

Photometric Analysis Per ODOT Qualified Products List (QPL)

During stage 2 design, Michael Baker International (MBI) developed a proposed lighting layout for the CCG3A project per ODOT freeway/ramp lighting criteria and ODOT standards for photometrics using Visual Lighting 2020. The methodology used to develop this design and layout is discussed in the following design memos submitted as part of the stage 2 design submission: *82382_ODOT Photometrics_Memo.pdf* and *82382_Circuit Analysis_Memo.pdf*.

The photometric model of the proposed lighting layout was developed with Holophane solid-state LED luminaires included in ODOT’s QPL for solid state LED luminaires (see Alternative 1 in **Table 1** for fixture details). Additional detail regarding the development of the photometric model is discussed in the design memo *82382_ODOT Photometrics_Memo.pdf* submitted as part of the stage 2 design submission.

| Alt. | Symmetric Low Mast Luminaire (50' Mounting Height) | Asymmetric Low Mast Luminaire (50' Mounting Height) | High Mast Luminaire(s) (Variable Mounting Height) | Underpass Luminaire (Variable Mounting Height) |
|------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------|
| 1 | Holophane HMLED4-P3-30K-XVOLT-HGR-AW | Holophane HMLED4-P3-30K-XVOLT-HGR-AW-HMLED4D180 | Holophane HMLED4-P3-30K-XVOLT-HGR-AW | Holophane W4GLED-10C1000-30K-T3S-480-SPD |
| 2 | GE Evolve ERHM-03-5-70-VW-7-30-N-1-4B-GRAY-R | GE Evolve ERHM-03-5-40-C6-7-30-N-1-4B-GRAY-R | GE Evolve ERHM-03-5-70-VW-7-30-N-1-4B-GRAY-R | GE Evolve EWAS-01-5-B3-AW-7-30-N-1-FM-GRAY-F |
| 3 | Cooper Streetworks Celesteon CST-CA8-430-730-8-T5-AP | Cooper Streetworks Celesteon CST-CA8-330-730-8-T3-AP | Cooper Streetworks Celesteon CST-CA8-430-730-8-T5-AP | Cooper Streetworks Wal-Pak WKP-6B-LED-E-8-GL-AP-10K-7030-B |

Table 1: Solid-state LED Luminaires Applied to Photometric Model

To progress stage 3 design, the photometric model of the proposed lighting layout was rerun with two (2) additional solid-state LED luminaire products included on the ODOT QPL. Altogether, three (3) iterations of the model (referred to as alternatives) were developed, each with a different luminaire manufacturer. **Table 1** details the solid-state LED luminaire products applied in each alternative photometric analysis. Spec sheets for these products are included in *Exhibit F-ODOT Light Fixtures-Specs*.

The solid-state LED luminaires referenced in **Table 1** were applied to the photometric model for the full project corridor using the light loss factor (LLF) – the amount of light that will be lost over time due to dirt accumulation on the luminaire and lamp depreciation – specified in the ODOT QPL for each fixture. However, if a fixture spec provided a lower LLF than the ODOT QPL, that was used instead. The output from the photometric model for each alternative photometric analysis is included in *Exhibit G-CCG3A Photometric Analysis-ODOT QPL Analysis*.

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

For the proposed lighting layout to meet ODOT illuminance criteria, I-90 must have an average illuminance value of at least 0.9 footcandles, an absolute minimum illuminance value of 0.3 footcandles, and a preferred uniformity ratio (average/minimum) of 3:1 (see Table 1197-04 in the ODOT TEM for Freeways/Ramps) for each alternative. While the preferred ratio is 3:1, the uniformity ratio for continuous freeway lighting can vary; however, the maximum allowable uniformity ratio is 4:1 and the typical range for uniformity ratio is 2:1 to 3:1 (see section 1106-2.3 of the ODOT TEM). A summary of the illuminance output for each alternative photometric analysis is included on the tables in the photometric exhibits included in ***Exhibit G-CCG3A Photometric Analysis-ODOT QPL Analysis***.

The lighting layout was designed with the Holophane (Alternative 1) fixtures, so ODOT illuminance criteria was met for alternative 1. Alternatives 2 and 3 met the average and absolute minimum illuminance requirements and did not have uniformity ratios more than 4:1.

The photometric contours for the GE Evolve (Alternative 2) fixtures and the Cooper Streetworks Celesteon (Alternative 3) fixtures have a larger footprint than the comparable Holophane (Alternative 1) fixtures. This increased the areas of overlap between the photometric contours for each light fixture, which produced uniformity ratios lower than 2:1 on some freeway/ramp segments in Alternatives 2 and 3. A lower uniformity ratio indicates more even lighting across a given area. While uniformity ratios less than 2:1 fall outside of the typical uniformity ratio range, a lower uniformity ratio indicates a better design. Given this, all three QPL alternatives meet ODOT illuminance criteria, and the proposed lighting layout is acceptable.