

Innerbelt Contract Group 3A

January 17, 2024

Photometric Analysis: City of Cleveland Street and Pedestrian Lighting

Per previous coordination with ODOT and CPP, the following approach was determined for CCG3A lighting infrastructure improvements:

1. Existing high mast lighting (for infrastructure installed in 2010 or later) will be used in the Central Interchange area to the extent feasible. Asymmetric distributions for new high mast lighting will be considered where advantageous.
2. Any existing lighting infrastructure in the Central Interchange area installed prior to 2010 will be removed or replaced.
3. Lighting between East 22nd Street and Carnegie Avenue Overpasses is proposed to be low mast, supplemented with conventional wall packs.
4. High mast towers north of Carnegie Avenue will generally remain unless impacted.
5. Local street lighting will comply with CPP standards. East 14th Street (where not in conflict with the future CCG3B project), East 18th Street, and East 22nd Street will be shoeboxes on fiberglass poles with underground conduit. All other CPP lighting will be luminaires with 8' arms on wood poles. Segments of luminaires with 8' arms on wood poles shall have overhead wiring except when running overtop of bridges 13 and 14, where conduit shall be used to pass wiring under the bridge decks and/or in the parapets.
6. The shared use path and pedestrian corridor being installed along East 22nd Street and the north side of Midtown Connector will comply with ODOT standards for illuminance criteria and CPP standards for installation. Lighting will be shoeboxes on fiberglass poles with underground conduit.
7. CPP is responsible for any necessary circuit design for luminaires with 8' arms on wood poles with overhead wiring on Carnegie Avenue, Cedar Avenue, Midtown Connector, and Central Avenue Connector (generally all project locations where primary poles are being relocated and the lighting is secondary to the primary poles). The CCG3A project is responsible for furnishing and installing the wood poles and luminaires with 8' arms in these locations.
 - a. CPP will be responsible for making connections between relocated/new poles and transformers.
8. The CCG3A Project is responsible for the light poles on the Carnegie bridge, which will be powered from conduit in the parapet also installed by the project. CPP will be responsible for connecting these lights to the overhead circuitry for the lights on either side of the bridge.
9. The CCG3A project is responsible for bronze shoebox on fiberglass poles with underground conduit along E. 22nd street, E. 14th street north of Ramp B6, and E. 18th street, as well as luminaires with 8' arms on wood poles with overhead wiring on E. 14th street south of Ramp B6. The CCG3A project is also responsible for bronze shoebox on fiberglass poles with underground conduit for pedestrian and shared pathway applications along East 22nd Street and Midtown Connector. The project will take care of circuit design and layout for these poles.
10. CPP will provide new poles with transformers, and CPP staff will perform actual connection(s) to the existing CPP infrastructure.

Michael Baker International (MBI) developed a preliminary lighting layout per the local street and shared use path lighting criteria listed above and CPP standards for spacing and photometrics. **Table 1** includes the spacing and photometric criteria for each local street and **Table 2** includes ODOT illuminance criteria for shared-use paths (per Table 1197-04 in the ODOT TEM).

City Street	Roadway Class Land Use	Pole Type	Pole Spacing	Avg. / Min. Illuminance (Footcandles)	Max. Uniformity Ratio
E. 14 th St.	Collector Intermediate	Wood pole luminaires south of Ramp B6 Shoebox poles north of Ramp B6	Varies (100'-125')	2.7 / 0.9	3.0:1
E. 18 th St.	Collector Intermediate	Shoebox Poles	±120'	2.7 / 0.9	3.0:1
E. 22 nd St.	Collector Commercial	Shoebox poles	±100'*	3.6 / 1.2	3.0:1
Carnegie Ave.	Arterial Commercial	Wood pole luminaires	Varies (125'-150')	4.0 / 1.4	3.0:1
Central Ave. Connector	Local Intermediate	Wood pole luminaires	±130'	1.8 / 0.6	3.0:1
Midtown Connector	Collector Residential	Wood pole luminaires	±165' West of Cedar ±125' East of Cedar	1.5 / 0.5	3.0:1
Cedar Ave.	Collector Residential	Wood pole luminaires	±150'	1.5 / 0.5	3.0:1

*Indicates spacing closer than necessary to meet CPP photometric criteria. However, being proposed to match existing condition along the corridor.

Table 1: Pole spacing and photometric criteria for city street lighting. Criteria from CPP.

After laying out the pole types per the criteria included in **Table 1** and **Table 2**, MBI performed a photometric analysis of the city street lighting within the project limits. Per previous coordination with CPP, the photometric analysis performed does not consider any illuminance from ODOT lighting within the project limits. Analysis was performed using the Visual Lighting 2020 software. **Table 3** includes the light fixtures specified by CPP that were applied to the lighting model. Specifications for each fixture – including system watts, lumens, and distribution type – are included in **Exhibit C-CPP Specified Light Fixtures-Specs**. In areas under bridges with dark spots, wallpack fixtures were proposed. Locations and justifications for wallpack fixtures installed on the project are included in **Exhibit E-Wallpack Structure Matrix**.

While CPP standards include criteria for an average illuminance value for city streets, CPP has indicated in the past that this value is high and would require compromising their pole spacing criteria to obtain. With this in mind, a *roadway segment/intersection was considered to be meeting CPP criteria as long as the minimum illuminance for the given section was greater than or equal to the minimum illuminance values included in Table 1 and the uniformity ratio (average to minimum illuminance) was less than or equal to 3:1.*

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values included in **Table 1** and the uniformity ratio (average to minimum illuminance) was less than or equal to 3:1.

