 0.2 fc
 Maximum: 2.8 fc
 Max:Min 18:1

The surface parking lot servicing the CUB building has the following illuminance:

Minimum: 0.2 fc
 Maximum: 2.3 fc
 Max:Min 12:1

For a surface parking lot, the IESNA recommends a minimum horizontal illuminance level greater than 0.2 footcandles. The minimum horizontal illumination of all surface parking lots submitted as part of the application are above the recommended minimum.

Additionally, the IESNA recommends a Max:Min uniformity ratio better than 20:1. With ratios of 12:1 and 18:1 the lighting of the two surface lots on the site have better uniformity than the IESNA recommendations.

Exhibit B – Summary of IESNA Recommendations for Intersections

IESNA publication **RP-8-18 Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting** | Chapter 12: Intersections, Roundabouts and Crosswalks, recommends that illumination levels at intersections be based on a matrix of Average Daily Traffic (ADT) and pedestrian activity.

RP-8-18 classifies roadways based on their function:

- **Major Roadway:** Over 3,500 vehicles ADT
- **Collector Roadway:** 1,500 to 3,500 vehicles ADT
- **Local Roadway:** 100 to 1,500 vehicles ADT

Per the memorandum issued October 5, 2020 titled **Traffic Impacts of the Initial Projects within the Near Term Phase of the Princeton University Lake Campus GDP:**

“... the developments that are part of the first two site plan applications are projected to generate a total of 136 vehicle trips in the morning peak hour and 257 vehicle trips in the pm peak hour.”

With a projected 393 Average Daily Trips, the roadways within the Lake Campus Site Development can be classified as Local for purposes of illuminance. In contrast, Washington Road has a much higher traffic level than the internal campus roadways and would be classified as Major for purposes of illumination.

In the same chapter, pedestrian activity levels are defined by the highest one-hour average annual night time pedestrian volume:

- **High pedestrian activity:** Urban commercial areas and city centers with greater than 100 pedestrians over a one-hour period.
- **Medium pedestrian activity:** Neighborhood shopping, multifamily residential, and transit lines with 11 to 99 pedestrians over a one-hour period.
- **Low pedestrian activity:** Small urban streets and low-density residential development with 10 or fewer pedestrians per one hour period.

Additionally, the IESNA provides illuminance criteria for intersections based on whether the intersecting roads are continuously illuminated or not. The internal campus roads Tiger Lane, Innovation Way, and Spine Road are designed for continuous illumination. Washington Road currently does not have continuous illumination between Route 1 and the bridge.

There are two internal intersections of the campus are considered Full Intersections by the IESNA as they occur where continuously illuminated roadways meet. Per Table 12-1, the IESNA recommends an average horizontal illumination of between 0.7 fc and 1.3 fc for Low and Medium pedestrian areas. The designed illuminance at the crosswalks is designed to have the highest illuminance of the intersection to enhance pedestrian visibility.

Table 12-1. Pavement Illuminance Criteria for Full Intersection Lighting (lux/ft).

Illuminance for Intersections				
Functional Classification	Pedestrian Activity Level Classification			E _{avg} /E _{min}
	High	Medium	Low	
Major/Major	34/3.2	26/2.4	18/1.7	3.0
Major/Collector	29/2.7	22/2.0	15/1.4	3.0
Major/Local	26/2.4	20/1.9	13/1.2	3.0
Collector/Collector	24/2.2	18/1.7	12/1.1	4.0
Collector/Local	21/2.0	16/1.5	10/0.9	4.0
Local/Local	18/1.7	14/1.3	8/0.7	6.0

IESNA RP-8-18 Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting

Intersections where continuous lighting does not exist along one or more of the roads are considered Partial Intersections. As part of the Lake Campus Site Development, Isolated intersections occur where Tiger Lane and Innovation Way meet Washington Road.

The intent of lighting at these types of intersections is to create a situation that alerts drivers to the possibility of cars turning or entering the drive lane, while keeping lighting (or lack thereof) along the primary path of travel. As demonstrated in Table 12-2, the IESNA illumination recommendations for this situation are lower than those of full intersections.

Table 12-2. Pavement Illuminance Criteria for Partial (Isolated) Intersection Lighting.

Road Classification	Pavement Classification			Uniformity Ratio E _{avg} /E _{min}
	R1 lux/ft	R2 & R3 lux/ft	R4 lux/ft	
Major	6/0.6	9/0.8	8/0.7	3.0
Collector	4/0.4	6/0.6	5/0.5	4.0
Local	3/0.3	4/0.4	4/0.4	6.0

IESNA RP-8-18 Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting

Pedestrian activity is not considered for isolated intersections as they typically do not have crosswalks or adjacent sidewalks. The construction of the bike and pedestrian paths as part of the Lake Campus Site Development separates pedestrian and bicycle traffic from the Washington Road and reduces the potential pedestrian conflict at those areas. The bicycle path and crosswalks are located 90 feet away from the vehicular intersections with Washington Road.

As demonstrated in the following table, the average maintained horizontal illumination of the intersections submitted as part of the applications meet or exceed the IESNA recommended illuminance criteria.

Intersection	Classification	IESNA Average (fc)	Designed Average (fc)	Designed Maximum (fc)
Washington Road & Tiger Lane	Partial (Isolated) Major	> 0.8 fc	1.2 fc	2.8 fc
Washington Road & Innovation Way	Partial (Isolated) Major	> 0.8 fc	1.7 fc	3.0 fc
Tiger Lane & Innovation Way	Local/Local, Low Pedestrian Activity	> 0.7 fc	1.2 fc	2.6 fc
Innovation Way & Spine Road	Local/Local, Low Pedestrian Activity	> 0.7 fc	1.2 fc	3.0 fc