Average Maintained Illuminance Design Values

Average Illuminance on the Pavement ¹			
Roadway and Walkway Classification ²		Foot-Candles	Uniformity (avg./min.)
Freeway (including ramps) ³		0.9	3:1
Expressway (including ramps) ³	Commercial	1.4	3:1
	Intermediate	1.3	
	Residential	0.9	
Major ³	Commercial	1.7	3:1
	Intermediate	1.3	
	Residential	0.9	
Collector ³	Commercial	1.2	4:1
	Intermediate	0.9	
	Residential	0.6	
Local ³	Commercial	0.9	6:1
	Intermediate	0.7	
	Residential	0.4	
Sidewalks	Commercial	1.4	3:1
	Intermediate	0.9	4:1
	Residential	0.4	6:1
Pedestrian Ways and Bicycle Paths ⁴		2.0 (mixed ped, veh)	4:1
		1.0 (ped only)	

Notes:

1. Based upon R3 pavement classification, i.e. asphalt road surface, rough texture, $Q_D = 0.07$. ODOT generally does not separate Freeway into classes A and B as RP-8 does (Note 3).
2. The terms "commercial," "intermediate" and "residential" are defined in **Section 1103-4**. See **Chapter 1301** for definitions of the other terms.
3. Adapted from **American National Standard Practice for Roadway Lighting ANSI/ES RP-8, 200/2005: Illuminating Engineering Society of North America**. Used by permission.
4. This assumes a separate facility. Facilities adjacent to a vehicular roadway should use the illuminance levels for that roadway.

Table 2: Recommended values for shared use path illuminance. Table from ODOT TEM.

I N T E R N A T I O N A L

Fixture Type	Corresponding Fixture
Wood Pole Luminaires - Carnegie	GE Evolve – ERL2-0-23-C3-40-A-GRAY-I-L
Wood Pole Luminaires – All other streets	GE Evolve – ERLH-0-13-C3-40-A-GRAY-I-L
Shoebox Pole Luminaires – Street Lighting (30’ poles)	Cooper Lighting Solutions Streetworks – USSL-C027-D-U-T3-SA-BZ-10MSP-4N7-TH
Shoebox Pole Luminaires – Pedestrian Lighting (15’ poles)	Cooper Lighting Solutions Streetworks – BAA-USSL-P-C014-D-U-T3-SA-BZ-10MSP-4N7-TH
Underpass Lighting	VersaLED – WP3-Q-41L-QT-40K

Table 3: Street and Pedestrian lighting fixtures.

Photometric Analysis Results

Exhibit A- CCG3A Photometric Analysis-City Streets includes MBI’s results from the photometric analysis of the city street lighting within the project limits and **Exhibit B-CCG3A Photometric Analysis-E 22nd St and Midtown Connector Corridor** includes MBI’s results from the photometric analysis of the combined roadway and shared use path corridor along E. 22nd Street and Midtown Connector. Both exhibits do not consider any illuminance from proposed ODOT lighting infrastructure. For a photometric analysis of the ODOT ramps and freeways within the project limits, refer to the discussion included in the ODOT photometric analysis memo as well as **Exhibit D-CCG3A Photometric Analysis-ODOT Infrastructure**.

CPP’s minimum illuminance criteria and uniformity ratio was met for all city streets except for E. 14th Street, and ODOT’s average illuminance criteria and uniformity ratio was met for all pedestrian and shared use spaces along the East 22nd Street and Midtown Connector corridor. Minimum illuminance criteria were not met for E. 14th Street due to two dim spots (represented by the dark blue illuminance readings in **Exhibit A- CCG3A Photometric Analysis-City Streets**) in the proposed model: (1) the interchange between existing ramp E-17 to remain and interim E. 14th Street southbound and (2) the eastern edge of E. 14th Street northbound under bridges 10 and 11.

The illuminance at location (1) is constrained due to the interim conditions of ramp H4, ramp H5, and E. 14th Street not permitting space for a light pole on the east side of East. 14th Street. However, this constraint shall be remedied with the proposed work in CCG3B. Location (1) will be experiencing illuminance from proposed ODOT tower CN3-2, located approximately 80’ west from the dim spot. Considering proposed ODOT tower CN3-2 in the photometric analysis raises the minimum illuminance in this segment of E. 14th Street to 0.9 footcandles, which meets criteria. Given this, no further action is necessary to further illuminate location (1) at this time, as the location will be sufficiently lit by the proposed ODOT infrastructure until CCG3B occurs.

The illuminance at location (2) is constrained due to the roadway width in reference to the pier and abutment locations of bridges 10 and 11. The width of E. 14th Street northbound under bridges 10 and 11 tapers out to over 49’, which is wider than the length of throw of CPP’s standard wallpack for underpass lighting. Also, the eastern abutment of bridges 10 and 11 is more than 50’ from the eastern edge of E. 14th Street northbound, so CPP’s standard wallpack for underpass lighting just barely reaches the eastern edge of E. 14th Street northbound. Given these offsets and the length of throw from CPP’s standard wallpack, it is not feasible to meet minimum illuminance criteria in the east-most lane of E. 14th Street northbound between the central pier of bridges 10 and 11. This condition will not be improved by the proposed work in CCG3B.